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RADIOLOGICAL SURVEY OF A PORTION OF PROPERTY OWNED BY MODERN LANDFILL, INC. - FORMER LOOW SITE

Summary Report

Work performed
by the
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Summary Report

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Introduction

During the period, January 7, 1981, through January 13, 1981, a radiological survey was conducted on a portion of property owned by S. Washuta, Modern Landfill, Inc., Lewiston, New York. Only a sixteen-acre portion of this 200-acre tract was surveyed. It is situated in the northwestern corner of the Modern Landfill, Inc., tract and is bordered by Vine Street (on Washuta property) to the south, and Castle Garden Road and "0" Street (DOE property) to the west and north respectively (see Fig. 1). According to operational records and aerial photos, only small portions of this tract along Castle Garden Road and "0" Street were ever used during previous site operations. At some time in the past, there were two buildings located along "0" Street and two buildings along Castle Garden Road. In addition, there were three spur railroad tracks which traversed the site from east to west, as well as an over-land steam line.

Objective

The principal objective of this survey was to determine the current radiological status of the subject survey area, specifically the on-site gamma radiation levels and ^{226}Ra concentrations in soil, both relative to those levels considered as normal background for this part of New York.

Survey Techniques

A survey grid system (100-ft spacing) was established as seen in Fig. 2. North-south grid lines 1-14 and east-west grid lines A-M describe the area to be surveyed. Measurements were made at grid points formed by the intersection of these grid lines. The following activities constituted the survey of this site.

1. Gamma-ray measurements were made at the surface and 1 meter above the surface at each grid point and at a point mid-way (at 50 ft intervals) using a portable gamma-ray scintillation survey meter. Conversion of these measurements to exposure rates in micro-roentgens per hour were done in accordance with cross calibration in the field with an instrument whose response was proportional to gamma-ray exposure in roentgens. Typical spacing for these measurements may be seen in Fig. 2 (353 grid point locations).

2. Beta-gamma dose rate measurements were made 1 cm above the surface at each grid point and at a point mid-way of each grid point. These measurements were made using a portable G-M survey meter. Typical spacing for these measurements may be seen in Fig. 2 (353 grid point locations).

3. A soil sample was collected at each defined point (100 ft centers) in the survey grid inside the existing fence. These were counted at the DOE site using an ORNL gamma-ray spectrometry system (NaI detector) located in the former dispensary building. The sensitivity of this counting system for ^{226}Ra is less than 3 pCi/g in samples of at least 100 grams. A representative number of samples were returned to ORNL for counting in a high resolution gamma-ray spectrometer. The purpose of this was to verify field results. Typical spacing for soil samples is shown in Fig. 3 (91 systematic sample locations).

4. Biased radiation measurements and soil samples were taken at points as needed, based on a review of data from the grid point radiation survey. These were determined by the field team leader. A total of 9 bias samples were collected.

5. In addition to the grid point measurements, additional survey measurements were made along both sides of Vine Street at approximately 50 ft intervals.

Results

Gamma-Ray Exposure Rates - Gamma-ray exposure rates 1 m above the surface in the grid system were found to increase slightly from west to east as the measurement points neared the K-65 storage tower, a structure containing radium-bearing residues. In Table 1, for example, it is seen that the average gamma-ray exposure rate west of the north-south grid line 6 + 00 is 5.4 ± 5.2 μR/hr, while the average exposure rate east of grid line 6 + 00 is 9.6 ± 6 μR/hr. The gamma radiation level considered normal background for this part of New York as determined by others[1-3] ranges from 3 to 9 μR/hr. The maximum gamma-ray exposure rate 1 m above the surface at this site was 26 μR/hr. This was in the west end of the site near the former building pad D, as seen in Fig. 2. The corresponding maximum surface exposure rate in the grid system was 54.4 μR/hr at the same location as the maximum reading at 1 m. The maximum surface and 1 m gamma-ray exposure rate in the east end of the site was toward the K-65 tower at grid point 14,A. These were 17.6 and 22.8 μR/hr respectively. These elevated exposure rates were due principally to the nearness of the K-65 storage tower. Gamma-ray exposure rates at the surface for biased sample locations (see Table 2) ranged from 9.3 to 145 μR/hr.

Beta-Gamma Dose Rate - Measurements were made near the surface at each point on the 50 ft x 50 ft grid using a G-M survey meter. These measurements tended to confirm the gamma radiation levels noted in the previous section, thus indicating that there was no significant beta radiation field in the area surveyed. The one noted exception was at grid point 1 + 50, E where a biased sample was collected and where the surface gamma-ray exposure rate was 114 μR/hr. The combined beta-gamma dose rate was 140 μrad/hr.

^{226}Ra in Soil - All systematic and biased samples were dried for at least 16 hours at 110°C and pulverized by hand. Soil was then placed in plastic jars, labelled, weighed, and counted. The system used for counting these samples consisted of a 3" x 3" NaI detector coupled to a 1024 channel pulse height analyzer. Calibration of the system was obtained through daily counting of two soil samples (previously analyzed at ORNL) whose concentrations of ^{226}Ra (2.1 and 4.8 pCi/g) were well known. Each sample was counted for 10 minutes and the concentration of ^{226}Ra was calculated through a comparison between the counts in two photopeak regions for each sample and the same two photopeak regions of the two "standard" samples. Results of the analyses are presented in Fig. 4, where the concentration of ^{226}Ra in systematic samples is shown at each grid point. In an earlier study[3], 15 samples of soil were collected at locations ranging from 0.5 to 3 miles from the center of the DOE storage site. The range in concentration (pCi/g) for ^{238}U, ^{226}Ra, and ^{137}Cs was 0.2 to 1.9, 0.7 to 5.8, and 0.2 to 1.5, respectively. Similarly, the mean concentrations were 1.0, 1.3, and 0.8 pCi/g. A review of these data shows that all systematic grid point soil samples contained less than 5 pCi/g of ^{226}Ra, which is the EPA recommended average concentration of ^{226}Ra in any 5 cm thickness of soil or other materials on open land within one foot of the surface. Ninety-one percent of the samples contained less than 2 pCi/g, five percent 2.1 to 2.5 pCi/g, two percent 2.6 to 3 pCi/g, one percent 3.1 to 3.5 pCi/g, and one sample contained 4.6 pCi/g. Biased samples collected at points exhibiting elevated radiation levels and displayed in Table 2 may be located easily on the grid shown in Fig. 4. It should be noted that the first five entries in Table 2 are for samples located along the extreme western portion of the site and not more than 50 ft inside the fence which separates the Modern Landfill, Inc. property from the DOE storage site. Three of these samples were found to contain ^{137}Cs. They were located next to the existing concrete pad of a former change house (labelled D in Fig. 4). The source of this ^{137}Cs is unknown. However, since it was located next to two concrete pads, material containing ^{137}Cs may have been stored on these pads at some time in the past. The sixth, seventh, and ninth entry in the table represent samples collected at 3 points along Vine Street. These samples contained ^{226}Ra in the range, 77.6 pCi/g to 254.7 pCi/g. It is probable that the ^{226}Ra in these samples originated from the temporary storage of drums containing radium-bearing residues along this street in the early 1950's.[4] In a 1951 aerial photo of the property, there is clear indication of material storage along the south side of Vine Street. A similar 1958 photo shows the area to be clear. The eighth entry in Table 2 represents a sample of slag collected along the rail spur line leading from the concrete pad "C", location of a former train locomotive shed. The ^{226}Ra concentration in this sample was 4.2 pCi/g. It was sampled because its physical characteristics were similar to other types of slag common to the Niagara area. Some of these slags contain up to 50 pCi/g of ^{238}U and ^{226}Ra.

Conclusions

The above radiological survey results indicate that only a small portion of the sixteen-acre tract surveyed exhibits concentrations of ^{226}Ra in excess of the interim EPA standard for open land contaminated

with residues from uranium processing sites. The samples which exceeded the standard are few, and are in the vicinity of concrete pads of the former storage buildings or along the edges of Vine Street. It is recommended that no excavation be allowed in three areas until additional radiological measurements can be made to more accurately describe the extent of contamination. Specifically, these are two narrow strips (10 ft wide) on either side of Vine Street, and the strip of land which lies just inside the fence along Castle Garden Road east to grid line 2 + 00, and from grid line A south to grid line M. These areas were not surveyed adequately during the period of this survey because of some snow cover and general inclement weather. In three small areas, ^{137}Cs was observed in the soil. If a conservative assumption is made that the contamination was evenly distributed in two separate areas of 1 m^2 and to a depth of 10 cm, the resulting total quantity of ^{137}Cs in each area is less than 2% of the amount which licensees are permitted to bury (by the NRC, 10CFR20.304) on their property in a single burial. Gamma radiation levels are low in all areas.

In most area of this site, the gamma radiation levels were approximately the same as the level considered normal for western New York. If an individual were to occupy the site for 2000 hours (typical work year) during one year at the point of maximum penetrating radiation level 1 m above the surface (26 μR/h), his/her integrated exposure would be approximately 50 millirems. This represents 10% of the federally recommended maximum guideline level for the exposure of an individual in the general population. On the other hand, the annual exposure to an individual sitting on the ground for 2000 hours per year (for the maximum surface radiation level) would be 290 millirems. This level is slightly over one-half the guideline level for the exposure of an individual in the general population.

References

1. EG&G, Inc., *Summary Report - Aerial Radiological Survey, Lake Ontario Ordnance Works, Lewiston, New York*; Date of Survey: October 1978. WAMD-006, February 15, 1979.

2. EG&G, Inc., *Summary Report - Aerial Radiological Survey, Niagara Falls Area, Niagara Falls, New York*; Date of Survey: September 1979, WAMD-010, November 30, 1979.

3. B. A. Berven, et al., *Results of Ground Level Radiation Measurements in Support of the 1978 Aerial Survey of the Lake Ontario Ordnance Works, Lewiston, New York*, ORNL/TM-7004, September 1979.

4. C. E. Schumann to R. C. Heatherton, K-65 Shipping Operation at LOSA, November 18, 1952.

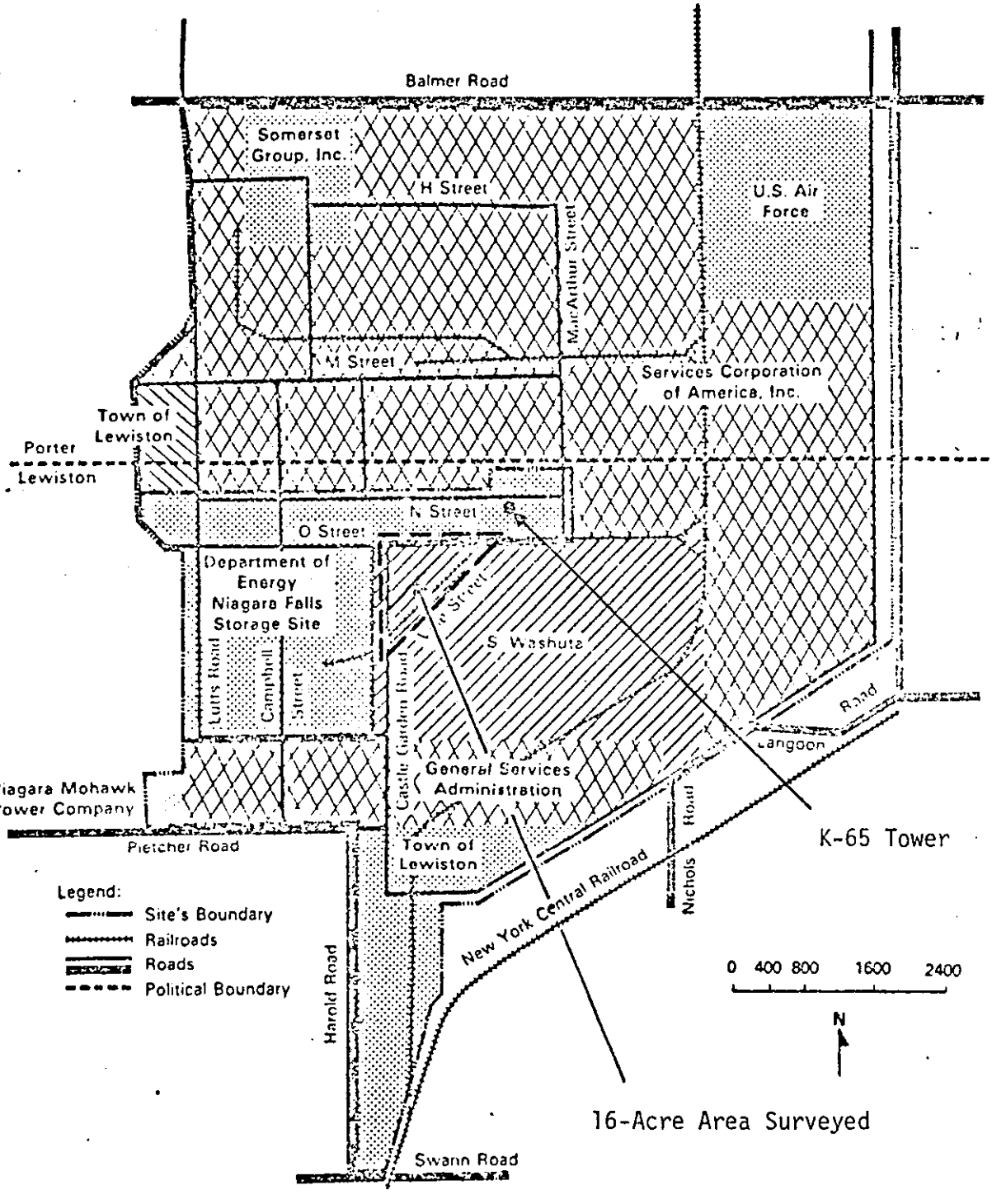

Fig. 1. Plan view of Former AEC Storage Site Showing Property Ownership (Original from Aerospace).

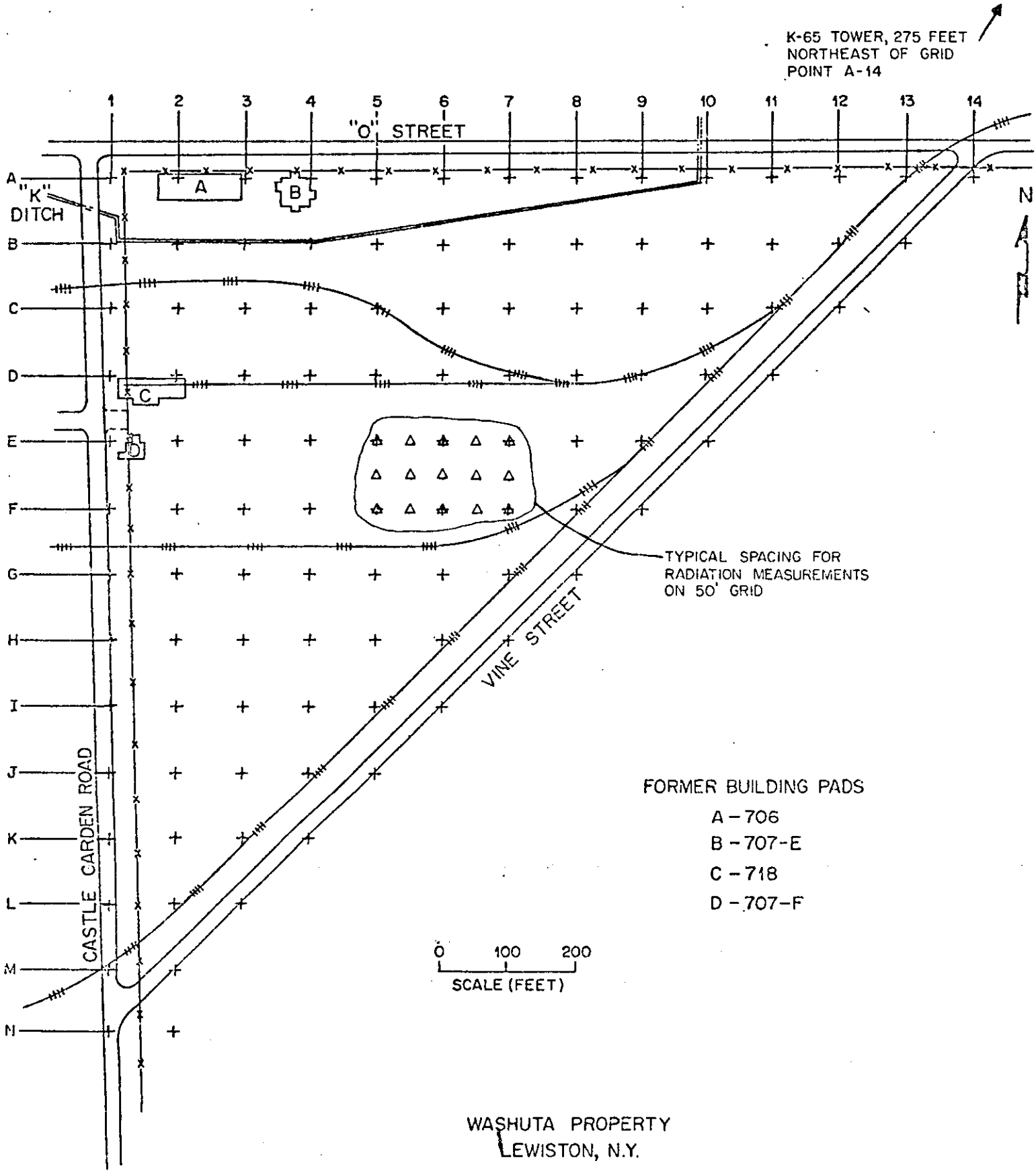

Fig. 2. Plan view of area surveyed showing typical spacing for radiation measurements on a 50' x 50' grid.

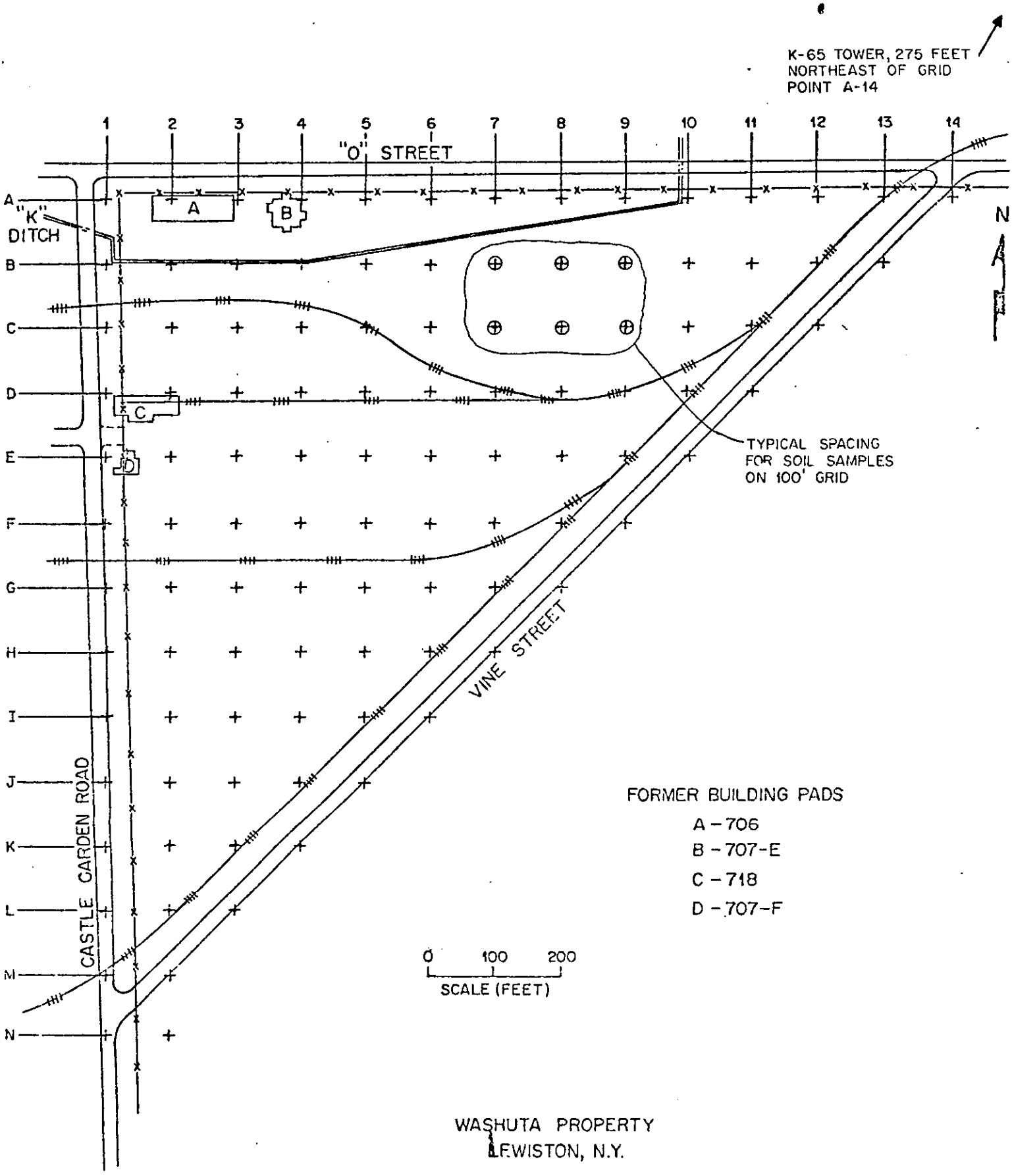

Fig. 3. Plan view of area surveyed showing typical spacing for soil samples on a 100' x 100' grid.

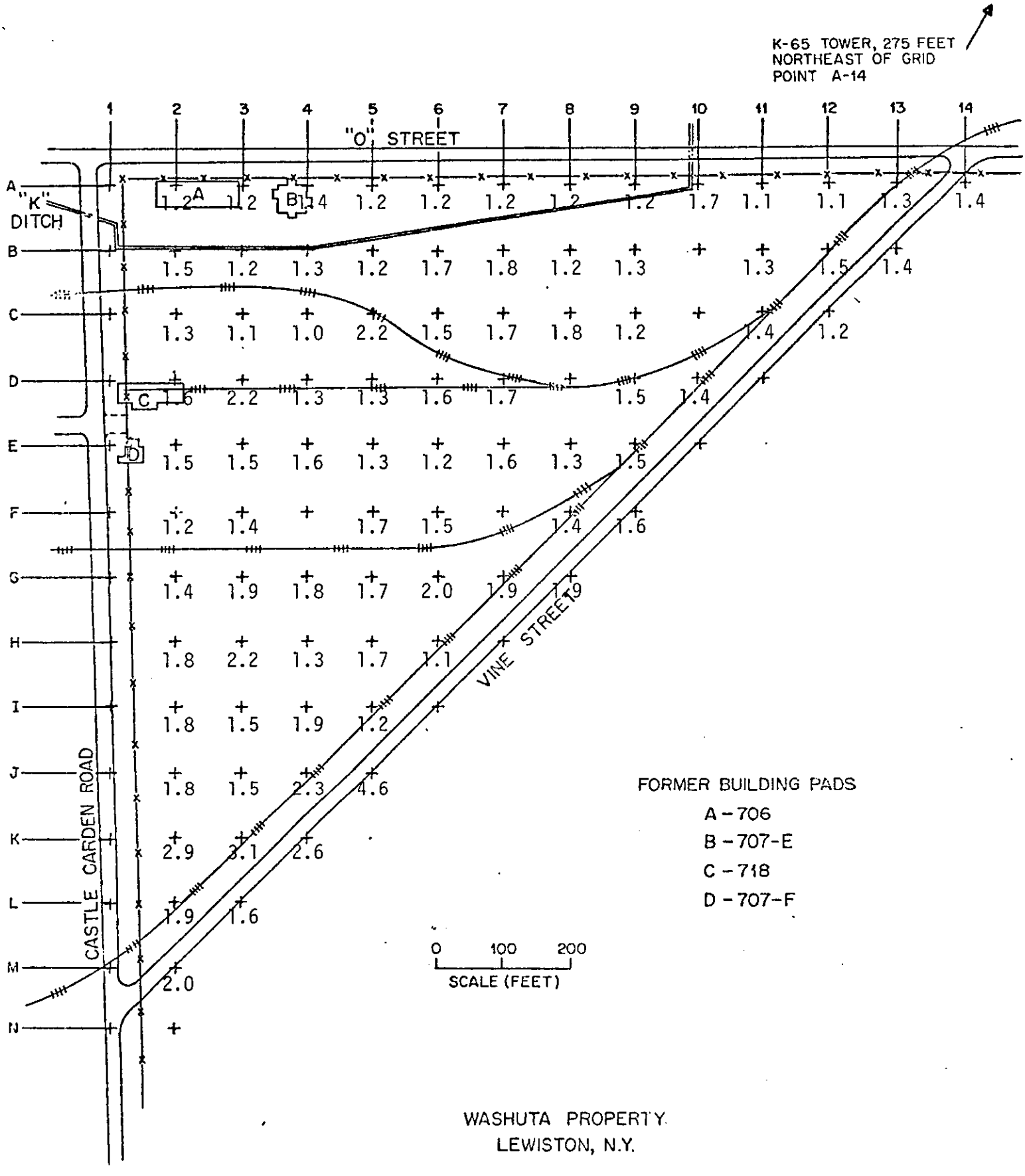

Fig. 4. ^{226}Ra concentrations (pCi/g) at systematic sampling points. (EPA limit for ^{226}Ra in soil is 5 pCi/g.)

Table 1. Average Gamma-Ray Exposure Rates

Area	1 m Above Ground	At Ground Surface
West*	5.4 ± 5.2 μR/hr range 3.6 - 25.9 μR/hr	5.9 ± 6.5 μR/hr range 3.6 - 54.4 μR/hr
East**	9.6 ± 6.0 μR/hr range 4.2 - 22.8 μR/hr	8.6 ± 6.4 μR/hr range 4.2 - 17.6 μR/hr
Along Vine Street***	7.9 ± 4.1 μR/hr range 4.7 - 22.8 μR/hr	8.0 ± 3.2 μR/hr range 4.7 - 17.6 μR/hr

*West Half - Area described by grid line 1 + 50 from line A south to line M + 50', east to grid line 6 + 00 and from line A south to line I.

**East Half - Area described by grid line 6 + 00, from line A south to line I, east to grid line 14 + 00 on line A.

***From intersection with Castle Garden Road northeast to "O" Street.

Table 2. Bias Soil Sample Locations and Gamma-Ray Exposure Rates at the Surface

Grid Location*	Exposure Rate (μR/hr)	^{226}Ra (pCi/g)	^{137}Cs (pCi/g)
1 + 25, D + 25	62.	327.	16.4
1 + 35, M	114.	280.	1.5
1 + 45, D + 85	145.	trace	839.
1 + 50, E	114.	trace	674.
1 + 85, C + 90	60.	830.	-
3 + 50, J + 95	42.	77.6	2.2
4 + 60, I + 50	67.	146.8	-
7 + 50, D	9.3	4.2	-
7 + 50, G + 50	104.	254.7	-

*Typical - Grid locations may be identified as follows: 1 + 25, D + 25 is a point 25 ft east of grid line No. 1 and 25 ft south of grid line D.