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Memorandum

Rebecca Kennedy for

To Luis E. Velazquez **From** James D. Berger

Date September 29, 1987 **Copies to** Boyle, Cloutier, File, List Below

Subject FINAL VERIFICATION REPORT - MIDDLESEX LANDFILL REMEDIAL ACTION

Enclosed are eight copies of the final verification survey report for Remedial Action on the Middlesex Municipal Landfill, Middlesex, New Jersey. This report should be forwarded to Mr. J. Fiore of DOE/NE's Division of Facility and Site Decommissioning Projects.

Questions may be referred to me at 576-3305.

JDB/sjf

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Prepared by
Oak Ridge Associated
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Prepared for
Division of
Facility and Site
Decommissioning
Projects

U.S. Department
of Energy

VERIFICATION OF REMEDIAL ACTION MIDDLESEX MUNICIPAL LANDFILL MIDDLESEX, NEW JERSEY

J. D. BERGER

Radiological Site Assessment Program
Manpower Education, Research, and Training Division

FINAL REPORT
SEPTEMBER 1987

VERIFICATION
OF
REMEDIAL ACTION
MIDDLESEX MUNICIPAL LANDFILL
MIDDLESEX, NEW JERSEY

Prepared by

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Prepared For

U.S. Department of Energy
as part of the
Formerly Utilized Sites - Remedial Action Program

FINAL REPORT

September 1987

This report is based on work performed under contract number DE-AC05-76OR00033 with the U.S. Department of Energy.

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VERIFICATION
OF
REMEDIAL ACTION
MIDDLESEX MUNICIPAL LANDFILL
MIDDLESEX, NEW JERSEY

INTRODUCTION

Between 1943 and 1955, the Middlesex Sampling Plant in Middlesex, New Jersey, about 29 km southwest of Newark (Figure 1), was used by the Manhattan Engineer District and U.S. Atomic Energy Commission, predecessors of the U.S. Department of Energy, for the assay of uranium and thorium ores. Although no supporting documentation is available, it is believed that construction activities at the Sampling Plant, between November 1947 and October 1948, resulted in the placement of soils, contaminated with uranium ore, into the Middlesex Municipal Landfill, approximately 0.9 km northwest of the Sampling Plant. Landfill operations in subsequent years, resulted in dispersion of the contaminated soil throughout the landfill site and covering of the contaminated material with varying thicknesses of noncontaminated soil. Use of the landfill for municipal waste disposal was discontinued in 1974.

The presence of low-level contamination in the Middlesex Municipal Landfill was initially discovered in May 1960, during a local civil defense exercise. In 1961, the top layer of material was removed from the landfill by the Atomic Energy Commission (AEC) and replaced with a layer of clean soil. The AEC conducted a radiological survey of the area in 1974 and Oak Ridge National Laboratory (ORNL) conducted an additional survey in 1978 at the direction of the U.S. Department of Energy (DOE).[1,2] Ford, Bacon, and Davis performed an engineering evaluation of remedial action alternatives in 1979.[3]

Results of the surveys and engineering evaluation indicated that the Middlesex Municipal Landfill contained radiological contamination levels in excess of the DOE guidelines, and the site was designated for remedial action under DOE's Formerly Utilized Sites Remedial Action Program (FUSRAP). From 1984 through 1986 Bechtel National, Inc. (BNI), the Project Management Contractor for FUSRAP, conducted additional characterization surveys, where necessary, to more accurately define the boundaries of the contamination and conducted remedial actions to remove the contaminated soil.

Remedial action was in accordance with an April 1984 action description memorandum and February 1986 work plan.[4,5] The remedial action consisted of removal of noncontaminated cover material, excavation of contaminated fill material, and transport of the contaminated material to the Middlesex Sampling Plant where it was placed in interim storage. Figure 2 is a plot plan of this landfill site, indicating the remedial action area. Following completion of excavations, BNI conducted surveys to demonstrate compliance with the cleanup guidelines, refilled the excavations, and restored the site surface. The remedial action and results of the followup surveys are described in a post-remedial action report and supporting data tables prepared by BNI.[6,7]

It is the policy of DOE to perform independent (third party) verifications of the effectiveness of remedial actions conducted within FUSRAP. The Radiological Site Assessment Program of Oak Ridge Associated Universities (ORAU) has been designated by DOE as the organization responsible for this task at the Middlesex Municipal Landfill. During May through July 1986, ORAU performed verification activities for the landfill site. This report describes the procedures and findings of that verification.

PROCEDURES

Objectives

The objectives of the verification were to confirm that the surveys, sampling, and analyses conducted prior to, during, and following remedial action and associated project documentation provide an accurate and complete description of the condition of the property and, thereby, confirm that remedial actions have been effective in meeting established criteria.

Procedures

1. Radiological survey reports, engineering evaluations, work plans, and the post-remedial action reports (references 1-7) were reviewed. Data were evaluated to assure that areas exceeding criteria were identified and had undergone remedial action. Post-remedial action radionuclide

concentrations in soil and exposure-rate data were compared to criteria, and the post-remedial action report and data were reviewed for general thoroughness and accuracy.

2. Thirty soil samples, collected during the post-remedial action survey, were obtained from BNI and independently analyzed for Ra-226, U-238, and Th-232 by the ORAU laboratory to confirm the accuracy of BNI analyses.

3. Survey teams from ORAU visited the Middlesex area and performed visual inspections and limited independent gamma scans, exposure rate measurements, and soil sampling on representative portions of the excavated areas and restored landfill property. Dates of these independent surveys were May 29 and 30, 1986; June 20, 1986; June 30, 1986; and July 28, 1986.

Findings of the inspections and radiological surveys were compared with the post-remedial action report and the established Middlesex Municipal Landfill guidelines (Appendix A). Measurement and analytical equipment and procedures are described in further detail in Appendices B and C.

FINDINGS AND RESULTS

Document Review

Review of the AEC and ORNL survey reports and the interim data, developed by BNI during successive excavations, indicated appropriate decisions concerning requirements for remedial action. During remedial action, a narrow band of contaminated soil, not previously identified by the ORNL or BNI characterization surveys, was discovered on the south side of the landfill and was excavated. Visual ORAU inspections of selected areas of remedial action confirmed the extent of excavations as identified by BNI in the post-remedial action report. Several samples, reported in the BNI data tables, contain Ra-226 and/or Th-232 concentrations exceeding the guideline concentrations. However, these samples represent small, isolated regions and in combination

with other samples collected from adjacent excavated regions, the resulting average concentrations satisfy the guidelines, for contiguous areas of 100 m^2. In addition, many of the samples listed in the data tables were obtained at interim excavation depths for remedial action control monitoring. Because of the need for timely excavation decisions, such samples were not dried, pulverized, and held for radon ingrowth before analysis; the concentrations determined were, instead, multiplied by conservative factors to account for anticipated effects of standard preparation and analysis procedures. Based on previous additional analyses of such samples, this approach has been found to yield concentration levels, which are conservatively overestimated by up to a factor of 2 to 3, depending upon the radionuclides and soil characteristics. Therefore, some of the data values reported in the BNI tables over estimate the actual concentrations in soil at this site. It should also be noted that the concentrations reported in the BNI data tables include background contributions from naturally occurring materials.

Confirmatory Sample Analyses

Table 1 presents the results of gamma spectrometry analyses, performed by ORAU and BNI, for 30 soil samples from the remediated areas. For the primary radionuclide of concern, Ra-226, data are in agreement within their respective 2σ confidence levels for 23 of the 30 samples and within 3σ confidence levels for 25 of the 30 samples. Only one sample (from grid coordinate N5760.5, E10917.5 in BNI data Table 17) indicated a substantial difference between ORAU and BNI analyses. The BNI value was 36.3 ± 2.2 pCi/g of Ra-226 as compared to the ORAU value of 4.8 ± 0.5 pCi/g; a reason for the discrepancy could not be identified. Analyses of variance on paired Ra-226 data yielded a correlation factor of 0.98. Thorium 232 and U-238 data pairs were within their respective 3σ confidence levels for 29 of 30 and 28 of 30 samples. On the basis of these findings, it is ORAU's opinion that the BNI data are accurate, within the statistical limitations of the analytical procedures.

Verification Surveys

Excavated Area

Figure 3 indicates the portions of the excavation which were independently surveyed by ORAU. Surface scans of the excavations identified six small,

isolated locations of elevated gamma radiation (Figure 4). The size of these locations, i.e. <1 m^2, and the associated radiation levels indicated that the average soil concentrations in the 100 m^2 areas surrounding these elevated locations would likely satisfy the DOE guidelines for the landfill site. However, each of these locations was investigated further to determine the source of the radiation and to assure that the guideline concentrations were satisfied. At three of the locations, the sources were identified as "nuggets" of uranium ore, approximately 1 cm in diameter. Removal of these pieces of ore reduced the radiation levels to the ambient background ranges. Another of these locations was a clod of soil, which had apparently fallen into the completed excavation from the adjacent area, still being remediated. This piece of material was removed, again reducing the gamma radiation level to the background range. Discrete sources could not be identified at the other two locations of elevated radiation. Soil samples, obtained from these two locations, contained radionuclide concentrations within the guideline levels (Table 2).

Gamma exposure rates, measured in the surveyed portions of the excavation are presented in Table 3. Levels ranged from 8 to 34 μR/h at contact and 7 to 64 μR/h at 1 m above the bottom of the excavation. The two highest contact and 1 m measurements were at grid coordinates N5380, E10927, and N5380, E10955. Both of these measurements were at the edge of an ongoing excavation. At all other measurement points the highest contact and 1 m exposure rates were 15 μR/h and 17 μR/h, respectively.

Soil samples (15 cm depth) were collected at locations of gamma measurements; radionuclide concentrations in these samples are summarized in Table 4. All soil concentration values include background levels. Three of these samples contained Ra-226 concentrations above the guideline level of 15 pCi/g. The highest concentration was 48.0 pCi/g at grid location N5308, E10927; this sampling location was at the edge of an active excavation and included loose contaminated soil which had fallen onto the previously excavated surface. Most other samples contained Ra-226 concentrations well below 15 pCi/g, and averaging over an area of 100 m^2 would result in levels below the 15 pCi/g (above background) guideline. Thorium 232 concentrations were generally lower than the Ra-226 concentrations. The maximum Th-232

concentration measured was 3.0 pCi/g - well below the 15 pCi/g guideline level. The highest U-238 concentration was 57.7 pCi/g; this was the sample that also contained the highest Ra-226 concentration.

These direct measurements and samples indicate that remedial actions were effective in removing radiologically contaminated material from the landfill and reducing residual radionuclide levels to within the guidelines established for this project.

Backfilled Areas

Walkover scans of the entire landfill site, conducted after backfilling of excavations, identified 11 small (<1 m^2) isolated locations and two larger areas (up to approximately 25 m^2) of elevated contact gamma radiation. These locations are shown on Figure 5. As was the case with the areas of elevated radiation identified in the excavations, the small size of most of these locations and the associated radiation levels indicated that the average soil concentrations over 100 m^2 areas would still satisfy the Ra-226 guideline level of 5 pCi/g above background. Further investigations at the small isolated locations resulted in identification and removal of small nuggets of uranium ore from ten locations; a discrete source could not be identified at the other location. A soil sample obtained from the point of highest contact radiation at this location contained a Ra-226 concentration of 1.4 pCi/g (Table 2).

The two larger areas of elevated contact radiation were adjacent to the excavated portion of the landfill. Based on their location and the surface nature of the contamination, it is believed that these areas may have resulted from spillage during earlier activities at the landfill, i.e. before the current remedial actions. BNI performed removal of the surface soil at these locations to a depth of 15-30 cm. Followup gamma scans of these areas indicated that the radioactive contamination had been effectively removed. Soil samples were collected from locations in each of these areas, where the highest contact gamma radiation level was measured. The analyses, presented in Table 2, indicated a maximum Ra-226 concentration of 14.3 pCi/g. Because these samples represented what would become a subsurface layer after backfilling, concentrations were within the DOE guideline level of 15 pCi/g above

background. Uranium and thorium concentrations in these samples were less than the Ra-226 levels.

Gamma exposure rate measurements at 50 foot (15.15 m) intervals throughout the site are presented in Table 5. These levels ranged from 5-8 μR/h at surface contact and from 6-8 μR/h at 1 m above the surface. These levels are comparable to typical background exposure rates in the Middlesex, New Jersey area.

Radionuclide concentrations in surface soil samples from 100 foot intervals are presented in Table 6. Concentration ranges were Ra-226, 0.3 to 2.6 pCi/g; Th-232, 0.4 to 2.0 pCi/g; and U-238, <0.4 to 4.5 pCi/g. All of these samples contained concentrations of Ra-226 and Th-232, which are within the DOE's guidelines for surface soil, and concentrations of U-238, which are below the guideline levels typically used for remedial actions at DOE FUSRAP sites.

On the basis of the direct measurements and soil sampling, performed as part of this survey, external radiation levels and radionuclide concentrations on the backfilled landfill property satisfy the DOE remedial action guidelines.

CONCLUSIONS

Between May 1986 and May 1987, Oak Ridge Associated Universities' Radiological Site Assessment Program performed independent activities to verify the adequacy of remedial actions at the Middlesex Municipal Landfill and the accuracy of documentation supporting the remedial actions. The verification activities included document reviews, confirmatory laboratory analyses, and independent direct measurements and sample analysis. Based on the results and findings of these activities it is ORAU's opinion that the remedial action has been effective in satisfying the established DOE criteria. It is also ORAU's opinion that the documentation supporting the remedial action process is adequate and accurate. A verification letter, indicating these opinions, was provided to DOE in March 1987.[8]

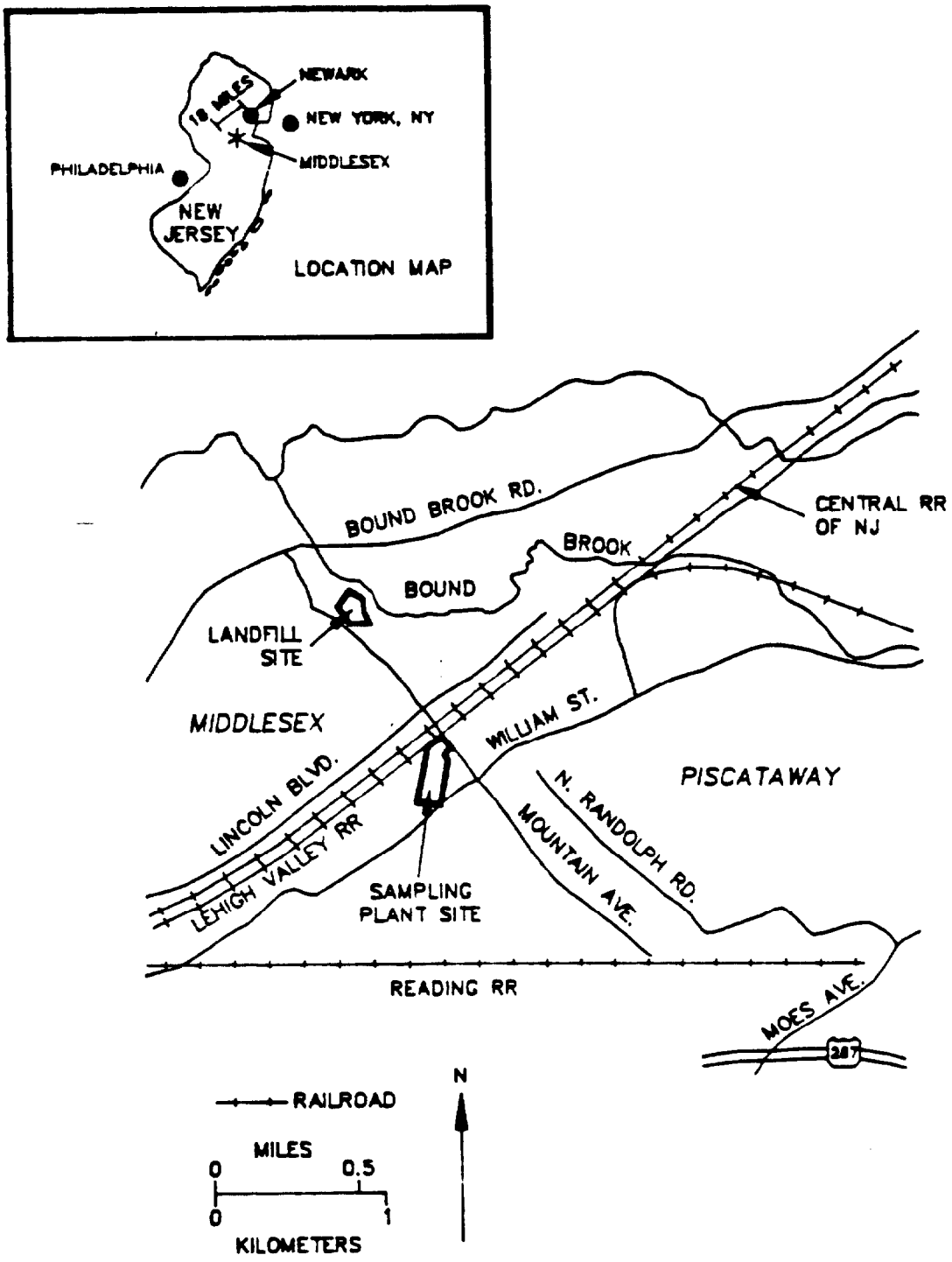

FIGURE 1: Location of the Middlesex Municipal Landfill Site

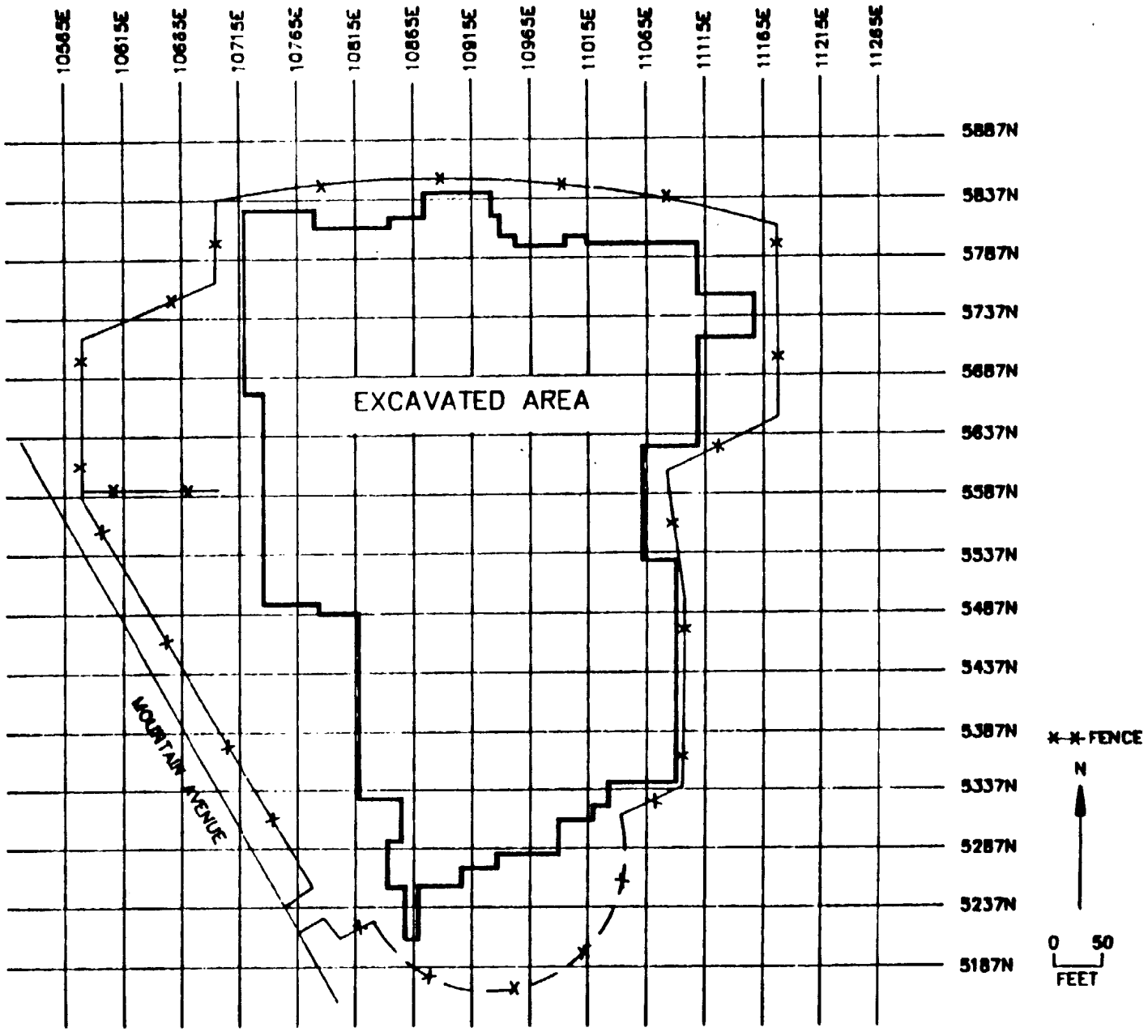

FIGURE 2: Middlesex Municipal Landfill Site Indicating Excavated Area and Grid System Established for Survey Reference

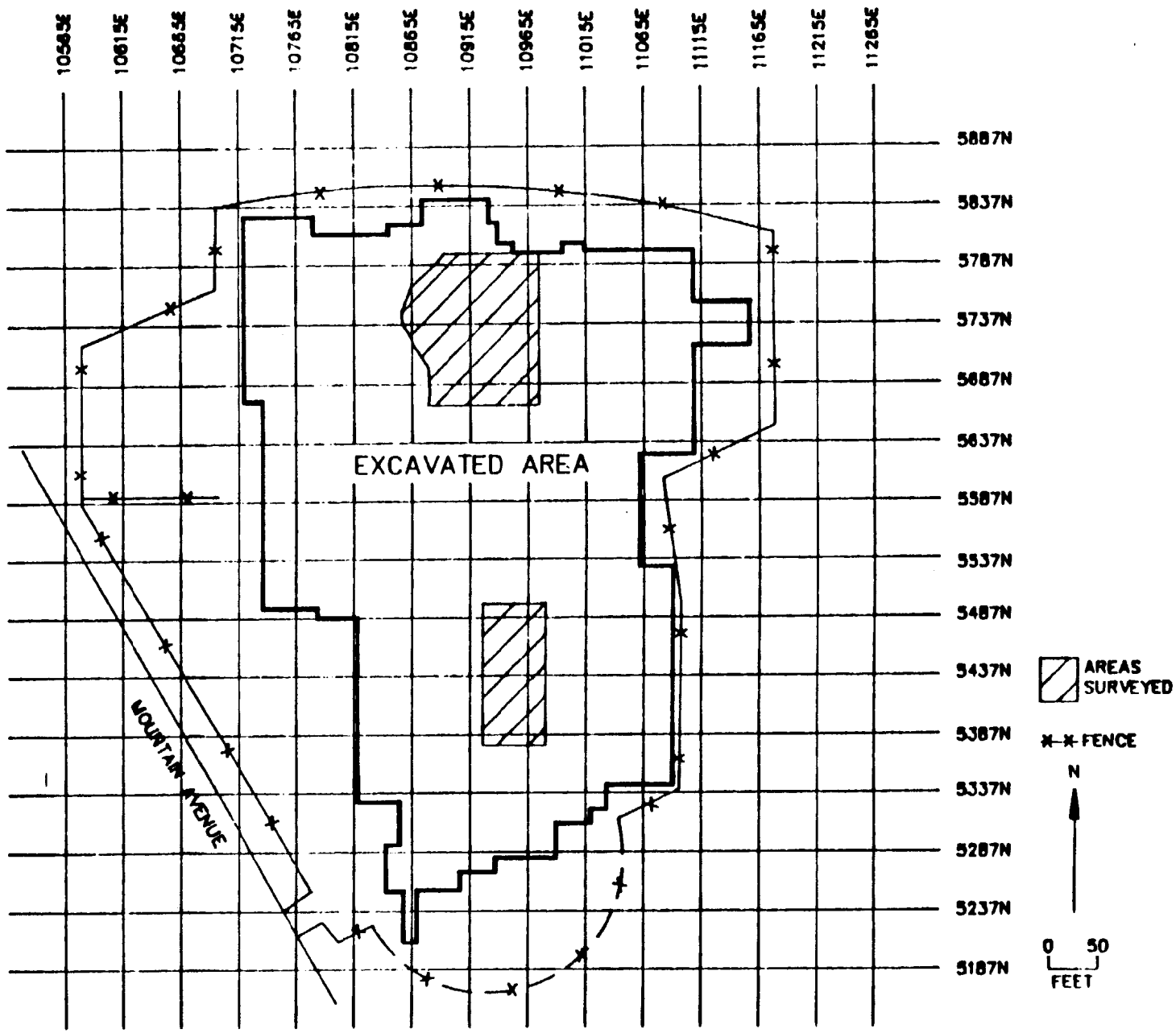

FIGURE 3: Portion of Excavated Area Included in Independent Survey

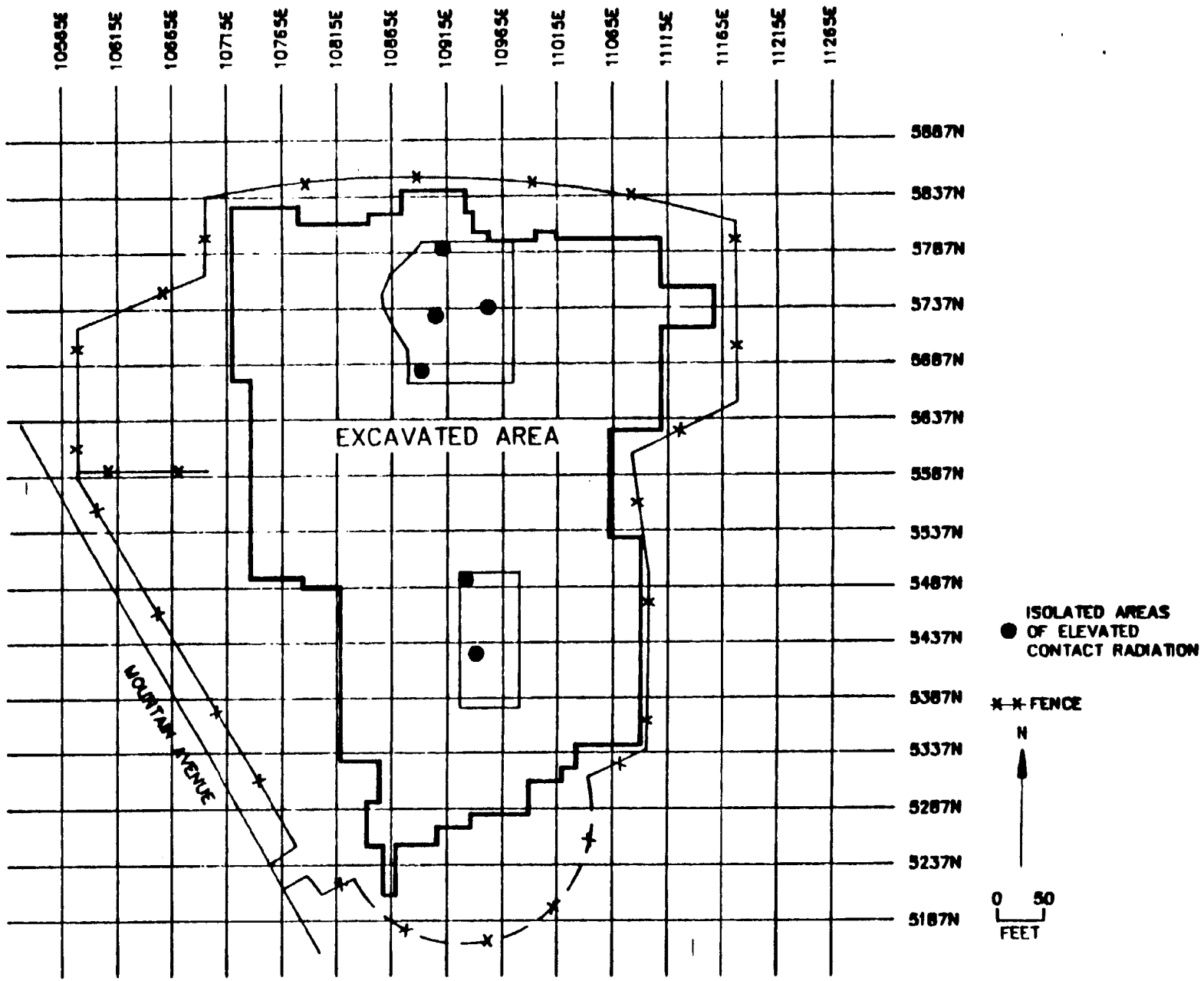

FIGURE 4: Locations of Elevated Contact Radiation Identified by Surface Scans

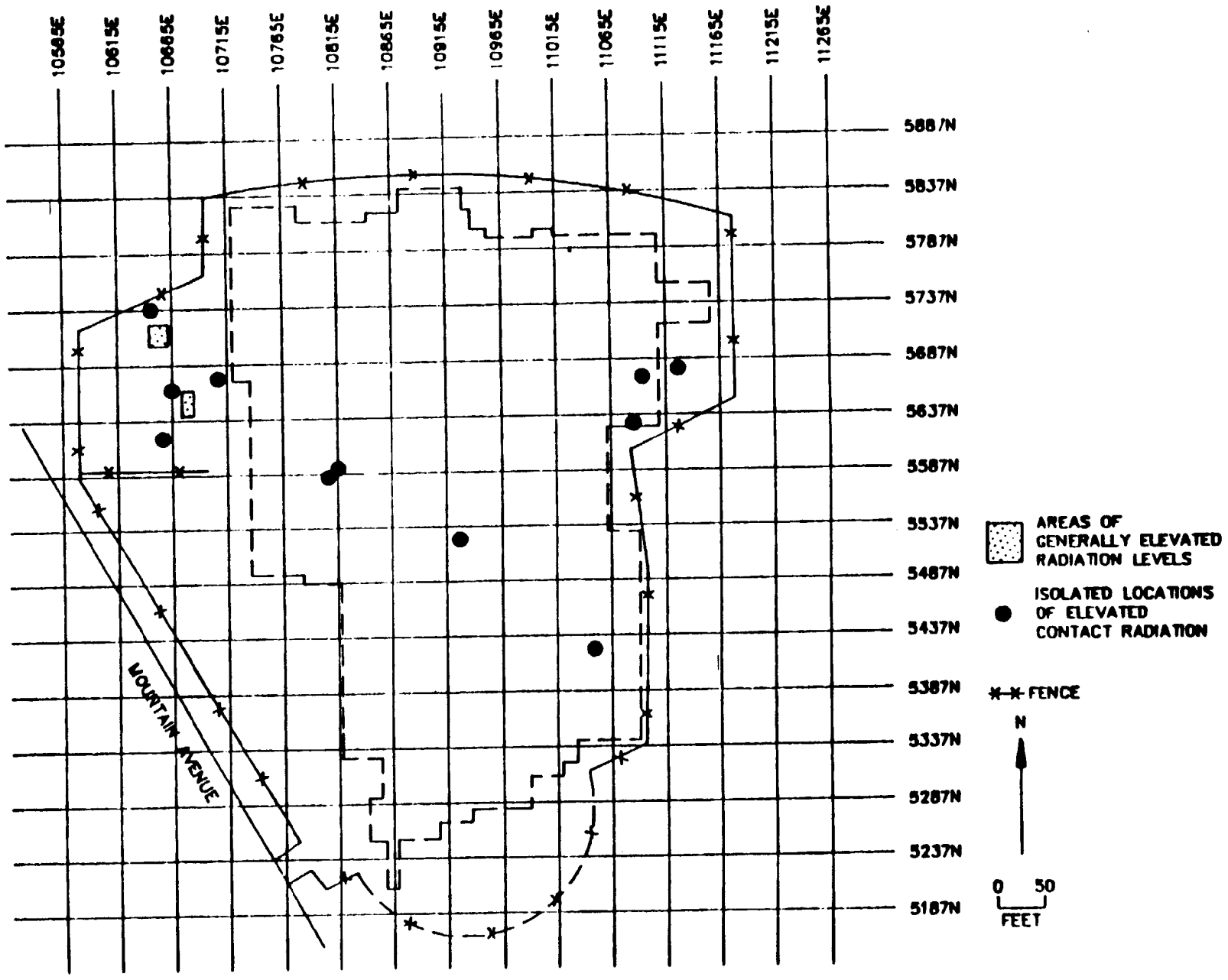

FIGURE 5: Locations of Elevated Contact Radiation Identified by Surface Scans of Site After Backfilling

TABLE 1

RESULTS OF CONFIRMATORY ANALYSES ON SOIL SAMPLES
FROM THE MIDDLESEX MUNICIPAL LANDFILL

Sample Identification[a]			Analysis	Radionuclide Concentrations (pCi/g)		
Table	Grid Coordinate N	Grid Coordinate E	By	Ra-226	Th-232	U-238
3	5655.5	10962.5	BNI	1.6 ± 0.4[c]	0.7 ± 0.1	<2.7
			ORAU	2.1 ± 0.3	1.4 ± 0.6	1.4 ± 2.8
10	5385.5	10857.5	BNI	5.2 ± 0.6	1.0 ± 0.3	6.7 ± 3.0
			ORAU	3.2 ± 0.3	1.5 ± 0.5	9.4 ± 1.7
11	5490.5	10857.5	BNI	7.2 ± 0.5	<0.8	9.1 ± 1.7
			ORAU	8.3 ± 0.5	1.1 ± 0.5	11.8 ± 1.2
	5525.0	11050.0	BNI	1.2 ± 0.1	1.2 ± 0.3	2.5 ± 1.8
			ORAU	1.2 ± 0.3	1.5 ± 0.5	2.4 ± 2.6
13	5430.5	11037.5	BNI	23.6 ± 7.1	<2.2	8.0 ± 1.4
			ORAU	29.7 ± 1.1	1.8 ± 1.0	20.2 ± 3.2
	5460.5	11037.5	BNI	14.2 ± 0.6	0.7 ± 0.3	12.0 ± 1.4
			ORAU	14.3 ± 0.8	2.4 ± 0.9	13.3 ± 2.4
	5745.5	11067.5	BNI	1.8 ± 0.2	<0.8	4.2 ± 1.5
			ORAU	2.3 ± 0.3	2.2 ± 0.6	3.6 ± 1.1
15	5790.5	10932.5	BNI	11.4 ± 3.1	0.9 ± 0.5	11.7 ± 4.4
			ORAU	16.3 ± 0.8	0.7 ± 0.7	15.9 ± 2.3
	5370.5	11022.5	BNI	11.4 ± 0.7	1.4 ± 0.5	8.7 ± 3.3
			ORAU	12.9 ± 0.8	1.5 ± 0.7	5.7 ± 3.1
	5430.5	11022.5	BNI	10.6 ± 0.6	0.6 ± 0.4	9.0 ± 1.7
			ORAU	11.1 ± 0.8	<0.5	14.8
17	5760.5	10917.5	BNI	36.3 ± 2.2	1.7 ± 0.9	26.0 ± 8.2
			ORAU	4.8 ± 0.5	1.2 ± 0.6	5.0 ± 2.4
	5670.5	10932.5	BNI	5.5 ± 0.6	1.0 ± 0.1	5.8 ± 3.1
			ORAU	6.0 ± 0.5	0.8 ± 0.3	6.2 ± 1.0
	5730.5	10932.5	BNI	11.1 ± 0.9	0.6 ± 0.7	16.4 ± 4.0
			ORAU	11.3 ± 0.8	<0.4	12.5 ± 2.4
19	5700.5	10947.5	BNI	8.2 ± 0.7	1.0 ± 0.7	6.5 ± 0.3
			ORAU	9.1 ± 0.6	2.4 ± 0.7	11.0 ± 4.5

TABLE 1 (Continued)

RESULTS OF CONFIRMATORY ANALYSES ON SOIL SAMPLES
FROM THE MIDDLESEX MUNICIPAL LANDFILL

Sample Identification			Analysis	Radionuclide Concentrations (pCi/g)		
Table	Grid Coordinate N	Grid Coordinate E	By	Ra-226	Th-232	U-238
19	5670.5	10962.5	BNI	8.5 ± 0.5	1.0 ± 0.3	8.1 ± 4.0
			ORAU	8.8 ± 0.6	1.1 ± 0.6	9.4 ± 3.0
21	5475.5	10902.5	BNI	8.9 ± 1.0	1.3 ± 0.3	15.3 ± 2.8
			ORAU	12.6 ± 0.8	1.7 ± 0.7	8.9 ± 6.0
	5445.5	10977.5	BNI	1.6 ± 0.3	1.0 ± 0.5	<6.3
			ORAU	2.1 ± 0.4	1.6 ± 0.6	9.9 ± 2.3
	5490.5	10977.5	BNI	3.7 ± 0.6	1.3 ± 0.5	3.7 ± 3.3
			ORAU	4.1 ± 0.4	1.3 ± 0.7	9.8 ± 2.6
23	5768.0	10782.5	BNI	0.6 ± 0.1	0.7 ± 0.2	<5.4
			ORAU	0.8 ± 0.2	0.9 ± 0.4	1.7 ± 0.5
	5790.5	10902.5	BNI	6.4 ± 0.6	1.3 ± 5.2	4.9 ± 2.0
			ORAU	8.4 ± 0.7	2.1 ± 0.7	3.4 ± 4.9
	5700.5	10932.5	BNI	14.6 ± 0.6	<0.9	9.9 ± 4.8
			ORAU	17.3 ± 1.0	<0.5	14.2 ± 7.9
25	5805.5	10887.5	BNI	0.5 ± 0.2	0.7 ± 0.3	1.3 ± 0.6
			ORAU	1.0 ± 0.3	1.1 ± 0.4	<1.1
	5615.0	10900.0	BNI	4.2 ± 0.2	1.3 ± 0.9	6.1 ± 2.4
			ORAU	4.6 ± 0.5	1.3 ± 0.6	5.5 ± 1.0
	5510.0	11005.0	BNI	11.5 ± 1.1	0.6 ± 0.5	16.8 ± 4.7
			ORAU	11.6 ± 0.9	1.4 ± 1.1	13.7 ± 5.3
	5555.0	11005.0	BNI	10.4 ± 0.8	<1.1	9.5 ± 5.3
			ORAU	9.9 ± 0.7	<0.6	<15.1
	5645.0	11005.0	BNI	5.7 ± 0.6	1.9 ± 0.5	6.4 ± 2.0
			ORAU	6.3 ± 0.6	2.7 ± 0.7	6.1 ± 4.1
26	5570.0	10900.0	BNI	3.0 ± 0.3	2.0 ± 1.3	1.8 ± 0.3
			ORAU	3.5 ± 0.5	4.0 ± 1.0	3.0 ± 2.1
29	5280.5	10917.5	BNI	1.3 ± 0.2	0.9 ± 0.5	5.6 ± 1.3
			ORAU	1.6 ± 0.2	1.4 ± 0.6	5.0 ± 2.2

TABLE 1 (Continued)

RESULTS OF CONFIRMATORY ANALYSES ON SOIL SAMPLES
FROM THE MIDDLESEX MUNICIPAL LANDFILL

Sample Identification			Analysis	Radionuclide Concentrations (pCi/g)		
Table	Grid Coordinate N	E	By	Ra-226	Th-232	U-238
29	5280.5	10932.5	BNI	1.5 ± 0.3	1.3 ± 0.5	6.4 ± 1.5
			ORAU	1.3 ± 0.3	1.3 ± 0.4	5.2 ± 1.7
	5280.5	10977.5	BNI	1.7 ± 1.0	1.0 ± 0.5	5.4 ± 1.8
			ORAU	2.1 ± 0.4	1.5 ± 0.6	4.8 ± 3.9

[a]From Post-Remedial Action Report data tables.
[b]Concentrations include background contributions from naturally occurring radionuclides in soil.
[c]Uncertainties are 2σ based only on counting statistics: systematic ORAU laboratory uncertainties, estimated at ± 6 to 10%, are not included in the reported values for the ORAU analyses.

TABLE 2

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
FROM LOCATIONS IDENTIFIED BY WALKOVER SCANS

Grid Location	Radionuclide Concentrations (pCi/g)[a]		
	Ra-226	Th-232	U-238
Excavated Area[b]			
N5411, E10937	3.1 ± 0.9[d]	2.1 ± 0.9	3.0 ± 2.0
N5675, E10905	11.3 ± 0.9	2.0 ± 0.9	12.4 ± 4.6
Backfilled Area[c]			
N5593, E10816 (hot spot)	1.4 ± 0.3	1.3 ± 0.4	0.5 ± 0.8
N5657, E10681	14.3 ± 0.7	10.7 ± 1.1	11.4 ± 4.3
N5722, E10656	5.4 ± 0.5	5.4 ± 0.7	2.3 ± 4.0

[a]Concentrations include background contributions from naturally occurring radionuclides in soil.
[b]Refer to Figure 4.
[c]Refer to Figure 5.
[d]Uncertainties are 2σ based only on counting statistics; additional analytical uncertainties of ± 6 to 10% have not been propagated in these data.

TABLE 3

GAMMA EXPOSURE RATES MEASURED IN EXCAVATED AREAS

Grid Location[a]		Exposure Rate (μR/h)[b]	
N	E	Surface Contact	1 m Above Surface
5380	10927	34	64
5380	10955	16	20
5384	10980	10	8
5408	10927	10	10
5408	10955	14	14
5408	10975	9	9
5438	10927	15	17
5438	10955	14	14
5438	10975	8	8
5468	10926	12	10
5468	10955	14	15
5468	10970	8	8
5498	10925	10	10
5498	10955	8	8
5498	10970	7	7
5515	10970	8	10
5516	10927	10	12
5516	10955	13	10
5657	10913	8	12
5663	10925	10	10
5663	10925	14	10
5668	10985	14	12
5668	11007	14	14
5678	10913	8	10
5678	10923	8	8
5678	10955	14	12
5678	10985	12	14
5678	11007	14	17
5708	10910	12	14
5708	10925	10	10
5708	10955	10	10
5708	10985	10	10
5708	11008	14	15
5738	10906	14	10
5738	10925	12	12
5738	10955	10	10
5738	10985	10	10
5738	11008	10	12
5768	10908	10	10
5768	10925	12	12
5768	10955	10	10
5768	10985	10	10

TABLE 3 (Continued)

GAMMA EXPOSURE RATES MEASURED
IN EXCAVATED AREAS

Grid Location		Exposure Rate (μR/h)	
N	E	Surface Contact	1 m Above Surface
5768	11008	12	10
5798	10930	12	10
5798	10955	10	10
5798	10985	10	10
5798	11010	8	10

[a]Refer to Figure 3.
[b]Includes background exposure rate-typical range, 6 to 10 μR/h.

TABLE 4

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES COLLECTED FROM EXCAVATED AREAS

Grid Location[a]		Radionuclide Concentrations (pCi/g)[b]		
N	E	Ra-226	Th-232	U-238
5380	10927	48.0 ± 1.4[c]	1.5 ± 0.7	57.7 ± 2.9
5380	10955	9.9 ± 0.8	0.8 ± 0.7	8.6 ± 3.6
5384	10980	3.6 ± 0.5	1.6 ± 0.5	2.3 ± 2.4
5408	10927	1.7 ± 0.5	1.4 ± 0.8	1.1 ± 1.2
5408	10955	2.2 ± 0.7	2.1 ± 0.9	3.3 ± 2.9
5408	10975	6.8 ± 0.9	3.0 ± 1.5	1.9 ± 2.2
5438	10927	1.7 ± 0.5	1.1 ± 0.8	2.8 ± 1.9
5438	10955	3.5 ± 0.8	2.5 ± 1.2	14.0 ± 3.1
5438	10975	1.7 ± 0.6	1.2 ± 0.9	5.5 ± 2.7
5468	10926	1.9 ± 0.5	1.2 ± 0.6	<0.5
5468	10955	4.3 ± 1.3	2.1 ± 1.0	4.8 ± 1.9
5468	10970	3.0 ± 0.6	1.6 ± 0.6	3.0 ± 2.3
5498	10925	1.9 ± 0.7	1.4 ± 0.7	3.3 ± 1.5
5498	10955	1.2 ± 0.2	1.5 ± 0.4	0.5 ± 0.4
5498	10970	1.7 ± 0.8	1.5 ± 1.5	1.4 ± 1.7
5515	10970	1.2 ± 0.4	0.3 ± 0.4	2.1 ± 1.2
5516	10927	2.0 ± 0.6	1.5 ± 1.0	2.0 ± 2.9
5516	10955	3.7 ± 0.4	0.9 ± 0.6	2.5 ± 0.9
5657	10913	1.4 ± 0.3	1.2 ± 0.6	0.9 ± 2.3
5663	10925	5.3 ± 0.8	1.6 ± 0.8	3.8 ± 3.4
5663	10955	2.9 ± 0.5	1.3 ± 0.5	3.0 ± 3.0
5668	10985	1.0 ± 0.3	1.6 ± 0.4	1.7 ± 1.2
5668	11007	1.6 ± 0.4	1.8 ± 0.6	2.9 ± 2.4
5678	10913	2.2 ± 0.4	1.2 ± 0.5	3.7 ± 1.1
5678	10923	0.8 ± 0.3	0.5 ± 0.3	1.1 ± 1.6
5678	10955	3.2 ± 0.5	2.3 ± 1.1	5.2 ± 1.8
5678	10985	4.4 ± 0.5	1.5 ± 0.8	10.0 ± 1.5
5678	11007	24.5 ± 1.5	<0.6	13.7 ± 6.3
5708	10910	1.6 ± 0.4	1.2 ± 0.6	2.6 ± 2.3
5708	10925	12.0 ± 0.8	1.1 ± 0.8	2.9 ± 1.3
5708	10955	0.8 ± 0.2	1.4 ± 0.5	4.1 ± 4.1

TABLE 4 (Continued)

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
COLLECTED FROM EXCAVATED AREAS

Grid Location		Radionuclide Concentrations (pCi/g)		
N	E	Ra-226	Th-232	U-238
5708	10985	2.0 ± 0.5	1.3 ± 0.6	3.8 ± 3.0
5708	11008	14.5 ± 0.9	0.9 ± 1.3	6.5 ± 3.4
5738	10906	1.5 ± 0.4	1.2 ± 0.4	2.1 ± 2.5
5738	10925	6.1 ± 0.6	1.2 ± 0.4	3.2 ± 1.2
5738	10955	3.9 ± 0.6	1.0 ± 0.7	5.7 ± 4.3
5738	10985	2.3 ± 0.5	1.6 ± 0.7	2.5 ± 1.8
5738	11008	3.8 ± 0.5	2.1 ± 0.7	3.3 ± 1.8
5768	10908	1.5 ± 0.3	1.2 ± 0.4	0.6 ± 0.7
5768	10925	5.0 ± 0.8	2.4 ± 1.0	12.0 ± 4.1
5768	10955	6.3 ± 0.6	0.6 ± 0.4	4.8 ± 3.6
5768	10985	3.0 ± 0.5	1.2 ± 0.6	3.8 ± 1.0
5768	11008	6.0 ± 0.6	1.4 ± 0.5	6.9 ± 2.2
5798	10930	3.9 ± 0.7	1.1 ± 0.7	6.6 ± 2.4
5798	10955	1.6 ± 0.4	1.1 ± 0.7	5.0 ± 3.8
5798	10985	0.7 ± 0.3	0.7 ± 0.5	0.9 ± 2.0
5798	11010	0.8 ± 0.2	0.8 ± 0.4	0.9 ± 1.3

[a]Refer to Figure 3.
[b]Concentrations include background contributions from naturally occurring radionuclides in soil.
[c]Uncertainties are 2σ based only on counting statistics; additional analytical uncertainties of ± 6 to 10% have not been propagated in these data.

TABLE 5

EXPOSURE RATES MEASURED AT 50 FOOT GRID INTERVALS AFTER BACKFILLING OF REMEDIAL ACTION EXCAVATIONS

Grid Location[a]		Exposure Rate (μR/h)[b]	
N	E	Surface Contact	1 m Above Surface
5187	10865	8	8
5187	10915	7	7
5187	10965	7	7
5237	10815	6	6
5237	10865	6	6
5237	19915	6	6
5237	10965	7	7
5237	11015	6	6
5287	10745	6	6
5287	10765	6	6
5287	10815	6	6
5287	10865	7	7
5287	10915	---[c]	---
5287	10965	---	---
5287	11015	---	---
5337	10725	7	7
5337	10765	6	6
5337	10815	6	6
5337	10865	---	---
5337	10915	7	7
5337	10965	7	7
5337	11015	6	6
5337	11065	8	8
5337	11095	8	7
5387	10705	6	6
5387	10715	6	6
5387	10765	5	6
5387	10815	8	8
5387	10865	8	8
5387	10915	8	8
5387	10965	7	7
5387	11015	7	7
5387	11065	6	6
5387	11093	7	7
5437	10672	6	6
5437	10715	6	7
5437	10765	6	6
5437	10815	8	8
5437	10865	8	8
5437	10915	7	7
5437	10965	6	6
5437	11015	7	7

TABLE 5 (Continued)

EXPOSURE RATES MEASURED AT 50 FOOT GRID INTERVALS AFTER BACKFILLING OF REMEDIAL ACTION EXCAVATIONS

Grid Location		Exposure Rate (μR/h)	
N	E	Surface Contact	1 m Above Surface
5437	11065	7	8
5437	11095	7	7
5487	10644	7	7
5487	10665	8	8
5487	10715	7	7
5487	10765	7	7
5487	10815	8	8
5487	10865	8	8
5487	10915	7	7
5487	10965	7	7
5487	11015	8	7
5487	11065	7	7
5487	11100	7	7
5537	10616	7	7
5537	10665	8	8
5537	10715	7	7
5537	10765	7	7
5537	10815	7	7
5537	10865	7	7
5537	10915	8	8
5537	10965	8	7
5537	11015	8	7
5537	11065	7	7
5537	11095	7	6
5587	10585	7	6
5587	10615	7	7
5587	10665	8	8
5587	10715	6	6
5587	10765	7	7
5587	10815	7	8
5587	10865	7	7
5587	10915	7	7
5587	10965	7	7
5587	11015	8	7
5587	11065	7	7
5587	11086	7	7
5637	10585	6	6
5637	10615	6	6
5637	10665	7	7
5637	10715	7	6
5637	10765	6	6
5637	10815	7	7
5637	10865	7	7

TABLE 5 (Continued)

EXPOSURE RATES MEASURED AT 50 FOOT GRID INTERVALS AFTER BACKFILLING OF REMEDIAL ACTION EXCAVATIONS

Grid Location		Exposure Rate (μR/h)	
N	E	Surface Contact	1 m Above Surface
5637	10915	7	7
5637	10965	7	7
5637	11015	7	7
5637	11065	6	7
5637	11115	7	6
5637	11148	6	6
5687	10585	6	6
5687	10615	6	6
5687	10665	6	6
5687	10715	7	7
5687	10765	6	6
5687	10815	6	6
5687	10865	7	7
5687	10915	7	7
5687	10965	7	6
5687	11015	7	7
5687	11065	7	7
5687	11115	6	6
5687	11165	6	6
5737	10644	6	6
5737	10665	6	6
5736	10715	7	6
5737	10765	6	6
5737	10815	6	6
5737	10865	6	6
5737	10915	7	7
5737	10965	6	6
5737	11015	6	6
5737	11065	7	7
5737	11115	7	7
5737	11165	6	6
5787	10700	6	6
5787	10715	6	6
5787	10765	6	7
5787	10815	7	7
5787	10865	6	6
5787	10915	7	7
5787	10965	6	6
5787	11015	7	6
5787	11065	7	7
5787	11115	7	7
5787	11165	6	6

TABLE 5 (Continued)

EXPOSURE RATES MEASURED AT 50 FOOT GRID INTERVALS AFTER BACKFILLING OF REMEDIAL ACTION EXCAVATIONS

Grid Location		Exposure Rate (μR/h)	
N	E	Surface Contact	1 m Above Surface
5837	10715	6	6
5837	10765	6	6
5837	10815	7	6
5837	10865	6	6
5837	10915	7	6
5837	10965	6	6
5837	11015	6	6
5837	11065	5	6
5849	10815	6	6
5853	10856	6	6
5855	10965	6	6
5858	10915	6	6

[a]Refer to Figure 2.
[b]Includes background exposure rate-typical range, 6 to 10 μR/h.
[b]No measurement taken: excavated area had not been backfilled at time of survey.

TABLE 6

RADIONUCLIDE CONCENTRATIONS IN SURFACE SOIL FROM BACKFILLED AREAS FOLLOWING REMEDIAL ACTION

Grid Coordinate[a]		Radionuclide Concentrations (pCi/g)[b]		
N	E	Ra-226	Th-232	U-238
5187	10865	0.9 ± 0.3[c]	1.8 ± 0.8	<0.8
5187	10965	0.5 ± 0.2	0.8 ± 0.4	0.9 ± 0.8
5237	10815	0.4 ± 0.1	0.8 ± 0.4	0.8 ± 1.0
5237	10865	0.5 ± 0.2	0.8 ± 0.4	<0.4
5237	10915	0.7 ± 0.2	0.5 ± 0.5	1.0 ± 0.8
5237	10965	0.4 ± 0.2	0.9 ± 0.4	<0.5
5237	11015	0.8 ± 0.3	1.2 ± 0.4	1.2 ± 0.9
5287	10765	0.3 ± 0.1	0.7 ± 0.4	0.8 ± 0.8
5337	10725	1.0 ± 0.3	1.8 ± 0.5	0.7 ± 1.0
5337	10815	0.5 ± 0.1	0.5 ± 0.4	0.9 ± 1.0
5337	10915	0.8 ± 0.2	1.0 ± 0.4	<0.6
5337	11015	0.4 ± 0.1	0.9 ± 0.3	0.3 ± 0.3
5337	11095	0.7 ± 0.3	1.1 ± 0.8	<0.9
5387	10705	0.7 ± 0.2	0.7 ± 0.3	<0.8
5387	10765	0.8 ± 0.2	1.4 ± 0.4	2.0 ± 1.4
5387	10865	1.0 ± 0.2	1.4 ± 0.4	0.5 ± 0.4
5387	10965	1.6 ± 0.4	0.9 ± 0.6	1.7 ± 2.2
5387	11065	0.9 ± 0.2	1.0 ± 0.4	0.4 ± 1.6
5437	10715	0.4 ± 0.2	1.0 ± 0.6	1.2 ± 1.1
5437	10815	1.0 ± 0.2	1.5 ± 0.5	2.8 ± 0.8
5437	10915	1.0 ± 0.2	0.9 ± 0.3	1.7 ± 1.3
5437	11015	1.2 ± 0.2	1.4 ± 0.5	0.7 ± 1.3
5437	11095	0.9 ± 0.2	1.2 ± 0.4	0.5 ± 0.8
5487	10665	1.0 ± 0.2	1.5 ± 0.3	2.3 ± 0.7
5487	10765	1.6 ± 0.3	1.6 ± 0.4	4.4 ± 5.6
5487	10865	1.1 ± 0.2	1.4 ± 0.4	2.1 ± 1.2
5487	10965	0.8 ± 0.2	0.8 ± 0.3	0.8 ± 0.5
5487	11065	1.9 ± 0.4	1.2 ± 0.6	4.5 ± 2.6
5537	10616	0.8 ± 0.2	1.3 ± 0.4	1.7 ± 0.8
5537	10715	0.7 ± 0.3	1.0 ± 0.3	1.7 ± 2.0
5537	10815	1.0 ± 0.2	1.8 ± 0.5	±
5537	10915	1.2 ± 0.2	1.3 ± 0.5	1.7 ± 0.8
5537	11015	1.3 ± 0.3	1.0 ± 0.4	1.1 ± 1.6
5537	11095	0.6 ± 0.3	0.6 ± 0.4	0.6 ± 1.2

TABLE 6 (Continued)

RADIONUCLIDE CONCENTRATIONS IN SURFACE SOIL
FROM BACKFILLED AREAS FOLLOWING REMEDIAL ACTION

Grid Coordinate		Radionuclide Concentrations (pCi/g)		
N	E	Ra-226	Th-232	U-238
5587	10585	1.1 ± 0.3	1.0 ± 0.5	1.1 ± 0.5
5587	10665	0.9 ± 0.4	1.8 ± 0.6	<1.0
5587	10765	0.8 ± 0.2	1.7 ± 0.5	<0.6
5587	10865	0.8 ± 0.2	1.5 ± 0.5	1.6 ± 0.8
5587	10965	1.2 ± 0.3	1.4 ± 0.5	3.9 ± 1.8
5587	11065	0.6 ± 0.2	1.4 ± 0.3	1.5 ± 0.7
5637	10615	1.1 ± 0.2	0.6 ± 0.3	<0.8
5637	10715	0.9 ± 0.2	1.4 ± 0.4	1.0 ± 1.3
5637	10815	0.9 ± 0.2	1.7 ± 0.4	2.9 ± 0.7
5637	10915	2.0 ± 0.3	1.5 ± 0.5	1.9 ± 2.3
5637	11015	1.2 ± 0.3	1.5 ± 0.6	3.0 ± 2.0
5637	11115	1.5 ± 0.3	1.3 ± 0.5	1.3 ± 1.0
5637	11148	2.6 ± 0.4	1.0 ± 0.9	2.9 ± 2.3
5687	10585	0.5 ± 0.2	0.5 ± 0.5	0.9 ± 1.1
5687	10665	0.5 ± 0.1	0.7 ± 0.3	0.6 ± 1.0
5687	10765	0.9 ± 0.3	1.5 ± 0.5	<0.8
5687	10865	0.8 ± 0.2	1.0 ± 0.5	0.9 ± 1.8
5687	10965	0.9 ± 0.2	1.2 ± 0.3	1.5 ± 0.6
5687	11065	1.1 ± 0.3	1.6 ± 0.6	<0.9
5687	11165	0.7 ± 0.2	1.5 ± 0.4	1.6 ± 1.1
5737	10644	0.8 ± 0.2	0.8 ± 0.3	0.5 ± 0.8
5737	10715	0.8 ± 0.2	1.0 ± 0.4	<0.8
5737	10815	1.0 ± 0.2	1.5 ± 0.5	<0.7
5737	10915	1.0 ± 0.2	0.8 ± 0.4	1.3 ± 0.9
5737	11015	0.9 ± 0.2	1.2 ± 0.5	<0.9
5737	11115	1.2 ± 0.3	1.2 ± 0.4	1.7 ± 1.0
5787	10700	0.6 ± 0.2	1.0 ± 0.6	0.4 ± 0.5
5787	10765	0.9 ± 0.3	1.4 ± 0.5	<1.8
5787	10865	1.0 ± 0.2	1.5 ± 0.5	1.8 ± 0.8
5787	10965	0.7 ± 0.2	1.0 ± 0.4	1.6 ± 0.6
5787	11065	0.8 ± 0.3	1.3 ± 0.5	<0.8
5787	11165	2.3 ± 0.4	1.1 ± 0.5	2.6 ± 1.5
5837	10715	0.7 ± 0.3	1.0 ± 0.4	1.1 ± 1.2
5837	10815	1.1 ± 0.4	1.9 ± 0.9	2.2 ± 2.5
5837	10915	1.0 ± 0.3	0.9 ± 1.6	<1.0
5837	11015	0.8 ± 0.2	0.8 ± 0.3	2.6 ± 0.6

TABLE 6 (Continued)

RADIONUCLIDE CONCENTRATIONS IN SURFACE SOIL
FROM BACKFILLED AREAS FOLLOWING REMEDIAL ACTION

Grid Coordinate		Radionuclide Concentrations (pCi/g)		
N	E	Ra-226	Th-232	U-238
5853	10865	1.8 ± 0.4	2.0 ± 0.7	1.6 ± 0.9
5855	10965	1.0 ± 0.2	1.3 ± 0.5	1.4 ± 1.2

[a]Refer to Figure 2.
[b]Concentrations include background contributions from naturally occurring radionuclides in soil.
[c]Uncertainties are 2σ based only on counting statistics; additional analytical uncertainties of ± 6 to 10% have not been propagated in these data.

REFERENCES

1. U.S. Atomic Energy Commission. U.S. Atomic Energy Commission Radiation Survey Report of the Middlesex Landfill Site, March 25-April 4, 1974, Germantown, MD, June 1974.

2. Oak Ridge National Laboratory. Radiological Survey of the Middlesex Municipal Landfill Site, Middlesex, New Jersey, DOE/EV-005/20, Oak Ridge, TN, April 1980.

3. Ford, Bacon and Davis Utah, Inc. Engineering Evaluation of the Middlesex Municipal Landfill Site, Middlesex, New Jersey, FBDC 230-004, July 1979.

4. Argonne National Laboratory. Action Description Memorandum, Proposed 1984 Remedial Actions at Middlesex, New Jersey, April 1984.

5. U.S. Department of Energy. Remedial Action Work Plan for the Middlesex Municipal Landfill Site, ORO-846, Rev. 2, Oak Ridge, TN, February 1986.

6. Bechtel National, Inc. Post-Remedial Action Report for the Middlesex Municipal Landfill Site, Middlesex, New Jersey, DOE/OR/20722-135, February 1987.

7. Letter, J.R. Kannard, Bechtel National, Inc., to J.D. Berger, Oak Ridge Associated Universities. "Middlesex Landfill Post-Remedial Action Data", CCN 043207, February 13, 1987.

8. Letter J.D. Berger, Oak Ridge Associated Universities, to J.J. Fiore, U.S. Department of Energy, Office of Nuclear Energy. "Verification of Remedial Actions at the Middlesex Municipal Landfill", March 16, 1987.

APPENDIX A

CRITERIA APPLICABLE TO THE MIDDLESEX MUNICIPAL LANDFILL SITE

APPENDIX A

Criteria Applicable to the Middlesex Municipal Landfill Site

The Department of Energy's radiological criteria for remedial action are presented in the "U.S. Department of Energy Guidelines for Residual Radioactivity at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites" Revision 2, March 1987. The portions of those guidelines applicable to the Middlesex Municipal Landfill Site are:

1. Radionuclide Concentrations in Soil

Radium 226 and Thorium 232

5 pCi/g (above background) averaged over the first 15 cm of soil below the surface; 15 pCi/g (above background) when averaged over any 15-cm-thick soil layer below the surface layer. Averaging may be performed over a contiguous 100 m^2 surface area.

Uranium 238

A site-specific uranium concentration guideline was not developed for the landfill, because the contaminant at this site would be expected to have a uranium content comparable to or lower than the corresponding radium-226 concentrations. Radium-226 will thus be the controlling radionuclide, even though some uranium levels may also be elevated. For other FUSRAP sites, where a uranium soil concentration guideline has been developed, the values are typically 40 to 75 pCi/g.

2. Direct Radiation

External direct gamma radiation levels should be such that, under reasonable conditions of site use and occupancy, an individual would not receive a dose equivalent in excess of 100 mrem/y above background.

APPENDIX B

MAJOR SAMPLING AND ANALYTICAL EQUIPMENT

APPENDIX B

Major Sampling And Analytical Equipment

The display or description of a specific product is not to be construed as an endorsement of that product or its manufacturer by the authors or their employer.

A. Direct Radiation Measurements

Eberline PRM-6
Portable Ratemeter
(Eberline, Sante Fe, NM)

Victoreen NaI Gamma Scintillation Probe
Model 489-55
(Victoreen, Inc., Cleveland, OH)

Reuter-Stokes Pressurized Ionization Chamber
Model RSS-111
(Reuter-Stokes, Cleveland, OH)

B. Laboratory Analysis

Ge(Li) Detector
Model LGCC2220SD, 23% Efficiency
(Princeton Gamma-Tech, Princeton, NJ)

Used in conjuction with:
Lead Shield, SPG-16
(Applied Physical Technology, Smyrna, GA)

High-Purity Germanium
Model GMX-23195-S, 23% Efficiency
(EG&G ORTEC, Oak Ridge, TN)

Used in conjunction with:
Lead Shield, G-16
(Gamma Products Inc., Palos Hills, IL)

High Purity Germanium Coaxial Well Detector
Model GWL-110210-PWS-S, 23% Efficiency
(EG&G ORTEC, Oak Ridge, TN)

Used in conjunction with:
Lead Shield Model G-16
(Applied Physical Technology, Atlanta, GA)

High Purity Germanium Detector
Model IGC25, 25% Efficiency
(Princeton Gamma-Tech, Princeton, NJ)

Used in conjunction with:
Lead Shield
(Nuclear Data, Schaumburg, IL)

Multichannel Analyzer
ND-66/ND-680 System
(Nuclear Data, Inc., Schaumburg, IL)

APPENDIX C

MEASUREMENT AND ANALYTICAL PROCEDURES

APPENDIX C

Measurement and Analytical Procedures

Gamma Surface Scans

Walkover surface scans were performed at approximately 1 meter intervals, using Eberline Model PRM-6 portable ratemeters with Victoreen Model 489-55 gamma scintillation probes, containing 3.2 cm x 3.8 cm NaI(Tl) scintillation crystals. Relative count rates were monitored using earphones and increased rates above the ambient background levels were noted.

Gamma Exposure Rate Measurements

Measurements of gamma radiation levels were performed using Eberline Model PRM-6 portable ratemeters with Victoreen Model 489-55 gamma scintillation probes. Count rates (cpm) were converted to exposure rates (μR/h) using calibration factors determined by comparison of gamma scintillation probe responses at various exposure levels as measured with a pressurized ionization chamber.

Soil Sample Analysis

Gamma Spectrometery

Soil samples were dried, mixed, and a portion placed in a 0.5 l Marinelli beaker. The quantity placed in each beaker was chosen to reproduce the calibrated counting geometry and ranged from 600 to 900 g of soil. Beakers were sealed and radon and radon daughters allowed to reach equilibrium with radium. Net soil weights were determined and the samples counted using germanium detectors coupled to a Nuclear Data Model ND-680 pulse height analyzer system. Background and Compton stripping, peak search, peak identification, and concentration calculations were performed using the computer capabilities inherent in the analyzer system. Energy peaks reviewed for determination of radionuclide concentrations were:

Ra-226 - 0.609 MeV from Bi-214*

Th-232 - 0.911 MeV from Ac-228*

U-238 - 0.094 MeV or 0.063 MeV from Th-234 or 1.001 MeV from Pa-234*

*Secular Equilibrium Assumed.

Uncertainties and Detection Limits

The uncertainties associated with the analytical data, presented in the tables of this report, represent the 95% (2σ) confidence levels, based only on counting statistics. Other sources of error associated with the analyses introduce an additional uncertainty of ± 6 to 10% in the results.

When the net sample count was less than the 2σ statistical deviation of the background count, the sample concentration was reported as less than the minimum detectable concentration (<MDC). Because of variation in background levels and the effects of the Compton continuum caused by other constituents in the samples, the MDC's for specific radionuclides differ from sample to sample.

Calibration and Quality Assurance

Laboratory and field survey procedures are documented in the following manuals developed specifically for the Oak Ridge Associated Universities' Radiological Site Assessment Program: "Survey Procedures Manual", Revision 2, March 1986; "Laboratory Procedures Manual", Revision 2, May 1986; and "Quality Assurance Manual", Revision 0, July 1986. Instruments were calibrated with NBS-traceable standards. Quality control procedures on all instruments included daily background and check-source measurements to confirm equipment operation within acceptable statistical fluctuations. The ORAU laboratory participates in the EPA and EML Quality Assurance Programs. All samples received by ORAU from BNI as part of this verification will be permanently archived.

Exhibit II (8) - State, County, and Local Comments on Remedial Action

	Page
The State of New Jersey was kept fully informed of all DOE activities associated with the cleanup of Middlesex Municipal Landfill. Copies of many reports, including the post-remedial action report, were transmitted to the New Jersey Department of Environmental Protection. The letter transmitting the post-remedial action report to the Borough of Middlesex and to the New Jersey Department of Environmental Protection is included in this exhibit.	II-317
Prior to the commencement of remedial action, a Memorandum of Understanding between the Borough of Middlesex, NJDEP, and DOE was agreed to and signed. It is included in this section of the docket.	II-318