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Formerly Utilized Sites Remedial Action Program (FUSRAP)
Contract No. DE-AC05-81OR20722

MAYWOOD INTERIM STORAGE SITE ENVIRONMENTAL MONITORING SUMMARY

Maywood, New Jersey

Calendar Year 1984

March 1985

Bechtel National, Inc.
Advanced Technology Division

DOE/OR/20722-60

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ENVIRONMENTAL MONITORING SUMMARY
CALENDAR YEAR 1984

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1.0 INTRODUCTION

The Maywood Interim Storage Site (MISS) occupies 8.7 acres of the approximately 30-acre Stepan Chemical Company (SC) property (formerly the Maywood Chemical Works) in the Borough of Maywood, New Jersey (Figure 1). The site is approximately 12 miles north-northwest of downtown Manhattan (New York City) and 13 miles northeast of Newark, New Jersey.

The highly urbanized area surrounding the MISS contains a mixture of industrial, commercial, and transportation facilities and is also densely populated. Census figures for 1980 showed the population of the Borough of Maywood to be 9,895 (Ref. 1).

From 1916 through 1956, the Maywood Chemical Works processed monazite sand (thorium ore) for use in the manufacture of gas mantles for various lighting devices. During this time, process wastes from the thorium operations were pumped to diked areas west of the plant. Other process wastes were removed from the Maywood Chemical Works for use as mulch and fill on nearby properties. Some of the fill material included thorium processing wastes, which radioactively contaminated those properties where it was used.

As part of the research and development program authorized by Congress under the 1984 Energy and Water Appropriations Act, Bechtel National, Inc. (BNI) is conducting remedial action on-site and at the vicinity properties. The work is being performed as part of the Formerly Utilized Sites Remedial Action Program (FUSRAP), a U.S Department of Energy (DOE) effort to identify, clean up, or otherwise control sites where low-level radioactive contamination (exceeding current guidelines) remains from the early years of the nation's atomic energy program.

In 1984 DOE negotiated an access agreement with SC for 8.7 acres on which to establish the MISS pending execution of an agreement with SC to donate the site to DOE. Development of the storage site commenced, and contaminated materials from some vicinity properties were brought to the site. Further remedial action will be performed in 1985 and subsequent years. These materials will remain at the MISS until final disposition for them is determined.

As contaminated materials are brought to the site, they are consolidated in a storage pile. During periods of remedial action, the storage pile is uncovered but is kept moist to minimize dust. Sedimentation barriers are used to minimize potential migration of materials, and access to the pile is strictly controlled. During periods when no remedial action is being performed, the pile is covered to prevent erosion or migration of contaminated materials.

BNI is conducting a surveillance monitoring program at the MISS during the interim storage period to detect potential migration of contaminants from the storage pile via air, water, and sediment. This summary provides these monitoring data for calendar year 1984.

2.0 ENVIRONMENTAL MONITORING SUMMARY

The routine environmental monitoring program for the MISS includes surface water, groundwater, and sediment sampling as well as radon gas and external gamma radiation measurements to determine the site's compliance with DOE Concentration Guides (CGs) provided in DOE Order 5480.1A, Chapter XI (Ref. 4). The CGs represent the concentration of a radionuclide in air or water that would limit the dose to the most highly exposed individual to equal to or less than accepted radiation protection standards.

This section summarizes the various environmental sampling, monitoring, and analytical procedures and the extent of conformance with the CGs. Environmental monitoring results listed in the individual tables are the arithmetic average of individual results. Individual sources of error (i.e., analytical error, sampling error, etc.) have not been estimated. In computing averages, where values are less than the limit of sensitivity of the analytical method, the average value is reported without the notation "less than."

Monitoring locations are shown in Figures 2 and 3. Prior to beginning remedial action, BNI began baseline sampling of surface water and sediment from Westerley Brook in April 1984. Radon and external gamma radiation monitoring began in August 1984. Surface water, radon, and external gamma radiation sampling are conducted quarterly; sediment sampling is conducted annually.

SURFACE WATER

Once each quarter, surface water samples are collected, consisting of nominal 1-liter grab samples to fill a 4-liter container. Eberline Analytical Corporation (EAC) analyzes the samples for total uranium, radium-226, and thorium-232. Total uranium is determined by a fluorometric method. Radium-226 concentrations are determined by precipitating radium-226 as the sulfate, transferring the sulfate to a radon bubbler where the radon-222 daughter is allowed to come to equilibrium, and then counting the radon-222 by alpha spectrometry to determine the amount of parent radium-226 activity originally present. Thorium-232 is eluted in solution, electrodeposited on stainless steel discs, and counted by alpha spectrometry.

Table 1 shows the concentrations of total uranium, radium-226, and thorium-232 measured at each surface water location. Total uranium concentrations at all sampling locations averaged 3 pCi/l, which is 0.5 percent of the DOE Concentration Guide (CG) of 600 pCi/l for release to uncontrolled areas (Ref. 2). Radium-226 concentrations ranged from less than 0.1 pCi/l to 1.8 pCi/l, with the higher value occurring upstream of the MISS (Location 3). Both values are below the CG of 30 pCi/l for release to uncontrolled areas (Ref. 2). Thorium-232 concentrations ranged from less than 0.1 pCi/l to 0.8 pCi/l, which are below the CG of 2000 pCi/l for release to uncontrolled areas (Ref. 1).

GROUNDWATER

There were no existing groundwater monitoring wells at the MISS; however wells were installed in December 1984. Sampling will begin in 1985 to comply with State of New Jersey State Pollutant Discharge Elimination System (NJPDES) permit requirements and as part of the routine environmental monitoring program.

SEDIMENT

Sediment samples are approximately 500-gram composites obtained at surface water sampling locations where sediment is present. They are analyzed by EAC for isotopic uranium, radium-226, and thorium-232. Isotopic uranium is determined using alpha spectrometry, where the uranium has been leached and organically extracted and electroplated on a metal substrate. Samples taken during the first routine sampling (second quarter) were lost in shipment to EAC's laboratory. The results of sediment analysis for baseline samples are listed in Table 2.

There are no specific guidelines for radionuclide concentrations in sediment. However, Location 3 is upstream of the MISS and represents background conditions. In addition, decontamination of MISS is being conducted to DOE FUSRAP proposed guidelines for radionuclides in soil. For comparative purposes, these proposed guidelines are 5 pCi/g in the upper 6 in. and 15 pCi/g below 6 in. for radium and thorium, and 75 pCi/g for uranium (Ref. 3).

RADON

Radon gas is monitored using Terradex paired Type F and Type M Track-Etch detectors. Although this technique is experimental, it is the only one commercially available for monitoring radon-220 at environmental levels. In the presence of radon-220, the Type M detector provides an accurate measurement of radon-222 concentrations. The radon-220 concentration is obtained by subtracting the Type M reading from the Type F reading (Ref. 1). A negative or zero value indicates the absence of radon-220. Terradex Corporation performs the analysis.

Table 3 lists radon concentrations recorded at the MISS. Results were available for the period August 30 to September 25 and the fourth quarter (September 25 to December 19). Average concentrations of radon-220 ranged from -1.6 pCi/l (i.e., absent) to 9.9 pCi/l, which are 0 and 99 percent of the CG (annual average of 10 pCi/l), respectively. The highest concentration was recorded at Location 5 on the northeast corner of the MISS boundary. Average concentrations of radon-222 ranged from 0.6 pCi/l to 2.7 pCi/l, which are 20 percent and 90 percent of the CG (annual average of 3 pCi/l), respectively. The highest concentration of radon-222 was recorded at Location 11 along the western boundary.

EXTERNAL GAMMA RADIATION

External gamma exposure rates are obtained using lithium-fluoride thermoluminescent dosimeters (TLDs). Each dosimeter contains five individual chips, the responses of which are averaged. Analysis is performed by EAC. Results were available for the period August 30 to September 25 and the fourth quarter (September 25 to December 19).

Table 4 lists external gamma exposure rates recorded at the MISS. At all but one location, the average annual exposure rate is below the DOE guideline for external exposure to members of the public (60 uR/h) (Ref. 2). Averages ranged from 18.2 uR/h to 96.3 uR/h. The highest reading -- approximately 168 percent of the guideline -- was at Location 10, which is situated in an area of known contamination. Normal background measured for the Maywood area is approximately 9 uR/h (Ref. 3).

The highest radon-222 and external gamma radiation exposure levels occurred during the initial 4-week monitoring period. The highest radon-220 levels occurred during the fourth quarter. The variation in readings between the initial and fourth quarter monitoring periods is believed to be a result of the short initial monitoring period and the differing levels of remedial action activities near the various monitoring stations during the two periods.

3.0 ENVIRONMENTAL PROTECTION PERMITS

DOE applied for two permits/approvals for the MISS in 1984: a New Jersey State Pollutant Discharge Elimination System (NJPDES) permit and a Soil Erosion and Sediment Control Plan (SESCP) approval.

The New Jersey Department of Environmental Protection (NJDEP) Water Resources Division, issued an emergency NJPDES permit while the routine permit was being processed. Interim waste storage at the MISS is regulated by the emergency NJPDES permit with respect to potential groundwater contamination. The emergency permit stipulated that discharges to surface water or groundwater not be made. Construction of groundwater monitoring wells, as part of the permit requirements, was in progress at the end of calendar year 1984. The emergency NJPDES permit expiration date was extended to January 11, 1985.

The Bergen County Soil Conservation District certified the Soil Erosion and Sediment Control Plan in September 1984.

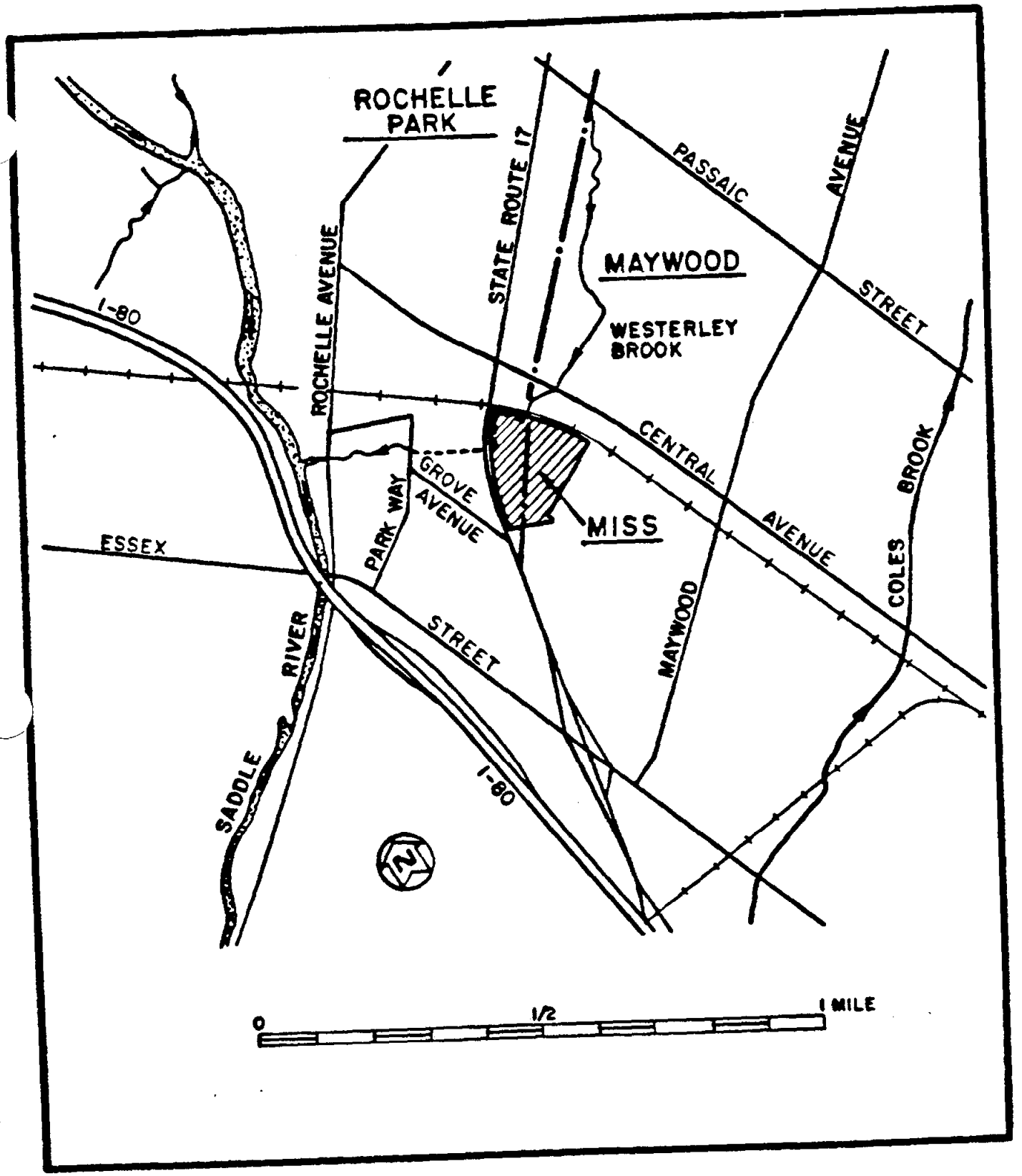

FIGURE 1 LOCATION OF THE MISS

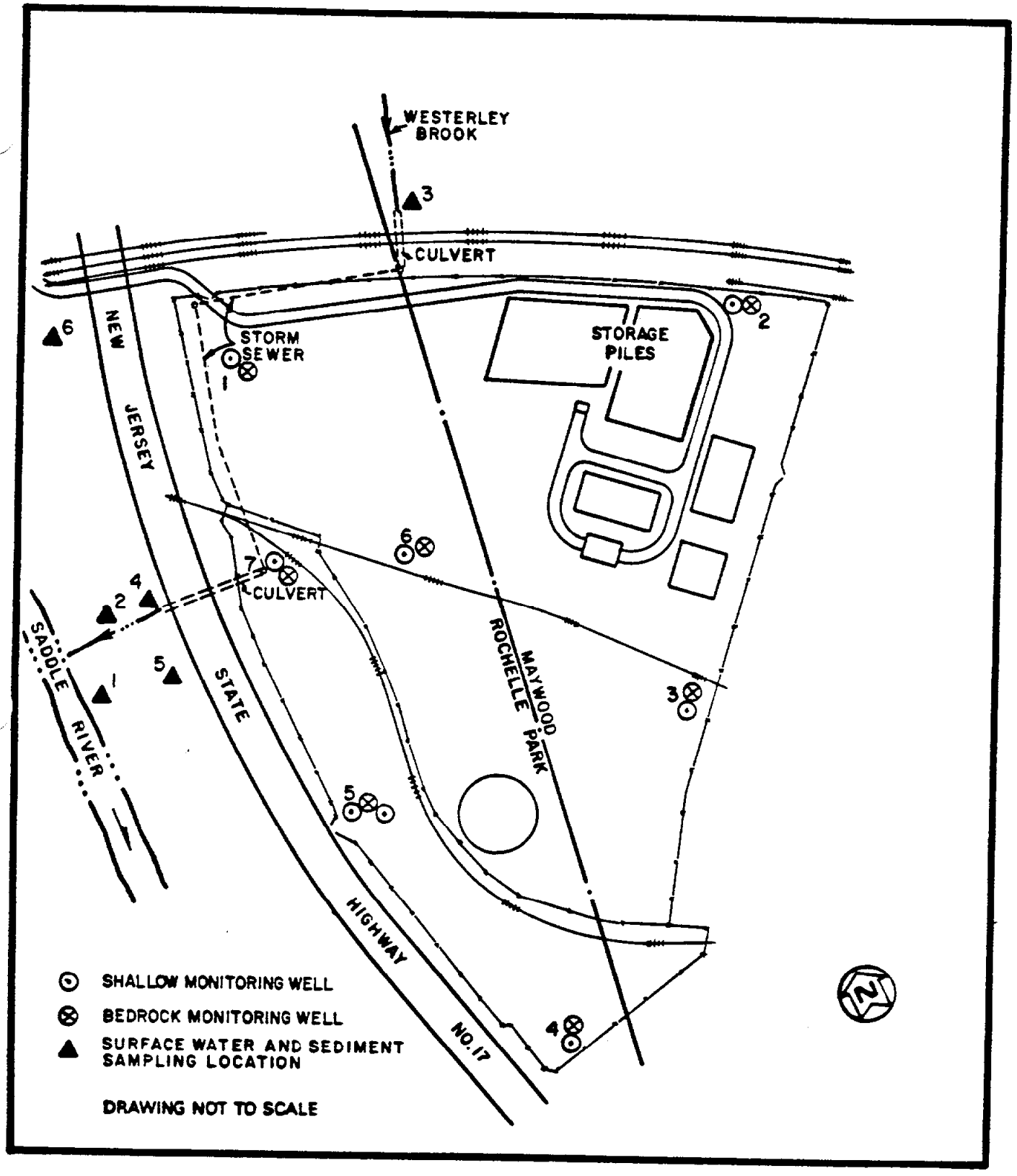

FIGURE 2 SURFACE WATER, GROUNDWATER, AND SEDIMENT MONITORING LOCATIONS AT THE MISS

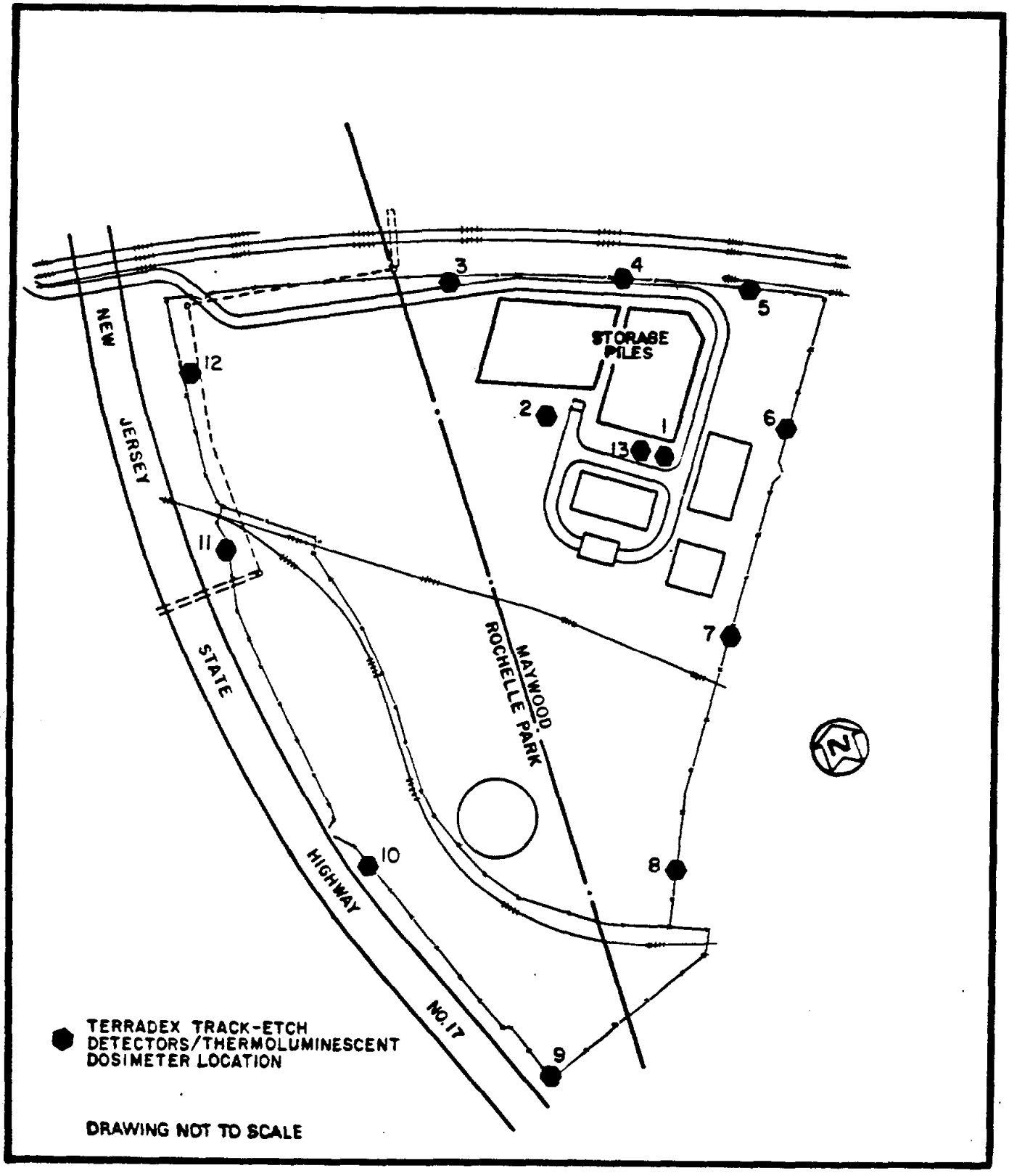

FIGURE 3 RADON AND EXTERNAL GAMMA RADIATION MONITORING LOCATIONS AT THE MISS

TABLE 1

TOTAL URANIUM, RADIUM-226, AND THORIUM-232 CONCENTRATIONS IN SURFACE WATER AT THE MISS, 1984

Sampling Location[a]	Number of Samples[b]	Concentrations (pCi/l)[c] Baseline	Minimum	Maximum	Average[d]	Percent of Standard[e]
Total Uranium						
1	4	3	3	3	3	0.5
2	4	3	3	3	3	0.5
3	4	3	3	3	3	0.5
5[f]	2	3	3	3	3	0.5
6[f]	1	11	-	-	-	-
Radium-226						
1	4	< 0.1	< 0.1	1.0	0.4	1.0
2	4	0.1	< 0.1	0.5	0.2	0.7
3	4	< 0.1	< 0.1	1.8	0.7	2.0
5[f]	2	0.4	0.7	0.7	0.7	2.0
6[f]	1	< 0.1	-	-	-	-
Thorium-232						
1	4	< 0.2	< 0.1	0.8	0.4	1.0
2	4	< 0.1	< 0.1	0.8	0.5	2.0
3	4	0.1	0.1	0.8	0.4	1.0
5[f]	2	< 0.1	< 0.1	< 0.1	0.1	0.0
6[f]	1	0.6	-	-	-	-

[a]Sampling locations shown in Figure 2. Location 4 is via a manhole and was not accessible because the cover was welded shut.

[b]Sampling included baseline and 2nd, 3rd, and 4th quarters.

[c]All results include background.

[d]In computing the average, quarterly values that are less than the limit of sensitivity are considered as being equal to the limit of sensitivity. Average values are reported without the notation "less than."

[e]Percent of standard determined using quarterly samples only. Does not include baseline sample. DOE CG for release to uncontrolled areas is 600 pCi/l for uranium, 30 pCi/l for radium-226, and 2000 pCi/l for thorium-232.

[f]Samples collected only when water is present during sampling period.

TABLE 2

URANIUM, RADIUM-226, AND THORIUM-232 CONCENTRATIONS IN SEDIMENT AT THE MISS, 1984[a]

Sampling Location[b]	Number of Samples	Concentrations (pCi/g)					
		Radium-226	Thorium-232	Uranium-234	Uranium-235	Uranium-238	Total Uranium
1	1	0.9	0.5	0.6	0.04	0.4	1.0
2	1	0.5	0.3	0.2	0.03	0.1	0.3
3	1	0.4	0.2	0.9	0.1	0.6	1.5
6	1	1.3	0.6	0.4	0.03	0.3	0.7

[a]There are no specific limits for radium, thorium, or uranium in sediment. However, decontamination of MISS is being conducted to the DOE FUSRAP proposed guidelines for radionuclides in soil. For comparative purposes, these proposed guidelines are 5 pCi/g in the upper 6 in and 15 pCi/g below 6 in. for radium and thorium, and 75 pCi/g for uranium (Ref. 3). Location 3 is upstream of the MISS and represents background.

[b]Sampling locations shown in Figure 2.

TABLE 3

RADON CONCENTRATIONS AT THE MISS, 1984[a]

Sampling Location[b]	Concentrations (pCi/l)[c] 08/30/84-09/25/84	09/25/84-12/19/84	Average	Percent of Standard[d]
Radon-220				
1	14.71	1.42	8.1	81
2	1.10	3.15	2.1	21
3	1.09	3.19	2.1	21
4	1.70	1.08	1.4	14
5	4.28	15.55	9.9	99
6	1.47	0.71	1.1	11
7	1.07	-0.69[e]	0.2	2
8	0.42	0.82	0.6	6
9	-0.57[e]	0.0[e]	-0.3[e]	0
10	4.27	0.0[e]	2.1	21
11	-3.20[e]	0.0[e]	-1.6[e]	0
12	2.59	0.20	1.4	14
13	f	1.23	1.2	12
14[g]	-0.03[e]	-1.82[e]	-0.9[e]	0
Radon-222				
1	0.95	0.78	0.9	30
2	1.28	0.25	0.8	27
3	1.11	0.78	0.9	30
4	0.95	0.57	0.8	27
5	2.11	0.57	1.3	43
6	1.44	0.94	1.2	40
7	0.78	1.0	0.9	30
8	0.62	0.52	0.6	20
9	1.44	0.48	1.0	33
10	0.78	0.89	0.8	27
11	4.70	0.68	2.7	90
12	1.83	1.05	1.4	47
13	f	0.68	0.7	23
14[g]	0.62	2.01	1.3	44

[a]Sampling program was initiated in August 1984.

[b]Sampling locations shown in Figure 3. Location 13 is quality control station for Location 1.

[c]All results include background.

[d]DOE CG for radon-220 is 10 pCi/l (annual average above background) for uncontrolled areas. DOE CG for radon-222 is 3 pCi/l (annual average above background) for uncontrolled areas.

[e]A negative or zero value indicates the absence of radon-220.

[f]QC station for Location 1 not installed until 09/25/84.

[g]Background station located at the Department of Health, Patterson, NJ.

TABLE 4

EXTERNAL GAMMA EXPOSURE RATES AT THE MISS, 1984[a]

Sampling Location[b]	Exposure Rates (uR/h)[c] 08/30/84-09/26/84	09/26/84-12/19/84	Average
Boundary			
3	46.5	16.7	31.6
4[d]	34.6	25.3	30.0
5	67.8	34.8	51.3
6	56.7	25.5	41.1
7	39.1	13.1	26.1
8	42.8	13.5	28.2
9	42.5	16.0	29.3
10	113.3	79.3	96.3[e]
11	f	19.4	19.4
12	f	33.0	33.0
On-Site			
1	f	19.5	19.5
2	f	19.3	19.3
13	f	18.2	18.2
Background			
14[g]	--	--	--

[a]Sampling program was initiated in August 1984.

[b]Sampling locations shown in Figure 3.

[c]All results include background, which is approximately 9 uR/h (Ref. 5).

[d]Exposed 111 days: badge missing on 09/26/85, found on the ground on 12/19/85.

[e]Location 10 is situated in an area of known contamination.

[f]TLD not installed until 09/26/84.

[g]Background station established at the Department of Health, Patterson, NJ on 09/19/84, but TLD not installed.

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4. Letter, R. A. Oswald, Terradex Corporation, to A. J. Kuhaida, Bechtel National, Inc., February 6, 1985.

5. Oak Ridge National Laboratory. State Background Radiation Levels: Results of Measurements Taken During 1975-1979, ORNL/TM-7343, Oak Ridge, TN, November 1981.