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ENVIRONMENTAL RADIOACTIVITY AT THE NEVADA TEST SITE July, 1967 through June, 1968

REYNOLDS ELECTRICAL & ENGINEERING CO., INC.
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ENVIRONMENTAL RADIOACTIVITY AT THE NEVADA TEST SITE JULY 1967 THROUGH JUNE 1968

by
The Staff of
The Environmental Surveillance
Group

ENVIRONMENTAL SCIENCES DEPARTMENT
TECHNICAL AND SUPPORT SERVICES DIVISION
REYNOLDS ELECTRICAL AND ENGINEERING CO., INC.

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The Environmental Surveillance group of the Radiological Sciences Department collected all samples, prepared the initial text and provided technical guidance during the final preparation of the report. Laboratory analysis was performed by the Department's Laboratory Operations group. The Reports Coordination group prepared the various figures, edited the text, and coordinated the final preparation of the report.

ABSTRACT

This report summarizes the data obtained from periodic environmental surveys at the Nevada Test Site (NTS) from July, 1967 through June, 1968.

The Environmental Surveillance group performed routine and special surveys of the NTS. Samples of potable water were collected for laboratory analysis from living quarters, administrative facilities, and cafeterias. Additionally, samples of water from waste ponds, sewage basins, reservoirs, springs, and wells were collected on a routine basis to determine ambient levels of radioactivity or any changes of radioactivity. Air samples were also routinely collected at selected locations throughout NTS for the same purpose as for water samples. Soil and vegetation samples were collected to provide information for assessing trends in the distribution of fallout radioactivity levels.

All environmental samples, except soil and vegetation, were analyzed routinely for gross beta radioactivity, and selected samples were additionally analyzed for plutonium alpha activity. Soil and vegetation samples were routinely analyzed for gross gamma radioactivity. Significant increases or changes in the radioactivity levels of these samples were reported to the appropriate field monitoring groups for investigation and remedial action. All sample results are permanently maintained by the Environmental Surveillance group for record purposes and for comparison with previous results to determine trends and correlations where feasible.

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INTRODUCTION

This report contains a summary of the data obtained concerning the radiological conditions in the environment of the Nevada Test (NTS), performed under contract to the AEC by the Radiological Sciences Department of the Reynolds Electrical & Engineering Co., Inc.

The Environmental Surveillance Group performs routine and special surveys of the NTS. Samples of air and water are collected for laboratory analysis from living quarters, administrative buildings, and cafeterias. Additionally, samples of water from waste ponds, sewage basins, reservoirs, springs, and wells are collected on a routine basis to determine normal levels of radioactivity or any change of radioactivity. Air samples are also routinely collected at selected locations throughout NTS for the same purpose as for water samples. This report also contains a summary of the data obtained from the first year's collection of soil and vegetation samples from selected locations within the NTS.

All environmental samples are analyzed routinely for gross beta radioactivity, and selected samples are additionally analyzed for plutonium alpha activity. Significant increases or changes in the radioactivity levels of these samples are reported to the appropriate field monitoring groups for investigation and remedial action. All sample results are kept by the Environmental Surveillance Group for record purposes and for comparison with previous results to determine trends and correlations where feasible.

This report presents the data derived from the sampling program for the period July, 1967 through June, 1968.

SECTION 1

AIR SAMPLING

1.1 Introduction

The Environmental Surveillance group maintains low-volume, continuously-operating air samples at 22 permanent locations (Figure 1 and Table 1) situated to provide monitoring of the particulate airborne radioactivity within the Nevada Test Site (NTS) boundaries.

1.2 Description of Equipment

The sampling equipment used consists of a positive displacement Gast pump that pulls air through a 4" (Whatman 41) filter paper mounted in a disposable plastic filter head. A dry gas meter is utilized to measure the total volume of displaced air over a period of seven days. The total volume of air sampled during a regular seven day sampling period is approximately 1 x 10^3 cubic meters. The flow rate of air through the filter is maintained at approximately four cubic feet per minute.

1.3 Counting Procedures

All collected air samples were held in storage for at least five days before counting. This time interval allowed the naturally occurring radon and thoron daughters to decay to insignificant levels. Air samples were analyzed for gross alpha and beta using a Beckman WIDE-BETA II gas proportional system having an efficiency (the ratio of observed counts to known disintegrations) of 30.9% for alpha and 52.4% for beta. This system replaces the Nuclear Chicago ULTRASCALER which was used previously. Background counts for alpha and beta on the WIDE-BETA II system were determined by counting for 100 minutes each. A Baird Atomic SPECTROMETER was used for determination of gross gamma activity. If the activity for gamma was such that the apparent 2σ counting error was less than 50%, then the sample was transferred to a 400-channel gamma-spectrum analyzer to qualitatively determine the contributing radionuclides.

Sample activity results, reported by the Radiological Measurements Laboratory, were compared with an established "alert level". The determination of the alert level is based on the concentrations guides of unknown radionuclides in air for a period of 168 hours (CG) as outlined in USAEC manual chapter 0524. The alert level for beta activity has been maintained at 1.0 x 10^{-11} μCi/cc of air after a five day decay period and at

1.0×10^{-14} μCi/cc for alpha activity.

Though a sample may exceed this alert level, it does not necessarily mean that the actual CG has been exceeded. Whenever a sample does approach or exceed this established guide, more intensive sampling and more involved analyses are performed to determine if the high concentration is valid.

1.4 Data Discussion

The means and ranges of gross beta radioactivity in weekly collections of air samples from the 22 permanent locations from July, 1967 through June, 1968 are tabulated in Table 2 and plotted in Figure 2. During this fiscal year (July, 1967 through June, 1968) two sample activity values exceeded the alert level of 1.0×10^{-11} μCi/cc in air. During the latter week of January 1968, the air sampler located at Area 1, gravel pit (see Figure 1) recorded a value of 5.15×10^{-11} μCi/cc. This was attributed to an event conducted in Area 2 on January 18, 1968. The effluent cloud resulting from a slight venting moved in a southwesterly direction, passing over the Area 1 sampler and fringing the air sampler at Area 16 which resulted in the highest recorded reading at the latter area 1.25×10^{-12} μCi/cc for the fiscal report period.

The highest recorded activity value for this report period, 3.48×10^{-10} μCi/cc, occurred after the BUGGY detonation, a Plowshare event, conducted in Area 30 on 3/12/68. This sample was collected from the Area 20, dispensary area, (Figure 1) for the third week in March, 1968. Also affected by the Buggy event was the air sampler located at stake 19C-10 (Figure 1) in Area 19 where the reading here was 3.60×10^{-12} μCi/cc, the highest recorded value for this location for the fiscal report period (see Figure 3). Fluctuation and trend for this fiscal year followed a trend of decrease from July, 1967 until about the latter part of September which were periods of reduced testing operations. A one magnitude increase in activity values occurred during the first week in January, 1968 and this trend was maintained till the end of the fiscal period (Figure 3). This increase in activity values may be correlated with fallout from foreign weapons tests. Gamma spectrum analyses of pre-filters confirmed the presence of fission products in all 22 locations from the test site.

Figure 3 and Table 3 show the plotted means and ranges for each of the mean values of all 22 sampling locations which averaged 1.56×10^{-13} μCi/cc. This value is slightly higher than the mean value observed for all air samples collected over two previous fiscal periods which averaged 1.02×10^{-13} μCi/cc for fiscal year 1967 and 1.37×10^{-13} μCi/cc for fiscal year 1966.*

The highest observed mean value for a sampling location was 9.23×10^{-13} μCi/cc in Area 1 gravel pit, and the lowest was 7.60×10^{-14} μCi/cc in Area 11, at Guard Station 293. The wide range of values encountered during this sampling period are shown in Table 3 and Figure 3. Greater than a factor of 100 was usually the result of a single high or low value. These extreme values did not drastically affect the mean values due to logarithmic transformation of the observed activity results. (The statistical treatment of data for this report is presented in Appendix A.)

Detectable alpha activity values for air during this period occurred infrequently and at isolated locations. Although 29% of the total number of air samples collected during this report period showed activity levels over background, a statistical summary of this data would not be meaningful because of the uncertainty associated with results uncorrected for self-absorption and the low activity values which result in a high relative 2σ counting error.

Routine gamma counting of pre-filters during the period commencing January, 1968 indicated the presence of short lived gamma emitting radionuclides. Gamma spectrum and decay analyses of the samples during the period January through June, 1968 indicated that origin was from foreign weapons testing. Other isolated cases where the presence of short lived gamma emitting radionuclides were present were associated with individual test operations. In all cases, the presence of gamma-emitting radionuclides, as determined qualitatively by spectrum analysis, did not pose a health hazard.

1.5 Summary

These results indicate, in general, a slight increase in mean values since preceding periods. This is attributed to the contribution of foreign weapons testing as noted in Figure 3 where an increase in activity values occurred in January, 1968.

Results of Environmental Surveillance sampling activity values obviously cannot be used in calculating personnel exposure doses. They are instead used as an index and in the detection of trends, and emphasis is either sustained or shifted to other sample types whenever significant changes in levels are noted.

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*Staff report, "Environmental Radioactivity at the Nevada Test Site, July, 1966 through June, 1967," unpublished report, Radiological Sciences Department, Reynolds Electrical & Engineering Co., Inc., May, 1968.

SECTION 2

Water Sampling

2.1 Introduction

Water samples were collected from selected waste ponds, reservoirs, sewage basins, natural springs, wells, and potable water sources, such as cafeterias, swimming pools, etc., on a "grab sample" basis.

2.2 Collection Methods

Water samples were collected in one liter glass bottles on a weekly, monthly, and special basis depending upon the potential for radioactive contamination. The potable water samples were collected from taps at the point of consumption after allowing the water to run for a length of time. All industrial reservoir water was collected near the inlet points of the reservoirs, while the natural spring water samples were "grab" samples obtained by dipping at the surface.

2.3 Sample Preparation

All water samples were analyzed for gross beta and tritium concentrations. A 15 ml aliquot was first taken from the original sample in a 5 dram plastic vial and submitted to the counting laboratory to be gamma counted. A 1 ml sample was taken for tritium analysis which was performed using standard liquid scintillation counting techniques. The remainder of the one-liter sample was evaporated to 15 ml, transferred to a two-inch stainless steel planchet, and evaporated to dryness under infra-red lamps. A wetting agent was added during final evaporation to provide even distribution of the sample on the planchet. From the preparation laboratory, the samples were sent to the counting laboratory, and counted for beta. When indicated, one-liter samples of water were submitted for gamma spectrum analysis.

2.4 Counting Procedures

All routine environmental water samples were analyzed for beta radioactivity by gas proportional counting. The water samples were analyzed by a Beckman WIDEBETA system equipped with an automatic sample changer. The efficiency, i.e., the ratio of observed counts to known disintegrations, on the WIDEBETA system, was 57% for beta. The average background count rate was 1.8 counts per minute for beta.

The tritium analyses were performed using a Packard Tri-Carb

Liquid Scintillation Spectrometer with an efficiency of 18% and an average background of 16 counts per minute.

2.5 Statistical Summary of Results for Water

2.5.1 Potable Water Samples

The statistical breakdown for potable water samples for fiscal year 1968 was based on nine sampling locations (Table 4 and Figure 4) taken on a weekly basis.

Table 5 and Figure 5 give the means and ranges for gross beta activity from July, 1967 through June, 1968. The means ranged from a low of 2.88×10^{-9} μCi/cc recorded on 5/19/68 to 1.95×10^{-8} μCi/cc recorded on 10/15/67. The maximum value for the year was 4.80×10^{-7} μCi/cc recorded March 25, 1968 at the Area 20 Dispensary. This maximum reading recorded for the report period was primarily contributions from the BUGGY event conducted on 3/12/68. Subsequent weekly samples at this location showed decreasing results which equaled pre-BUGGY ranges of normal activity. The average mean for fiscal year 1968 was 6.41×10^{-9} μCi/cc as compared with 3.77×10^{-9} μCi/cc for fiscal year 1967 and 6.29×10^{-9} μCi/cc for fiscal year 1966. The current year's value is slightly higher than that of last year but is still well below the CG level of 1.0×10^{-7} μCi/cc. This value is based on the exposure guides in USAEC manual chapter 0524.

Table 6 and Figure 6 give the means and ranges for gross beta activity of the nine potable water sample locations over the fiscal period 1968. The maximum mean value for a potable water sampling station was at the Area 6 Cafeteria at 1.11×10^{-8} μCi/cc. The wide range observed for the Area 20 Dispensary and Area 51 Cafeteria was a result of a single high observed reading. Due to logarithmic transformation of data, the means were not drastically affected by these unique individual readings.

With the exception of the potable water sample collected from Area 20 Dispensary on 3/25/68, all water samples collected during the year were well below the CG recommended guide level.

2.5.2 Natural Springs Water Samples

The term "natural springs" encompasses most of the naturally occurring spring fed pools located within the NTS. Although these springs may be used infrequently as drinking water by some individuals, they are considered as a separate classification from potable water sources. In an effort to adequately cover the test site, eight sampling locations have been selected (Figure 7 and Table 7). All of these stations were sampled once a month.

Table 8 and Figure 8 show the means and ranges for gross beta activity over a twelve month period. The means ranged from 7.04×10^{-9} μCi/cc recorded in May, 1968 to 2.61×10^{-8} μCi/cc recorded in September, 1967. The maximum recorded value for this fiscal period was 9.30×10^{-8} μCi/cc collected from Area 12, Gold Meadows Pond in July, 1967. This location is not a natural spring in the true sense in that most accumulated water is a result of runoff. Frequent occurrences of long lived radionuclides in collected samples indicates translocation by runoff from a known contaminated area on high ground. The average mean for fiscal year 1968 was 1.61×10^{-8} μCi/cc as compared to 1.27×10^{-8} μCi/cc for fiscal 1967 and 1.02×10^{-8} μCi/cc for fiscal year 1966. (Refer to footnote at end of Section 1.)

No natural springs water sample collected during fiscal year 1968 exceeded the concentration guide of 1.0×10^{-7} μCi/cc. The maximum mean and ranges occurred at Gold Meadow Pond (Table 9 and Figure 9). This location has a maximum potential for contamination due to runoff and accumulation, test site originated fallout, and foreign weapons tests contamination since it is completely exposed to the atmosphere.

2.5.3 Open Reservoir Water Samples

Open reservoirs have been created throughout the NTS to furnish a ready supply of water for various industrial purposes. Eleven of these reservoirs have been selected as sampling locations (Figure 10 and Table 10). The reservoir at Area 17, Well 1 which was previously sampled, has been eliminated from routine collections since the well pump was inoperative throughout this fiscal year.

Table 11 and Figure 11 give the means and ranges for gross beta activity over the twelve month period of fiscal year 1968. The means ranged from a low of 5.50×10^{-9} μCi/cc recorded in August, of 1967 to a high of 4.06×10^{-8} μCi/cc in March of 1968. The maximum recorded value for this reporting period was 2.71×10^{-6} μCi/cc which was collected from Area 20, Well U20a Reservoir during the latter half of March 1968. This reservoir (see Figure 10) was in the fallout path from the BUGGY event conducted in Area 30 on March 12, 1968. Two other open reservoirs on routine collection schedules also were exposed to this fallout path, Well Ue19e and Ue19gs reservoirs, both in Area 19. The former reservoirs recorded 1.04×10^{-7} μCi/cc and the latter 3.87×10^{-7} μCi/cc. The average mean value for fiscal year 1968 was computed at 1.32×10^{-8} μCi/cc which was higher than the mean for fiscal year 1967 which was 8.00×10^{-9} μCi/cc.

With the exception of the three reservoirs mentioned above which were in the fallout path during March, 1968 and the Well 4 Reservoir in Area 51 during July, 1967, (see Figure 12 and Table 12) all other open reservoir water samples collected during fiscal year 1968 were below the CG value of 1.0×10^{-7} μCi/cc.

2.5.4 Supply Wells Water Samples

Thirteen supply wells were sampled on the NTS during fiscal year 1968 (Figure 13 and Table 13). Water from these and other wells throughout the Test Site is used for a variety of purposes ranging from sanitary water supply to drilling mud preparation. The criteria for selecting particular wells to be sampled was based not only upon their potential use for human comsumption but also upon their value as an index for measuring the possible movement of radiation contamination in the aquifer. Most of these wells are located in areas where the movement of water in the aquifer is from known contaminated underground test sites. To date no data have been obtained that would indicate that the ground water at any well sampling location has been significantly affected by movement of contamination through the aquifer.

Table 14 and Figure 14 give the means and ranges for gross beta activity over a years' period from July, 1967 through June, 1968. Samples for

October, 1967 were lost during laboratory analysis. The means of sample activity ranged from a low of 7.77×10^{-9} μCi/cc recorded in April, 1968 to a high of 1.16×10^{-8} μCi/cc in January, 1968. The maximum sample value for this period was 6.18×10^{-8} μCi/cc recorded in November, 1967 from Well Ue5c in Area 5. The average of all mean values computed for fiscal year 1968 was 1.07×10^{-8} μCi/cc, which is slightly higher than the mean value 7.26×10^{-9} μCi/cc recorded in 1967 and 1.02×10^{-8} μCi/cc recorded in fiscal year 1968.

As mentioned previously, all sample values were well below any level of concern and did not exceed the CG value of 1.0×10^{-7} μCi/cc.

2.5.5 Final Effluent Water Samples

Four locations were sampled (Table 16 and Figure 16), all in NTS living areas, to determine what, if any, levels of radioactivity were present in sewage. This program of monthly collections was terminated in April of 1967 and re-instituted as quarterly collections beginning in July, 1967.

A total of 10 samples were analyzed from these 4 locations during this fiscal period. No tabular presentations were prepared due to the small sample sizes from each location. Available data indicates the lowest value to be 8.73×10^{-9} μCi/cc collected in July, 1967 from the Area 23, final effluent pond, and the highest value, 4.92×10^{-8} μCi/cc from Area 12, final effluent pond, collected in January, 1968. All other values fell within the ranges mentioned above. The average value for all results reported was computed to be 2.17×10^{-8} μCi/cc. This value is well below the CG value of 1.0×10^{-7} μCi/cc, even though it is highly unlikely that this water would ever be used for sanitary purposes.

2.5.6 Miscellaneous Water Samples

There were seven miscellaneous water sampling locations sampled during fiscal year 1968. Each location had some unique characterization that removed it from the preceding groups, and, because of this, each location has been treated separately.

The first two areas to be discussed are the Mercury swimming pool in Area 23 and the Groom Lake swimming pool in Area 51. Both pools are unique in that the water is constantly being filtered. The swimming pool in Mercury is open to atmospheric fallout at all times,

while the swimming pool at Groom Lake is enclosed, but dust from the outside can still be carried in and dispersed in the water.

The next group of related sample locations comprises the permanent bodies of contaminated water located in Area 12 at Upper and Lower Haines Lake, at the Control Point (CP) decontamination pad in Area 6 and the Laboratory sump in Area 23. The Haines Lakes were established as reservoirs for industrial water when a water source was exposed during construction of tunnel U12e (E Tunnel). This water source became contaminated from a test in E Tunnel in 1961 and also again in 1967. The waste pond in the CP area was constructed to contain liquid radioactive waste from the decontamination operations performed in the area. The Area 23 Laboratory sump is a receptacle for all plumbing wastes from the preparations and analyses complexes. The sump is connected to a network of underground perforated pipes which drains and leaches liquid residue collected in the sump.

Papoose Lake is the only natural drainage basin outside the Test Site which is continually sampled. Any contamination which shows up there is the result of airborne surface material or atmospheric fallout from past atmospheric detonations.

Table 17 and Figure 17 show the locations of the miscellaneous water sampling stations in relation to the entire test site. Table 18 and Figure 18 gives the means and ranges for all six locations based on samples collected once a month over a twelve-month sampling period except for the CP waste pond. This location was sampled on a quarterly basis only. The wide ranges noted from the Upper and Lower Haines Lake's samples for this fiscal report is a result of periods of peak activity when copious water inflow tended to dilute contamination levels at the points of collection. Though extreme values in ranges are encountered, the mean for both lakes is comparable to values recorded for the preceding fiscal year. Only one sample result was reported for the quarterly collection at the Area 6, CP waste pond. This value was 3.12×10^{-7} μCi/cc.

SECTION 3

Background Radiation Measurements

3.1 Introduction

Background radiation measurements were obtained at weekly intervals from eight sample locations, an increase of three more locations over fiscal year, 1967. Sampling commenced in August, 1967 for the three new additions and all background measurements were terminated in April of 1968. For a map of these locations see Figure 19. Methods and procedures followed were similar to those used in environmental surveillance programs at other atomic energy sites. The results are similar in that the ranges of values observed correlate well.

3.2 Measurement Methods

Background measurements were obtained using Victoreen Model 239 indirect reading ionization chambers. Five of these chambers were located in a small semi-protective enclosure at each location. The locations chosen were in NTS living areas. This particular model instrument has an effective range of 0-10 mR.

As a back-up for the ionization chambers, standard NTS film dosimeters were also included in each sample location. It is possible that, should a test vent, high levels of radioactivity would be encountered beyond the range of the ionization chambers. Therefore, a higher range dose-measuring device was necessary.

3.3 Analysis Procedures

The ionization chambers were collected on a weekly basis and read on a Victoreen Minometer II reader. Corrections were made for background and for drift (non-radiation induced discharge of the chambers). Two sets of chambers were involved, one set being used at the sample locations for measurements and another set fully charged stored in the laboratory. Each week these sets were exchanged, the fresh set being recharged and a record kept of the amount of "drift" while stored in the laboratory. A specially designed shock proof box was used to transport the chambers to minimize accidental discharge due to mechanical shock.

Readings from the five chambers in each location were averaged to obtain a mean value for each location per week, hence the lack of ranges for observed values in the accompanying figures and tables. Readings from individual chambers which were grossly higher than the others at a particular location were not used in compiling the data

since they probably were the result of shock or other malfunctions and not representative measurements.

3.4 Measurement Results

The statistical breakdown for the background measurements for fiscal year 1968 was based on eight sample locations on a weekly basis (Table 19 and Figure 19). Individual sample location results are plotted in Figures 20 through 27. Results are tabulated in Table 20.

The results presented in Table 20 reflect a reasonably stable ambient background for each of the sampling locations. Unusual fluctuations of the results were attributable to (1) foreign weapons tests, (2) NTS tests which vented, or (3) NRDS reactor runs which contributed measurable airborne contamination in some instances.

Evaluation of these results indicates that no significant radiation hazard existed in the vicinity of the ion chamber locations during fiscal year 1968. With the exception of two separate and known instances of atmospheric venting which contributed to positive readings above the normal range of values encountered (Figures 23 and 25), all other readings throughout the fiscal year averaged less than 1.0 mR/day.

SECTION 4

SOIL AND VEGETATION SAMPLING

4.1 Introduction

Soil and vegetation samples were collected from sixteen sampling locations throughout the Nevada Test Site. Both types of samples were obtained in close proximity to each other to permit correlation of future data results.

4.2 Sampling Method

Attempts at sampling soil and vegetation have been made locally and elsewhere in previous years with rather disappointing results. Particularly in the case of vegetation sampling, typical problems concerned the absence of homegeniety in choice of species selected, lack of sufficient attention to sampling topography, and lack of consideration of the most advantageous biological characteristics when selecting species of plants for sampling.

The sampling procedures used by the Environmental Surveillance group reflect a concerted attempt to overcome the problems outlined previously. Sampling locations were chosen to reflect a stable soil surface, i.e., a topographically appropriate area having a minimum amount of channeling effects due to canyons, sand-eddy formations, etc. Soil samples consisted of a series of cylindrical cores 1 cm in depth and aggregating approximately 100 grams.

Vegetation samples consisted of four species commonly available on the NTS on a year round basis--sagebrush, blackbrush, winter fat, and creosote. A number of considerations were taken into account when selecting species such as availability, leaf type, leaf density, and structure. Owing to the type of vegetation selected and the sparse rainfall encountered in a desert environment, uptake of radionuclides was minimized and the data reflect essentially fallout deposition. Sufficient vegetation was collected per sample to yield approximately 100 grams of leaf material. The vegetation was placed in a heavy paper sack, taped shut, and allowed to dry. After the leaves had become sufficiently brittle, they could be shaken loose from the stems and ground up to form a compact sample mass.

Since this was the first year of implementation of this program based on new sampling concepts, the data cannot be correlated with any previous data to observe any trends. It is expected that a technical paper will be forthcoming detailing more completely the newly implemented sampling techniques.

4.3 Counting Procedures

Both soil and vegetation samples received gamma spectrum analyses and gross gamma analyses. The samples were leached according to standard laboratory procedures and evaporated on counting planchets. A Baird Atomic SPECTROMETER was used for determination of gross gamma activity. If the activity was such that the apparent 2σ counting error was less than 50%, then the sample was transferred to a 400 channel gamma-spectrum analyzer to quantitatively determine the contributing radionuclides.

4.4 Data Discussion

Tables 21, 24 and Figure 28 give the sampling locations for soil and vegetation samples respectively. The means and ranges of gross gamma activity in monthly collections of soil samples and vegetation samples from July, 1967 through June, 1968 are tabulated in Tables 22, and 25 and plotted in Figures 29, and 30 respectively.

4.4.1 Soil Sampling Data

Mean values of gross gamma activity in surface soil ranged from 1.16×10^{-5} μCi/gm on 2/68 to a maximum of 1.75×10^{-5} μCi/gm on 3/68. The observed mean values exhibit a rather close grouping for the entire year. The highest recorded value was 1.26×10^{-4} μCi/gm obtained from the Area 5 old fallout station during the month of December, 1967.

4.4.2 Vegetation Sampling Data

Mean values of gross gamma activity deposited on vegetation exhibited considerably more variability than the results from soil sampling. Mean values ranged from 5.45×10^{-6} μCi/gm dry weight recorded in July, 1967 to a maximum of 3.09×10^{-5} μCi/gm in March, 1968. The average value of the monthly means was 1.23×10^{-5} μCi/gm. This compares favorably with the observed mean value for soil samples. The highest recorded value was 5.82×10^{-3} μCi/gm dry weight in March, 1968 from Area 19, Stake 19F-13. This location was in the fallout pattern from the BUGGY event conducted on March 12, 1968 in Area 30.

The mean values increased gradually to a peak in January, 1968 probably due to the effects of foreign weapon testing. A gradual decline to "pre-weapon effects" values then occurred.

TABLE 1

NTS ENVIRONMENTAL SURVEILLANCE
AIR SAMPLING STATION LOCATIONS

AREA	SAMPLE STATION LOCATION	MAP CODE FOR FIGURE 1
1	Gravel Pit	1a
2	Camp Compound	2a
3	North of Cafeteria	3a
5	East of Well 5B Reservoir	5a
	Guard Station 250	5b
6	Aid Station	6a
	Well 3 Complex	6b
9	9-300 Bunker	9a
10	Guard Station 700	10a
11	Guard Station 293	11a
12	Changehouse	12a
16	Tunnel Site Maintenance	16a
18	East of Cafeteria	18a
	North of Cafeteria	18b
19	Echo Peak	19a
	Stake 19C-10	19b
20	West of Aid Station	20a
23	Building 214	23a
	Health & Safety Building Rooftop	23b
27	West of Dispensary	27a
28	Project HENRE	28a
51	East of Cafeteria	51a

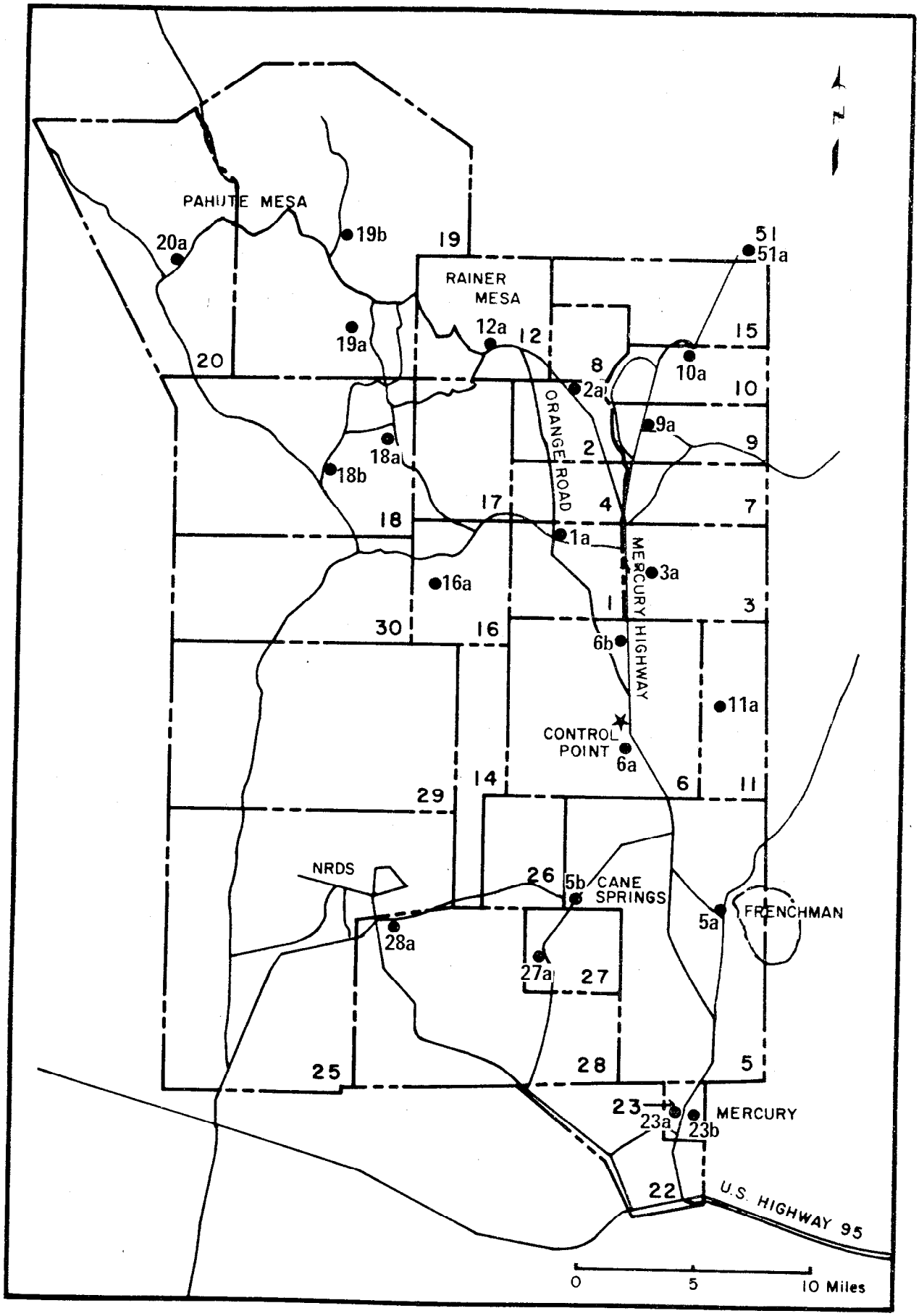

Fig. 1 NTS Environmental Surveillance Air Sampling Locations

TABLE 2

SAMPLING PERIOD MEANS AND RANGES OF
GROSS BETA RADIOACTIVITY IN ENVIRONMENTAL
AIR SAMPLES FROM NTS
JULY, 1967 THROUGH JUNE, 1968

AIR SAMPLES (Values in terms of μCi/cc)			
DATE (Week ending)	MEAN	RANGE	
		MAXIMUM	MINIMUM
07/09/67	4.64×10^{-14}	2.66×10^{-12}	3.88×10^{-14}
07/16/67	5.93×10^{-14}	7.12×10^{-12}	3.46×10^{-14}
07/23/67	1.35×10^{-14}	1.50×10^{-13}	1.06×10^{-14}
07/30/67	1.01×10^{-14}	8.52×10^{-14}	1.00×10^{-14}
08/06/67	2.13×10^{-14}	2.52×10^{-14}	1.48×10^{-14}
08/13/67	2.83×10^{-14}	4.41×10^{-14}	2.29×10^{-14}
08/20/67	2.79×10^{-14}	4.30×10^{-14}	1.49×10^{-14}
08/27/67	2.83×10^{-14}	5.71×10^{-14}	1.74×10^{-14}
09/03/67	2.23×10^{-14}	3.31×10^{-12}	1.00×10^{-14}
09/10/67	1.06×10^{-14}	1.02×10^{-13}	1.01×10^{-14}
09/17/67	1.46×10^{-13}	3.77×10^{-13}	1.12×10^{-14}
09/24/67	1.52×10^{-14}	9.71×10^{-13}	4.84×10^{-14}
10/01/67	9.09×10^{-14}	6.71×10^{-13}	4.92×10^{-14}
10/08/67	6.92×10^{-14}	1.82×10^{-13}	3.58×10^{-14}
10/15/67	2.08×10^{-14}	3.50×10^{-13}	8.30×10^{-15}
10/22/67	6.93×10^{-14}	1.79×10^{-13}	3.02×10^{-14}
10/29/67	6.30×10^{-14}	9.91×10^{-13}	2.20×10^{-14}
11/05/67	3.95×10^{-14}	1.03×10^{-13}	2.91×10^{-14}
11/12/67	4.40×10^{-14}	1.57×10^{-13}	2.64×10^{-14}
11/19/67	6.06×10^{-14}	1.91×10^{-13}	3.14×10^{-14}
11/26/67	1.80×10^{-14}	3.94×10^{-13}	3.52×10^{-15}
12/03/67	3.83×10^{-14}	1.88×10^{-13}	2.69×10^{-14}
12/10/67	5.10×10^{-14}	1.46×10^{-13}	2.69×10^{-14}
12/17/67	4.07×10^{-14}	8.57×10^{-14}	1.84×10^{-14}
12/24/67	3.18×10^{-14}	2.21×10^{-13}	1.06×10^{-14}
12/31/67	3.48×10^{-14}	5.81×10^{-13}	9.01×10^{-15}
01/07/68	3.14×10^{-13}	1.19×10^{-12}	8.33×10^{-14}
01/14/67	1.31×10^{-13}	2.38×10^{-13}	7.35×10^{-14}
01/21/67	6.90×10^{-13}	1.77×10^{-12}	3.92×10^{-13}
01/28/67	1.85×10^{-13}	5.15×10^{-11}	4.46×10^{-14}
02/04/68	3.92×10^{-13}	7.85×10^{-13}	2.08×10^{-13}
02/11/68	2.93×10^{-13}	1.21×10^{-12}	1.83×10^{-13}
02/18/67	1.75×10^{-13}	2.15×10^{-13}	1.40×10^{-13}
02/25/67	1.91×10^{-13}	2.26×10^{-13}	1.26×10^{-13}
03/03/68	1.57×10^{-13}	3.00×10^{-13}	1.15×10^{-13}
03/10/67	1.93×10^{-13}	6.44×10^{-13}	1.04×10^{-13}
03/17/67	2.32×10^{-13}	6.40×10^{-13}	1.51×10^{-13}

TABLE 2 (Contd)

(Values in terms of μCi/cc)

DATE (Week ending)	MEAN	RANGE	
		MAXIMUM	MINIMUM
03/24/68	4.62×10^{-13}	3.48×10^{-10}	1.62×10^{-13}
03/31/68	2.27×10^{-13}	1.52×10^{-12}	1.50×10^{-13}
04/07/68	3.97×10^{-13}	2.98×10^{-12}	1.12×10^{-13}
04/14/68	2.45×10^{-13}	8.20×10^{-13}	5.02×10^{-14}
04/21/68	2.84×10^{-13}	5.96×10^{-13}	2.22×10^{-14}
04/28/68	2.86×10^{-13}	5.07×10^{-13}	2.72×10^{-13}
05/05/68	4.00×10^{-13}	5.22×10^{-13}	3.14×10^{-13}
05/12/68	3.60×10^{-13}	4.94×10^{-13}	2.52×10^{-13}
05/19/68	3.89×10^{-13}	4.93×10^{-13}	2.96×10^{-13}
05/26/68	3.56×10^{-13}	5.10×10^{-13}	2.10×10^{-13}
06/02/68	3.44×10^{-13}	4.31×10^{-13}	2.75×10^{-13}
06/09/68	2.86×10^{-13}	6.06×10^{-13}	1.89×10^{-13}
06/16/68	2.35×10^{-13}	3.19×10^{-13}	1.52×10^{-13}
06/23/68	2.03×10^{-13}	3.18×10^{-13}	1.93×10^{-13}
06/30/68	2.21×10^{-13}	1.00×10^{-12}	8.05×10^{-14}

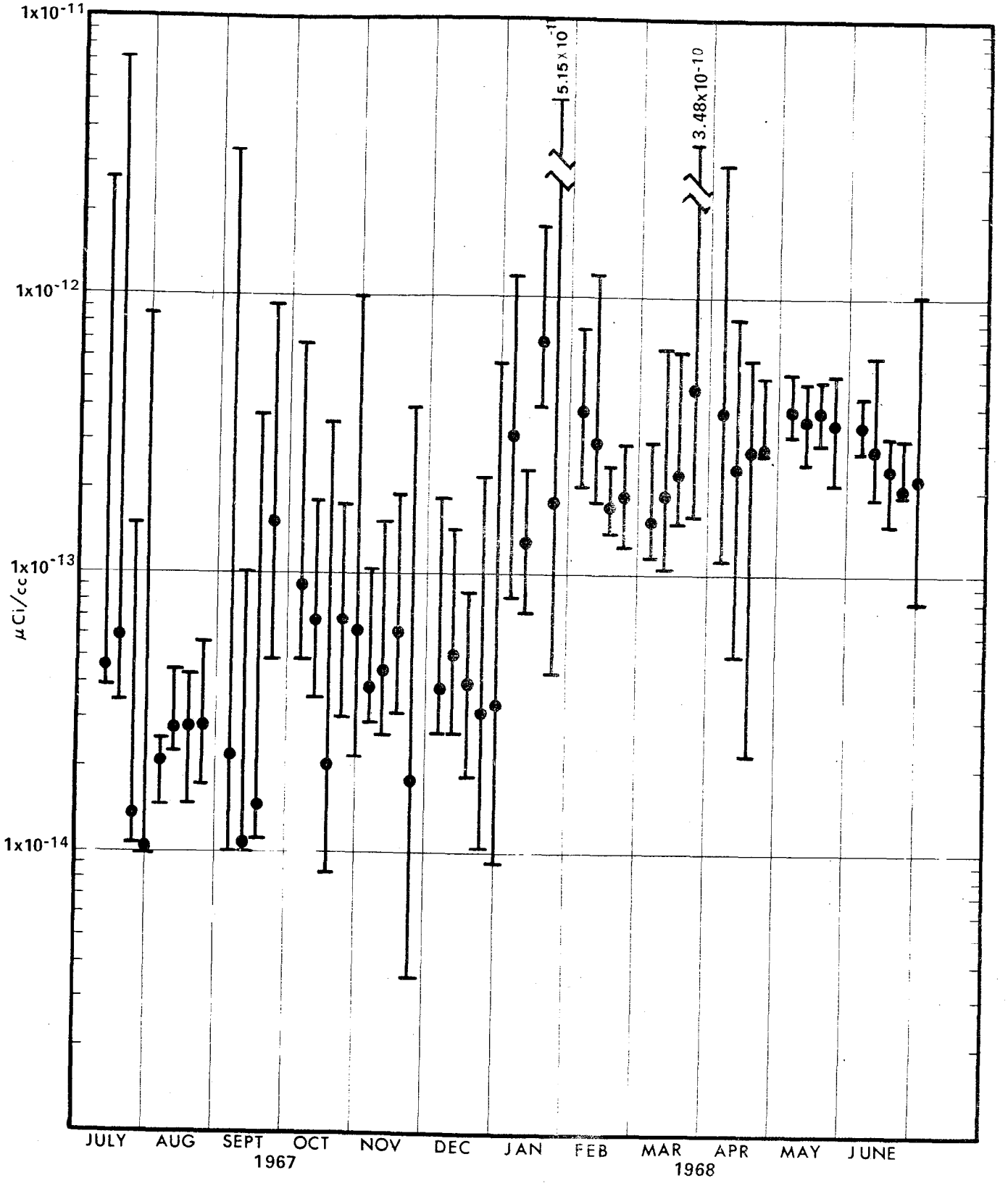

Fig. 2 Weekly Means and Ranges of Gross Beta Radioactivity from July, 1967 through June, 1968; Air Sampling

TABLE 3

MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
AT NTS ENVIRONMENTAL AIR SAMPLING STATION LOCATIONS
FROM JULY, 1967 THROUGH JUNE, 1968

(Values in terms of $\mu Ci/cc$)

STATION NUMBER AND LOCATION	MEAN	RANGE	
		MAXIMUM	MINIMUM
1. Area 1 Gravel Pit	9.23×10^{-13}	5.15×10^{-11}	3.03×10^{-14}
2. Area 2 Compound	1.06×10^{-13}	4.68×10^{-13}	3.52×10^{-15}
3. Area 3 North of Cafeteria	8.58×10^{-14}	5.07×10^{-13}	9.92×10^{-15}
4. Area 5 East of Well 5B	1.15×10^{-13}	7.49×10^{-13}	1.06×10^{-14}
5. Area 5 Gate 250 Guard Station	1.16×10^{-13}	7.43×10^{-13}	4.67×10^{-14}
6. Area 6 CP-2 Complex	9.62×10^{-14}	4.87×10^{-13}	1.28×10^{-14}
7. Area 6 Well 3 Complex	1.10×10^{-13}	3.31×10^{-12}	2.20×10^{-14}
8. Area 9 9-300 Bunker	1.43×10^{-13}	7.12×10^{-12}	2.31×10^{-14}
9. Area 10 Gate 700 Bunker	1.05×10^{-13}	1.19×10^{-12}	7.92×10^{-15}
10. Area 11 Gate 293 Guard Station	7.60×10^{-14}	6.26×10^{-13}	5.30×10^{-15}
11. Area 12 Changehouse	1.04×10^{-13}	1.17×10^{-12}	9.97×10^{-15}
12. Area 16 Tunnel Site Maintenance	1.43×10^{-13}	1.25×10^{-12}	8.10×10^{-15}
13. Area 18 East of Cafeteria	1.22×10^{-13}	9.05×10^{-13}	9.01×10^{-15}
14. Area 18 Airstrip	1.04×10^{-13}	8.74×10^{-13}	8.58×10^{-15}
15. Area 19 Echo Peak	8.84×10^{-14}	6.43×10^{-13}	9.27×10^{-15}
16. Area 19 Stake 19-C-10	9.87×10^{-14}	3.60×10^{-12}	8.32×10^{-15}
17. Area 20 Dispensary	1.41×10^{-13}	3.48×10^{-10}	1.98×10^{-14}
18. Area 23 Old Mouse House	1.05×10^{-13}	1.00×10^{-12}	1.17×10^{-14}
19. Area 23 H&S Rooftop	3.16×10^{-13}	1.21×10^{-12}	4.98×10^{-14}
20. Area 27 Dispensary	1.13×10^{-13}	6.86×10^{-13}	4.98×10^{-14}
21. Area 28 HENRE Site	1.07×10^{-13}	1.77×10^{-12}	1.04×10^{-14}
22. Area 51 East of Cafeteria	1.16×10^{-13}	9.00×10^{-13}	8.73×10^{-15}

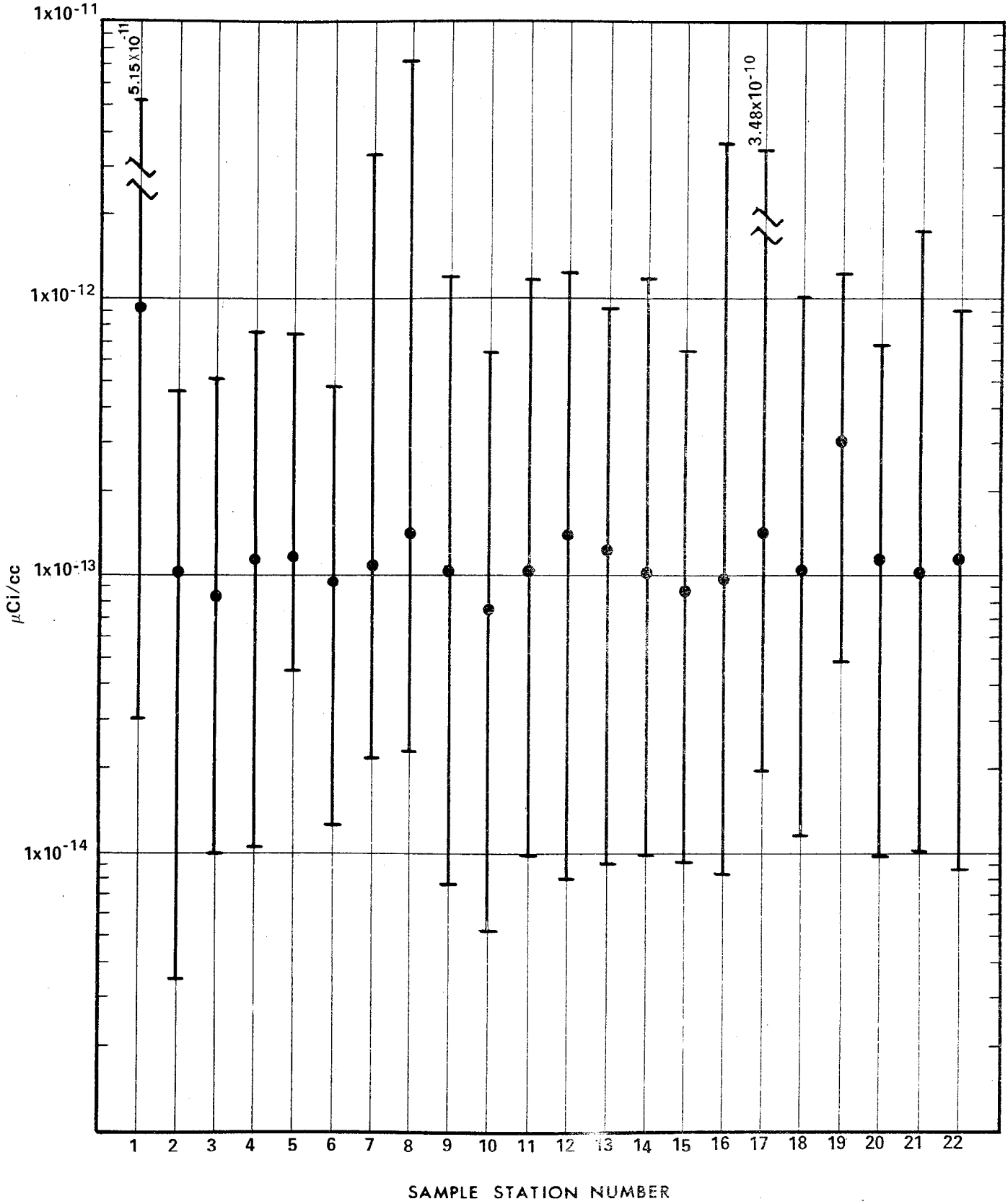

Fig. 3 Means and Ranges of Gross Beta Radioactivity in NTS Environmental Air Sampling Station Locations from July, 1967 through June, 1968

TABLE 4

ENVIRONMENTAL SURVEILLANCE
POTABLE WATER SAMPLING STATION LOCATIONS

AREA	SAMPLING STATION LOCATION	MAP CODE FOR FIGURE 4
2	Men's Rest Room	2a
3	Cafeteria	3a
6	Cafeteria	6a
12	Cafeteria	12a
18	Fire Station	18a
20	Dispensary	20a
23	Cafeteria	23a
27	Cafeteria	27a
51	Cafeteria	51a

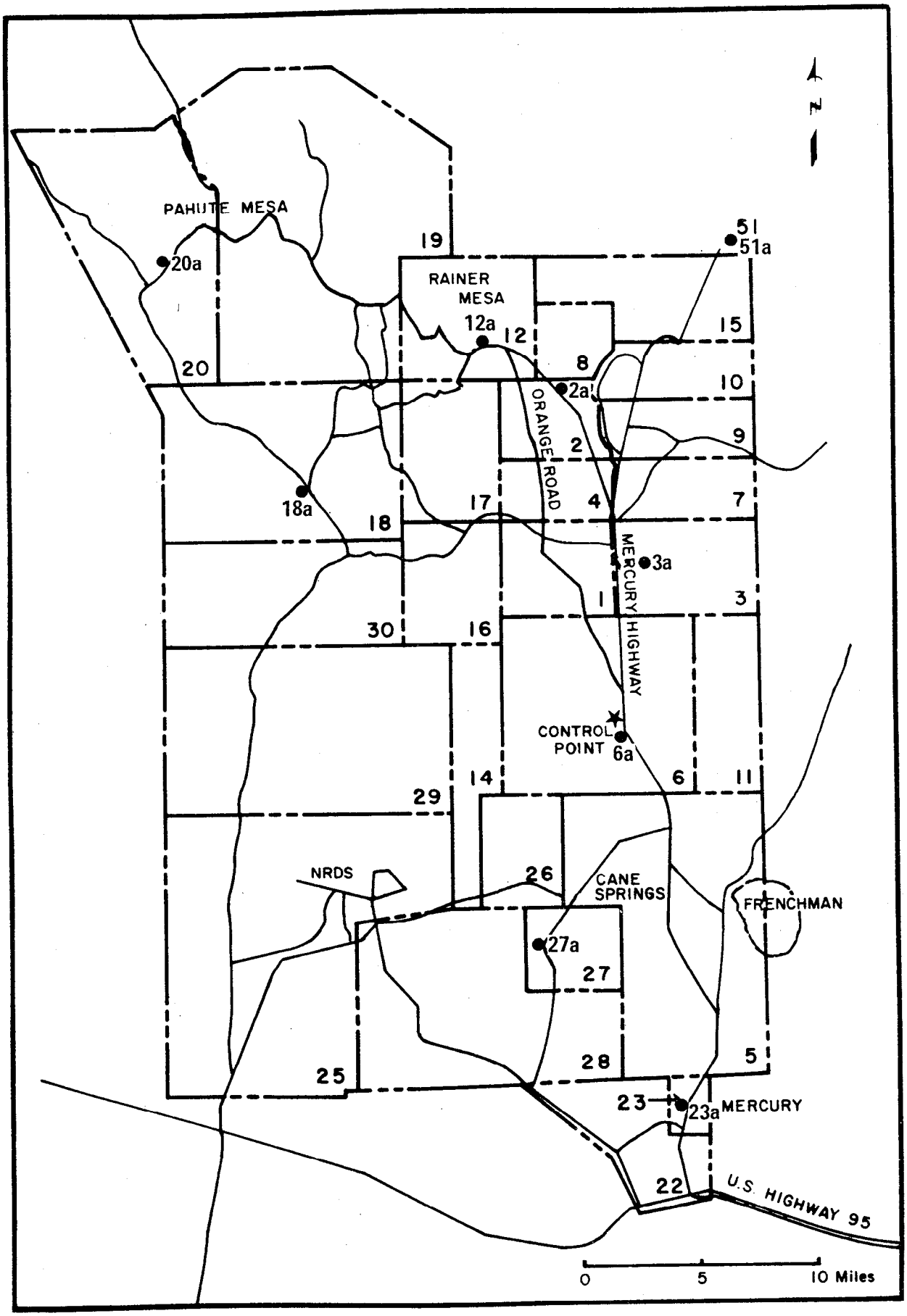

Fig. 4 NTS Environmental Surveillance Potable Water Sampling Locations

MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
AT NTS ENVIRONMENTAL POTABLE WATER SAMPLING STATION LOCATIONS
FROM JULY, 1967 THROUGH JUNE, 1968

(Values in terms of μCi/cc)

DATE (Week ending)	MEAN	RANGE	
		MAXIMUM	MINIMUM
07/09/67	6.13×10^{-9}	1.48×10^{-8}	2.32×10^{-9}
07/16/67	3.34×10^{-9}	7.24×10^{-9}	1.89×10^{-9}
07/23/67	3.95×10^{-9}	8.47×10^{-9}	2.27×10^{-9}
07/30/67	3.88×10^{-9}	7.40×10^{-9}	2.59×10^{-9}
08/06/67	5.25×10^{-9}	9.15×10^{-9}	2.39×10^{-9}
08/13/67	5.62×10^{-9}	1.52×10^{-8}	1.76×10^{-9}
08/20/67	5.36×10^{-9}	1.11×10^{-8}	2.40×10^{-9}
08/27/67	3.57×10^{-9}	2.38×10^{-8}	1.84×10^{-9}
09/03/67	9.66×10^{-9}	2.60×10^{-8}	3.35×10^{-9}
09/10/67	6.43×10^{-9}	1.73×10^{-8}	2.38×10^{-9}
09/17/67	7.18×10^{-9}	1.82×10^{-8}	3.95×10^{-9}
09/24/67	1.14×10^{-8}	5.23×10^{-8}	6.17×10^{-9}
10/01/67	1.74×10^{-8}	2.14×10^{-8}	1.34×10^{-8}
10/08/67	1.55×10^{-8}	2.48×10^{-8}	1.26×10^{-8}
10/15/67	1.95×10^{-8}	2.55×10^{-8}	1.64×10^{-8}
10/22/67	7.63×10^{-9}	1.00×10^{-8}	4.61×10^{-9}
10/29/67	6.64×10^{-9}	1.55×10^{-8}	3.25×10^{-9}
11/05/67	6.24×10^{-9}	1.37×10^{-8}	2.89×10^{-9}
11/12/67	6.09×10^{-9}	1.81×10^{-8}	2.11×10^{-9}
11/19/67	5.79×10^{-9}	1.33×10^{-8}	3.02×10^{-9}
11/26/67	4.30×10^{-9}	1.08×10^{-8}	1.90×10^{-9}
12/03/67	4.30×10^{-9}	8.50×10^{-9}	2.27×10^{-9}
12/10/67	1.03×10^{-8}	8.81×10^{-8}	3.54×10^{-9}
12/17/67	8.08×10^{-9}	2.06×10^{-8}	3.61×10^{-9}
12/24/67	6.00×10^{-9}	8.92×10^{-8}	3.23×10^{-9}
12/31/67	1.17×10^{-8}	2.18×10^{-8}	6.11×10^{-9}
01/07/68	6.32×10^{-9}	1.14×10^{-8}	3.68×10^{-9}
01/14/68	6.99×10^{-9}	1.85×10^{-8}	2.36×10^{-9}
01/21/68	5.16×10^{-9}	1.33×10^{-8}	2.43×10^{-9}
01/28/68	5.98×10^{-9}	1.36×10^{-8}	3.43×10^{-9}
02/04/68	4.07×10^{-9}	1.36×10^{-8}	2.09×10^{-9}
02/11/68	7.49×10^{-9}	1.35×10^{-8}	4.17×10^{-9}
02/18/68	5.35×10^{-9}	1.25×10^{-8}	2.98×10^{-9}
02/25/68	6.25×10^{-9}	1.38×10^{-8}	2.60×10^{-9}
03/03/68	7.11×10^{-9}	1.34×10^{-8}	3.53×10^{-9}
03/10/68	7.03×10^{-9}	1.10×10^{-8}	4.25×10^{-9}
03/17/68	5.22×10^{-9}	1.34×10^{-8}	2.20×10^{-9}
03/24/68	6.94×10^{-9}	2.87×10^{-8}	2.76×10^{-9}
03/31/68	9.92×10^{-9}	4.80×10^{-7}	2.82×10^{-9}

TABLE 5 (Contd)

(Values in terms of $\mu Ci/cc$)

DATE (Week ending)	MEAN	RANGE	
		MAXIMUM	MINIMUM
04/07/68	5.57×10^{-9}	6.70×10^{-8}	1.70×10^{-9}
04/14/68	8.13×10^{-9}	3.22×10^{-8}	3.69×10^{-9}
04/21/68	5.03×10^{-9}	1.02×10^{-8}	2.28×10^{-9}
04/28/68	4.11×10^{-9}	6.27×10^{-9}	2.09×10^{-9}
05/05/68	4.95×10^{-9}	8.86×10^{-8}	2.92×10^{-9}
05/12/68	4.91×10^{-9}	1.31×10^{-9}	1.42×10^{-9}
05/19/68	2.88×10^{-9}	6.69×10^{-9}	1.31×10^{-9}
05/26/68	4.01×10^{-9}	6.90×10^{-9}	1.89×10^{-9}
06/02/68	6.25×10^{-9}	3.54×10^{-8}	2.23×10^{-9}
06/09/68	3.42×10^{-9}	5.42×10^{-9}	1.44×10^{-9}
06/16/68	1.08×10^{-8}	1.18×10^{-8}	9.98×10^{-9}
06/23/68	1.26×10^{-8}	1.76×10^{-8}	8.46×10^{-9}
06/30/68	4.84×10^{-9}	1.05×10^{-8}	1.65×10^{-9}

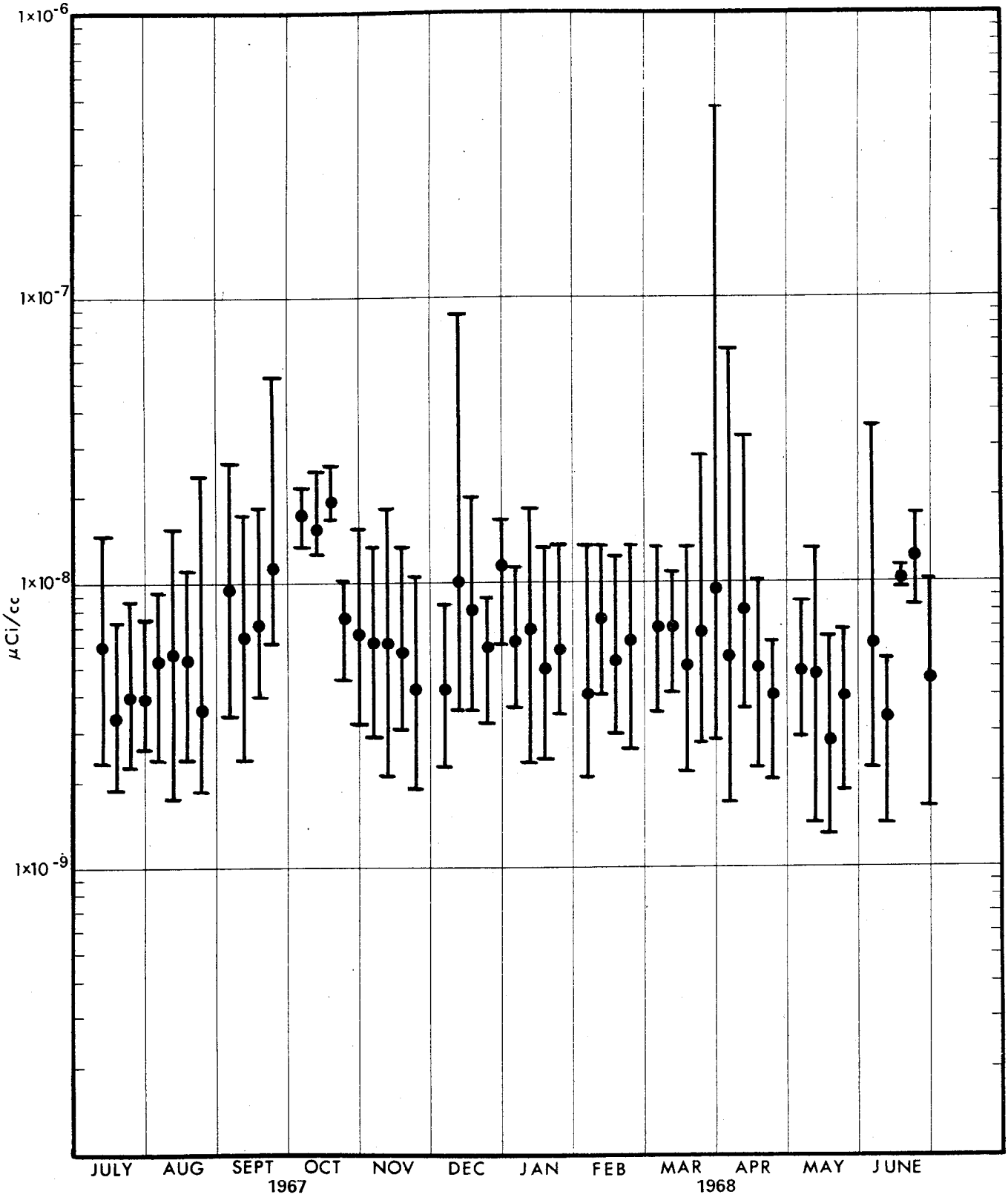

Fig. 5 Weekly Means and Ranges of Gross Beta Radioactivity in Potable Water Samples from July, 1967 through June, 1968

TABLE 6

MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
IN NTS ENVIRONMENTAL POTABLE WATER SAMPLING STATION LOCATIONS
FROM JULY, 1967 THROUGH JUNE, 1968

(Values in terms of μCi/cc)

STATION NUMBER AND LOCATION	MEAN	RANGE	
		MAXIMUM	MINIMUM
1. Area 2 Men's Room	4.66×10^{-9}	1.75×10^{-8}	2.10×10^{-9}
2. Area 3 Cafeteria	9.28×10^{-9}	1.95×10^{-8}	3.25×10^{-9}
3. Area 6 Cafeteria	1.11×10^{-8}	2.55×10^{-8}	3.27×10^{-9}
4. Area 12 Cafeteria	4.33×10^{-9}	1.64×10^{-8}	2.27×10^{-9}
5. Area 18 Fire Station	4.14×10^{-9}	2.87×10^{-8}	1.31×10^{-9}
6. Area 20 Dispensary	5.59×10^{-9}	4.80×10^{-7}	2.09×10^{-9}
7. Area 23 Cafeteria	5.65×10^{-9}	5.23×10^{-8}	1.84×10^{-9}
8. Area 27 Cafeteria	5.75×10^{-9}	2.09×10^{-8}	1.78×10^{-9}
9. Area 51 Cafeteria	7.18×10^{-9}	8.81×10^{-8}	2.76×10^{-9}

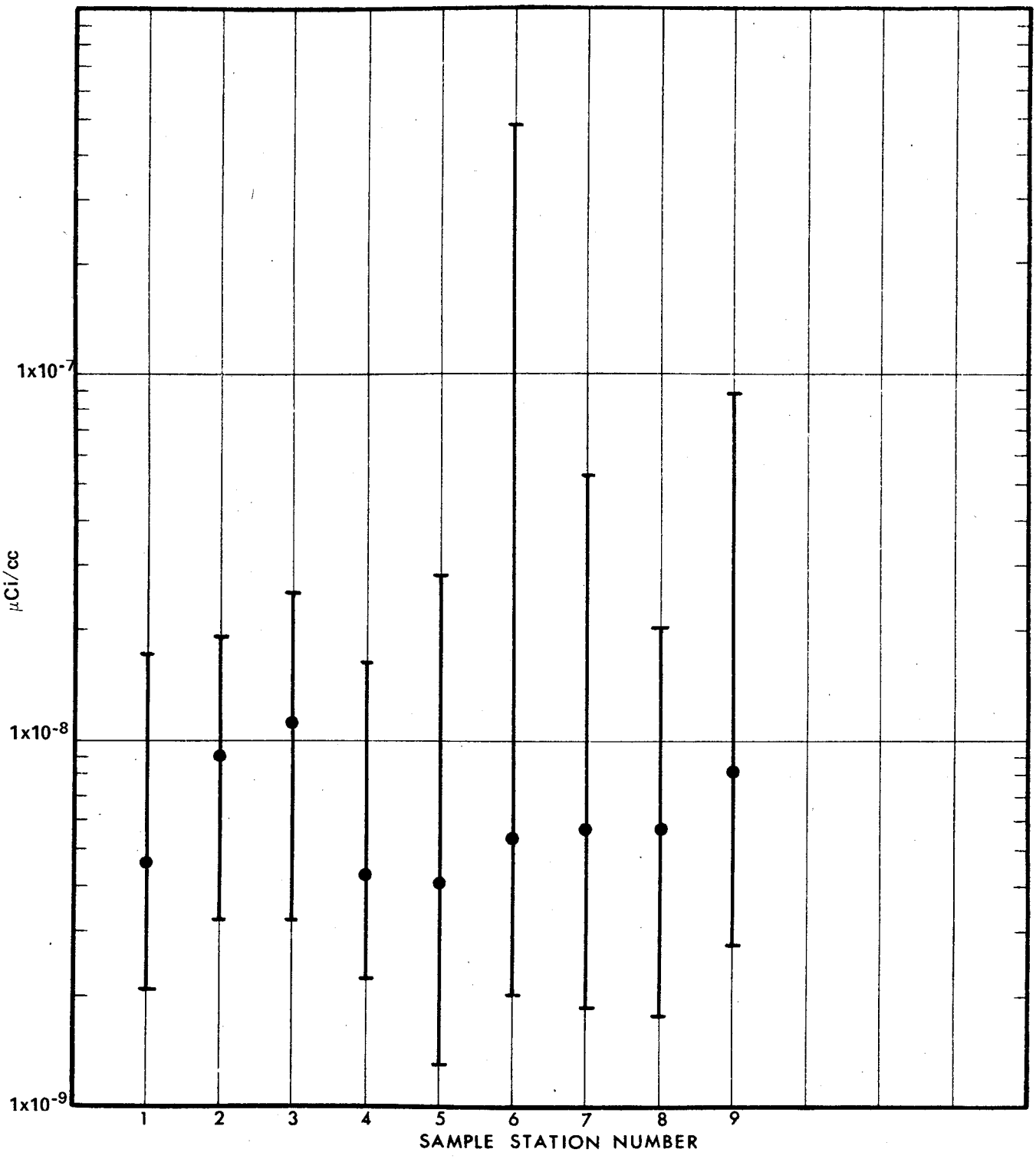

Fig. 6 Means and Ranges of Gross Beta Radioactivity at NTS Environmental Potable Water Sampling Locations from July, 1967 through June, 1968

TABLE 7

ENVIRONMENTAL SURVEILLANCE
NATURAL SPRINGS SAMPLING STATION LOCATIONS

AREA	SAMPLE STATION LOCATION	MAP CODE FOR FIGURE 7
5	Cane Springs	5a
12	Capt. Jack Spring	12a
	White Rock Spring	12b
	Gold Meadows	12c
15	Oak Spring	15a
	Tub Spring	15b
	John's Spring	15c
16	Tippipah Spring	16a

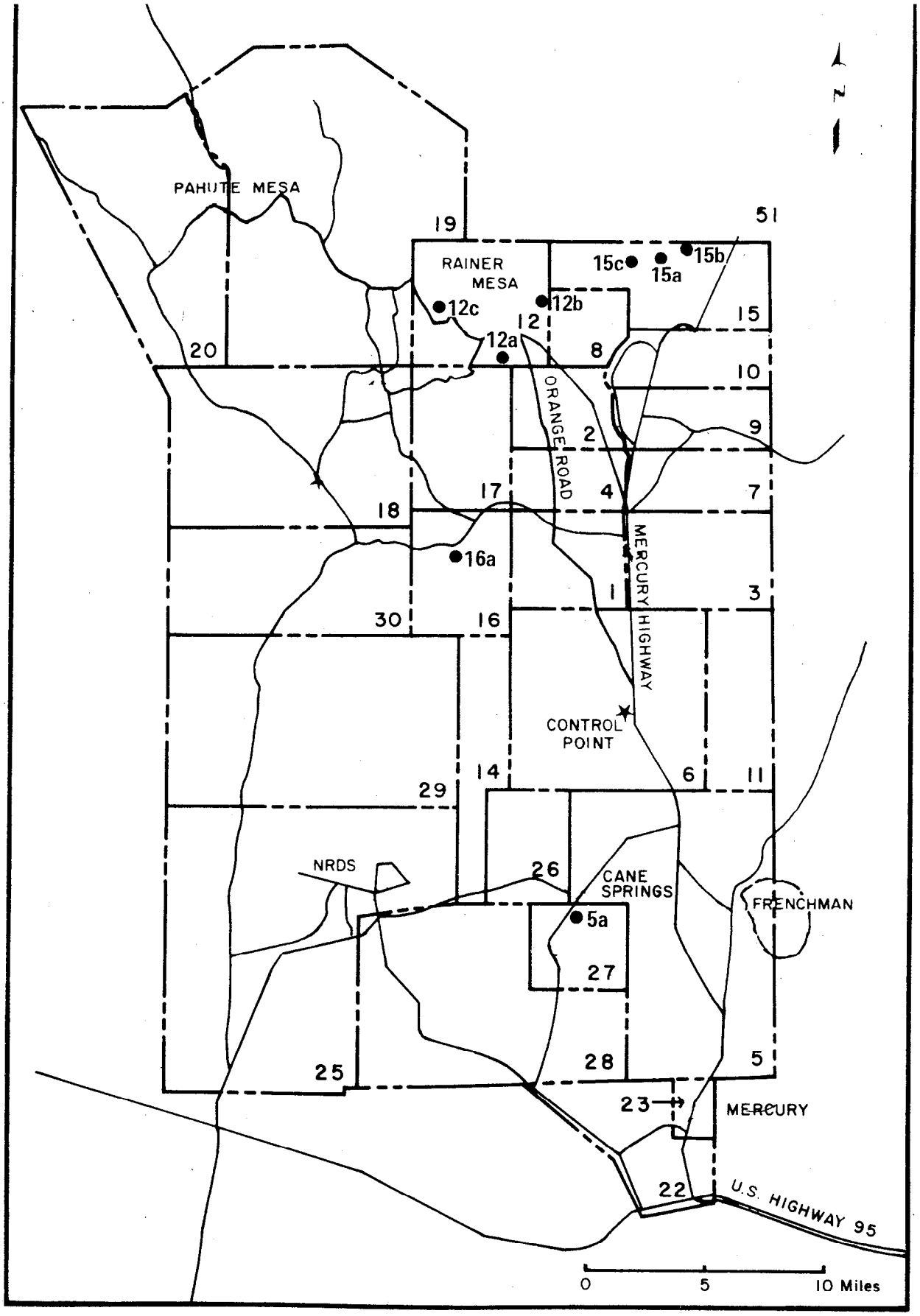

Fig. 7 NTS Environmental Surveillance Natural Springs Sampling Locations

TABLE 8

MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
AT NTS ENVIRONMENTAL NATURAL SPRINGS SAMPLING STATION LOCATIONS
FROM JULY, 1967 THROUGH JUNE, 1968

(Values in terms of μCi/cc)

DATE (Monthly)	MEAN	RANGE	
		MAXIMUM	MINIMUM
07/67	1.42×10^{-8}	9.30×10^{-8}	6.33×10^{-9}
08/67	1.06×10^{-8}	2.43×10^{-8}	5.28×10^{-9}
09/67	2.61×10^{-8}	4.99×10^{-8}	1.48×10^{-9}
10/67	7.28×10^{-9}	1.06×10^{-8}	5.00×10^{-9}
11/67	1.11×10^{-8}	1.91×10^{-8}	6.28×10^{-9}
12/67	1.76×10^{-8}	2.34×10^{-8}	1.46×10^{-8}
01/68	1.27×10^{-8}	3.13×10^{-8}	5.35×10^{-9}
02/68	1.03×10^{-8}	2.04×10^{-8}	5.98×10^{-9}
03/68	1.52×10^{-8}	3.46×10^{-8}	7.08×10^{-9}
04/68	1.03×10^{-8}	3.90×10^{-8}	2.93×10^{-9}
05/68	7.04×10^{-9}	4.37×10^{-8}	2.15×10^{-9}
06/68	1.24×10^{-8}	4.25×10^{-8}	7.31×10^{-9}

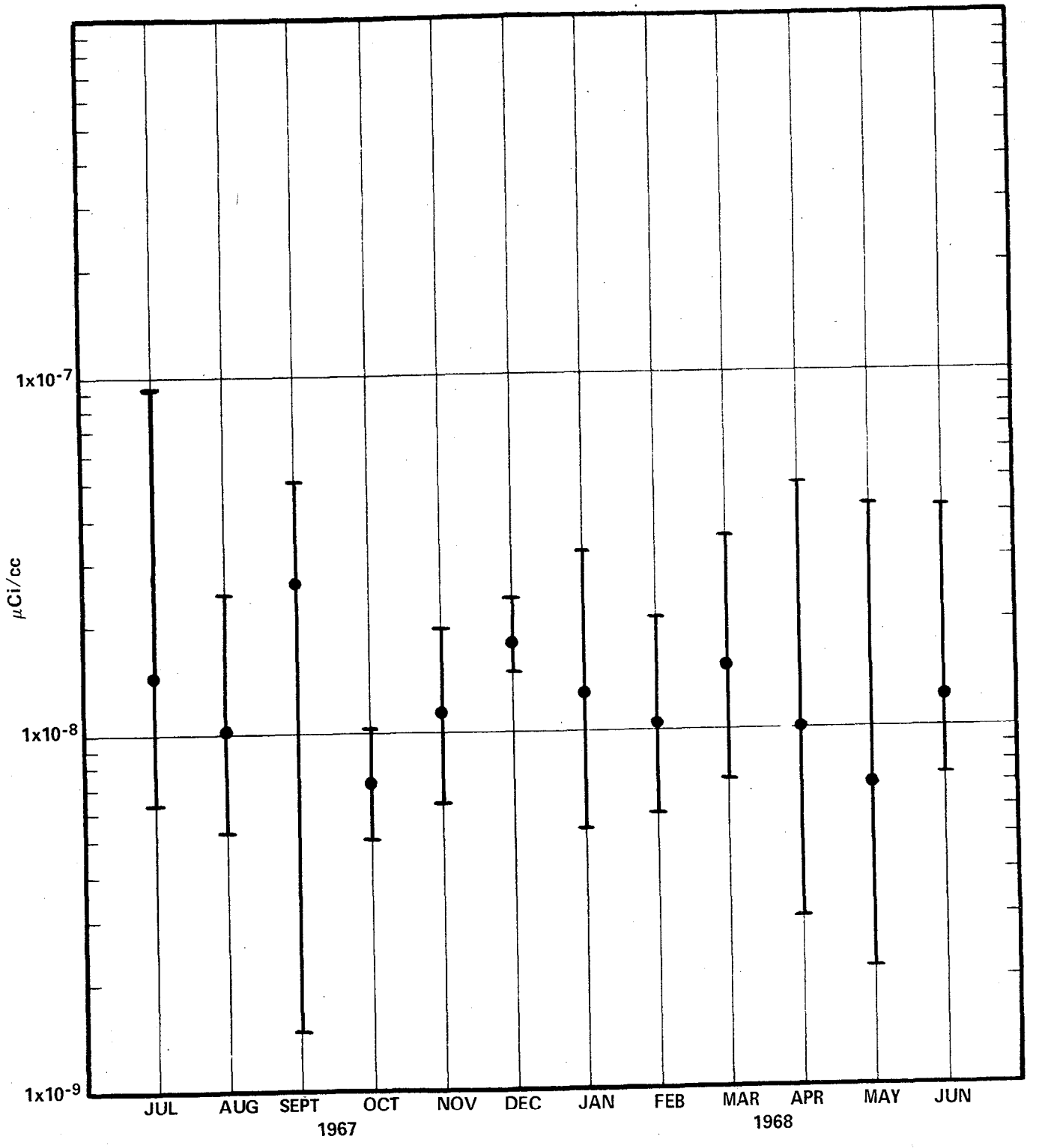

Fig. 8 Monthly Means and Ranges of Gross Beta Radioactivity in Natural Springs Water Samples from July, 1967 through June, 1968

TABLE 9

MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
AT NTS NATURAL SPRINGS WATER SAMPLING STATION LOCATIONS
FROM JULY, 1967 THROUGH JUNE, 1968

(Values in terms of $\mu Ci/cc$)

STATION NUMBER AND LOCATION	MEAN	RANGE	
		MAXIMUM	MINIMUM
1. Area 5 Cane Spring	1.17×10^{-8}	3.12×10^{-8}	5.28×10^{-9}
2. Area 12 White Rock Spring	9.78×10^{-9}	2.67×10^{-8}	2.15×10^{-9}
3. Area 12 Captain Jack Spring	9.82×10^{-9}	3.56×10^{-8}	5.35×10^{-9}
4. Area 12 Gold Meadows Spring	4.72×10^{-8}	9.30×10^{-8}	3.46×10^{-8}
5. Area 15 Oak Spring	1.08×10^{-8}	2.34×10^{-8}	6.28×10^{-9}
6. Area 15 Tub Spring	8.44×10^{-9}	1.46×10^{-8}	4.53×10^{-9}
7. Area 15 John's Spring	1.71×10^{-8}	4.99×10^{-8}	5.98×10^{-9}
8. Area 16 Tippipah Spring	1.41×10^{-8}	3.07×10^{-8}	2.93×10^{-9}

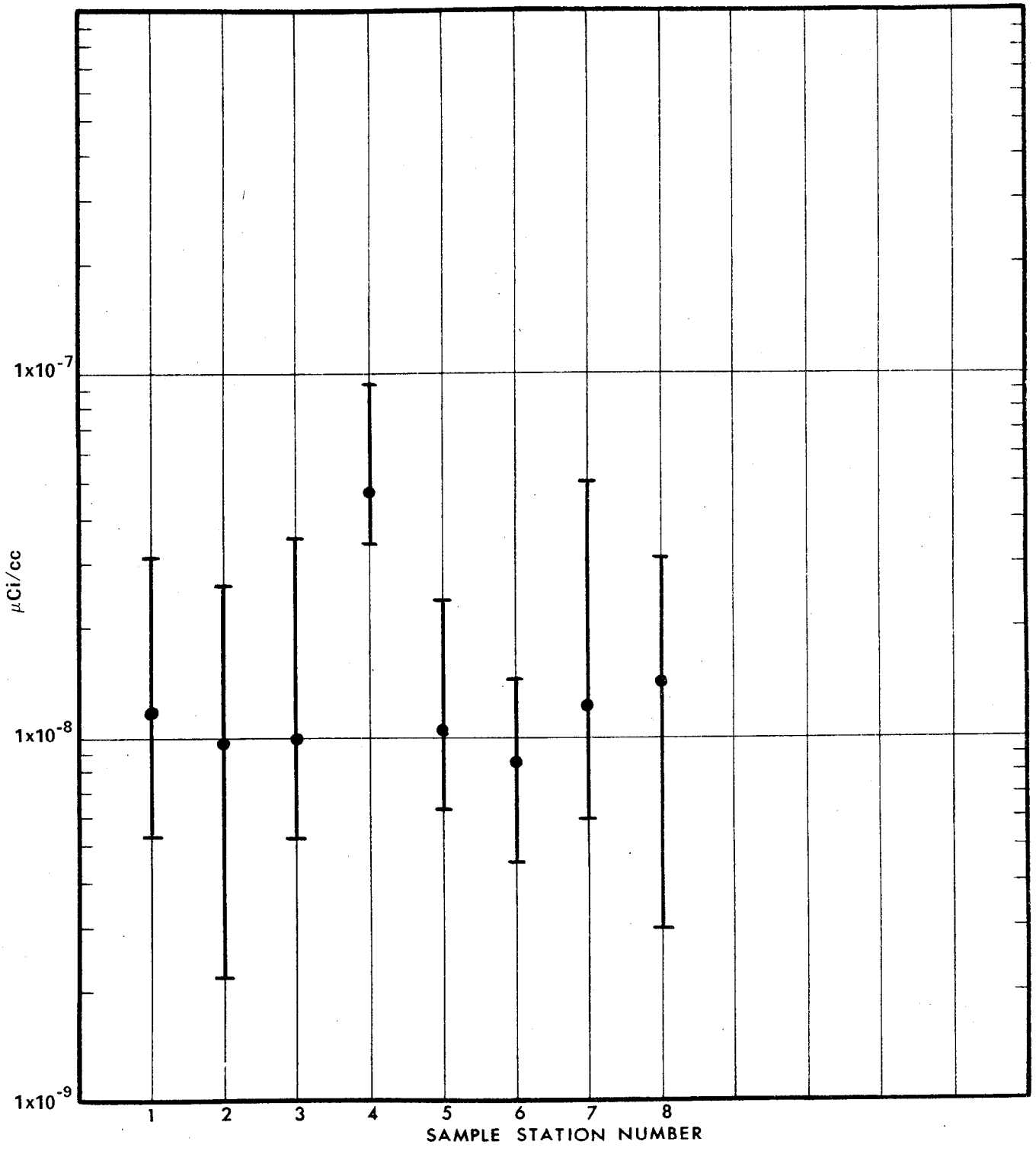

Fig. 9 Means and Ranges of Gross Beta Radioactivity at NTS Environmental Natural Springs Sampling Locations from July, 1967 through June, 1968

TABLE 10

ENVIRONMENTAL SURVEILLANCE
OPEN RESERVOIR SAMPLING STATION LOCATIONS

AREA	SAMPLING STATION LOCATION	MAP CODE FOR FIGURE
2	Well 2 Reservoir	2a
3	Well "A" Reservoir	3a
5	Well 5B Reservoir	5a
	Well Ue5c Reservoir	5b
6	Well C1 Reservoir	6a
15	Well Ue15d Reservoir	15a
18	Camp 17 Reservoir	18a
19	Well Ue19e Reservoir	19a
	Well Ue19gs Reservoir	19b
20	Well U20a Reservoir	20a
51	Well 4 Reservoir	51a

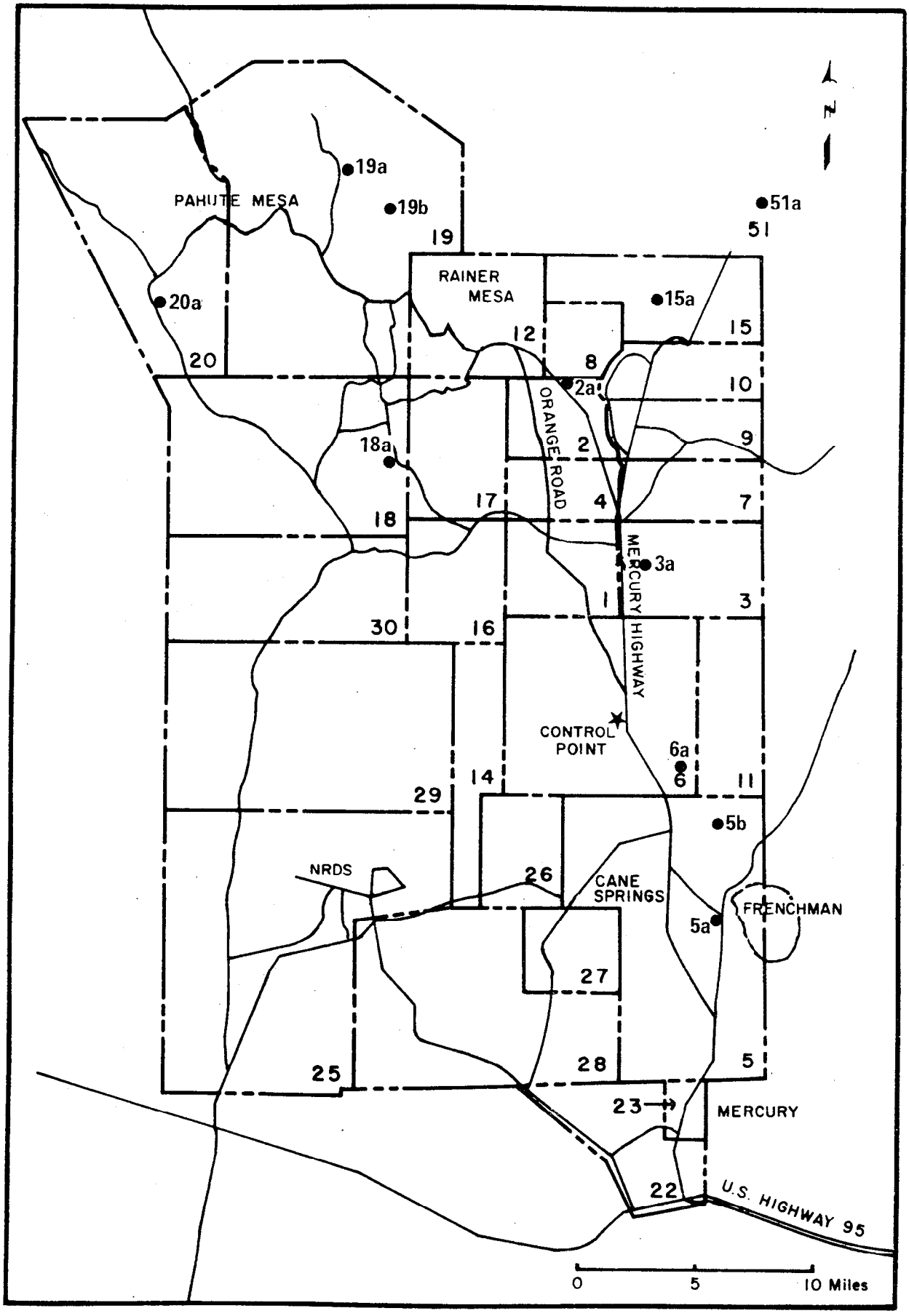

Fig. 10 NTS Environmental Surveillance Open Reservoirs Sampling Locations

TABLE 11

MONTHLY MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
AT ENVIRONMENTAL OPEN RESERVOIR SAMPLING STATION LOCATIONS
FROM JULY, 1967 THROUGH JUNE, 1968

(Values in terms of $\mu Ci/cc$)

DATE (Monthly)	MEAN	RANGE	
		MAXIMUM	MINIMUM
07/67	1.19×10^{-8}	1.08×10^{-7}	3.05×10^{-9}
08/67	5.50×10^{-9}	2.19×10^{-8}	1.13×10^{-9}
09/67	7.65×10^{-9}	4.11×10^{-8}	1.53×10^{-9}
10/67	7.64×10^{-9}	3.12×10^{-8}	2.66×10^{-9}
11/67	6.31×10^{-9}	3.08×10^{-8}	1.77×10^{-9}
12/67	1.10×10^{-8}	2.13×10^{-8}	5.32×10^{-9}
01/68	1.07×10^{-8}	4.14×10^{-8}	2.86×10^{-9}
02/68	1.10×10^{-8}	2.91×10^{-6}	3.23×10^{-9}
03/68	4.06×10^{-8}	2.71×10^{-7}	7.91×10^{-9}
04/68	1.70×10^{-8}	2.42×10^{-8}	5.23×10^{-9}
05/68	1.30×10^{-8}	3.84×10^{-8}	4.83×10^{-9}
06/68	1.71×10^{-8}	4.62×10^{-8}	8.03×10^{-9}

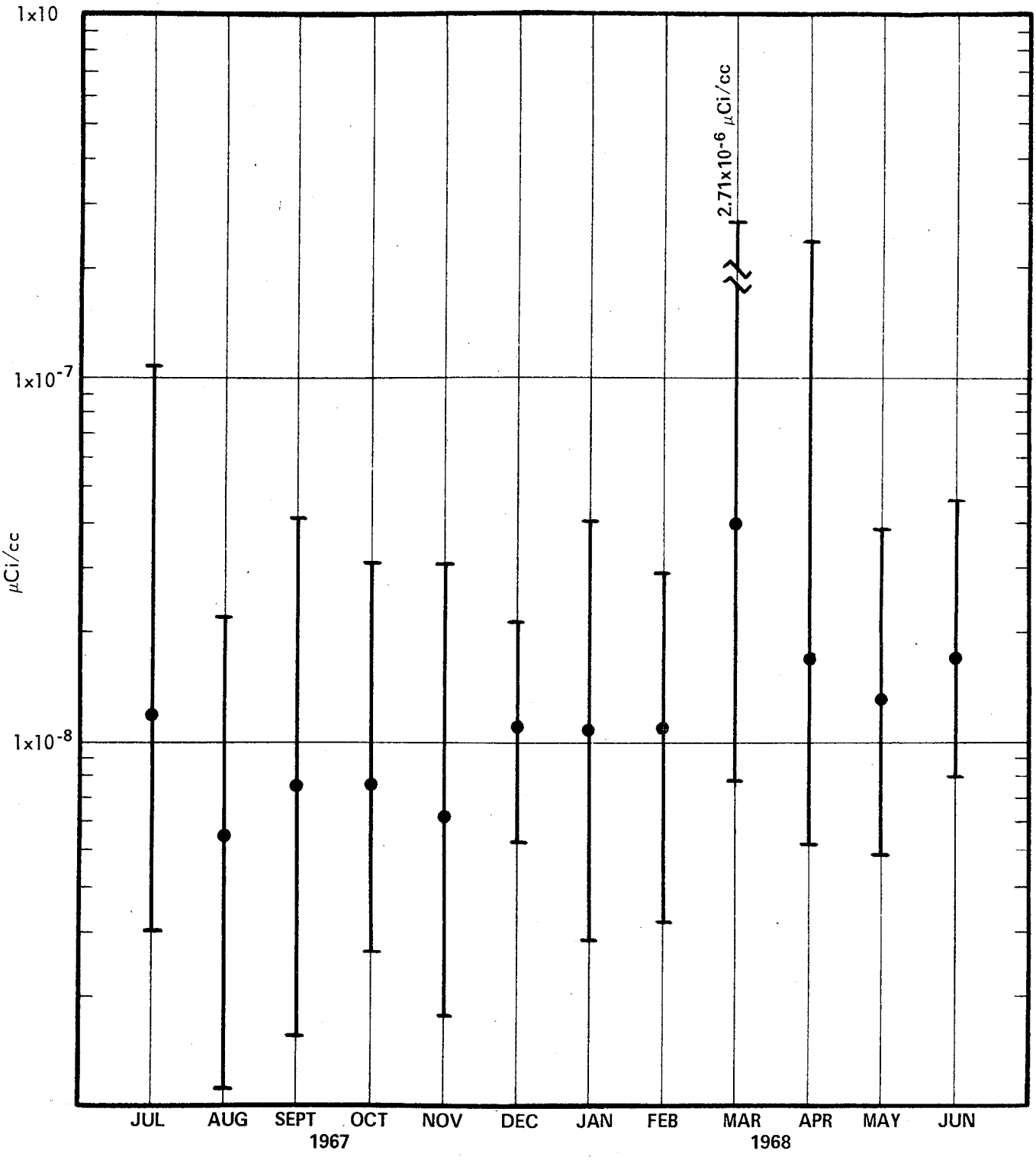

Fig. 11 Monthly Means and Ranges of Gross Beta Radioactivity in Open Reservoir Samples from July, 1967 through June, 1968

TABLE 12

MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
AT NTS OPEN RESERVOIR WATER SAMPLING STATION LOCATIONS
FROM JULY, 1967 THROUGH JUNE, 1968

(Values in terms of μCi/cc)

STATION NUMBER AND LOCATION	MEAN	RANGE	
		MAXIMUM	MINIMUM
1. Area 2 Well 2 Reservoir	8.91×10^{-9}	1.40×10^{-8}	4.25×10^{-9}
2. Area 3 Well "A" Reservoir	1.26×10^{-8}	4.49×10^{-8}	7.47×10^{-9}
3. Area 5 Well 5B Reservoir	1.13×10^{-8}	2.03×10^{-8}	1.13×10^{-9}
4. Area 5 Well Ue5c Reservoir	8.51×10^{-9}	1.08×10^{-8}	5.23×10^{-9}
5. Area 6 Well C1 Reservoir	9.46×10^{-9}	1.99×10^{-8}	4.63×10^{-9}
6. Area 15 Well Ue15d Reservoir	1.65×10^{-9}	2.83×10^{-8}	5.32×10^{-9}
7. Area 18 Camp 17 Reservoir	6.53×10^{-9}	1.45×10^{-8}	2.61×10^{-9}
8. Area 19 Well Ue19e Reservoir	8.24×10^{-9}	1.04×10^{-7}	2.12×10^{-9}
9. Area 19 Well Ue19gs Reservoir	1.21×10^{-8}	3.87×10^{-7}	1.77×10^{-9}
10. Area 20 Well U20a Reservoir	1.60×10^{-8}	2.71×10^{-6}	1.53×10^{-9}
11. Area 51 Well #4 Reservoir	3.54×10^{-8}	1.08×10^{-7}	2.13×10^{-8}

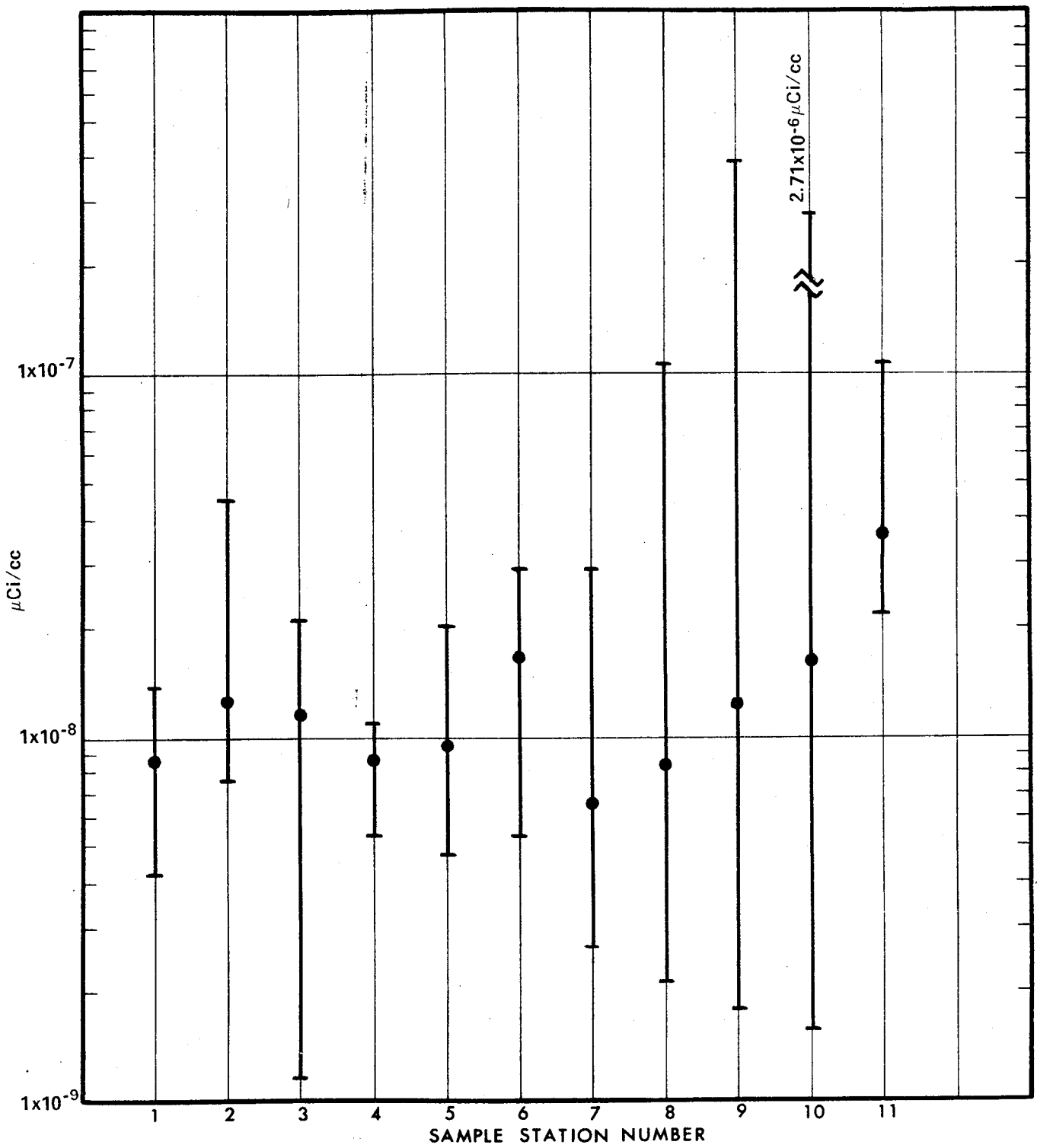

Fig. 12 Means and Ranges of Gross Beta Radioactivity at NTS Environmental Open Reservoir Sampling Locations from July, 1967 through June, 1968

TABLE 13

ENVIRONMENTAL SURVEILLANCE
SUPPLY WELLS SAMPLING STATION LOCATIONS

AREA	SAMPLING STATION LOCATION	MAP CODE FOR FIGURE 13
3	Well A	3a
5	Well 5A	5a
	Well 5B	5b
	Well 5C	5c
	Well Ue5c	5d
6	Well C1	6a
15	Well Ue15d	15a
19	Well Ue19gs	19a
	Well Ue19e	19b
20	Well U20a	20a
22	Army Well #1	22a
51	Well 3	51a
	Well 4	51b

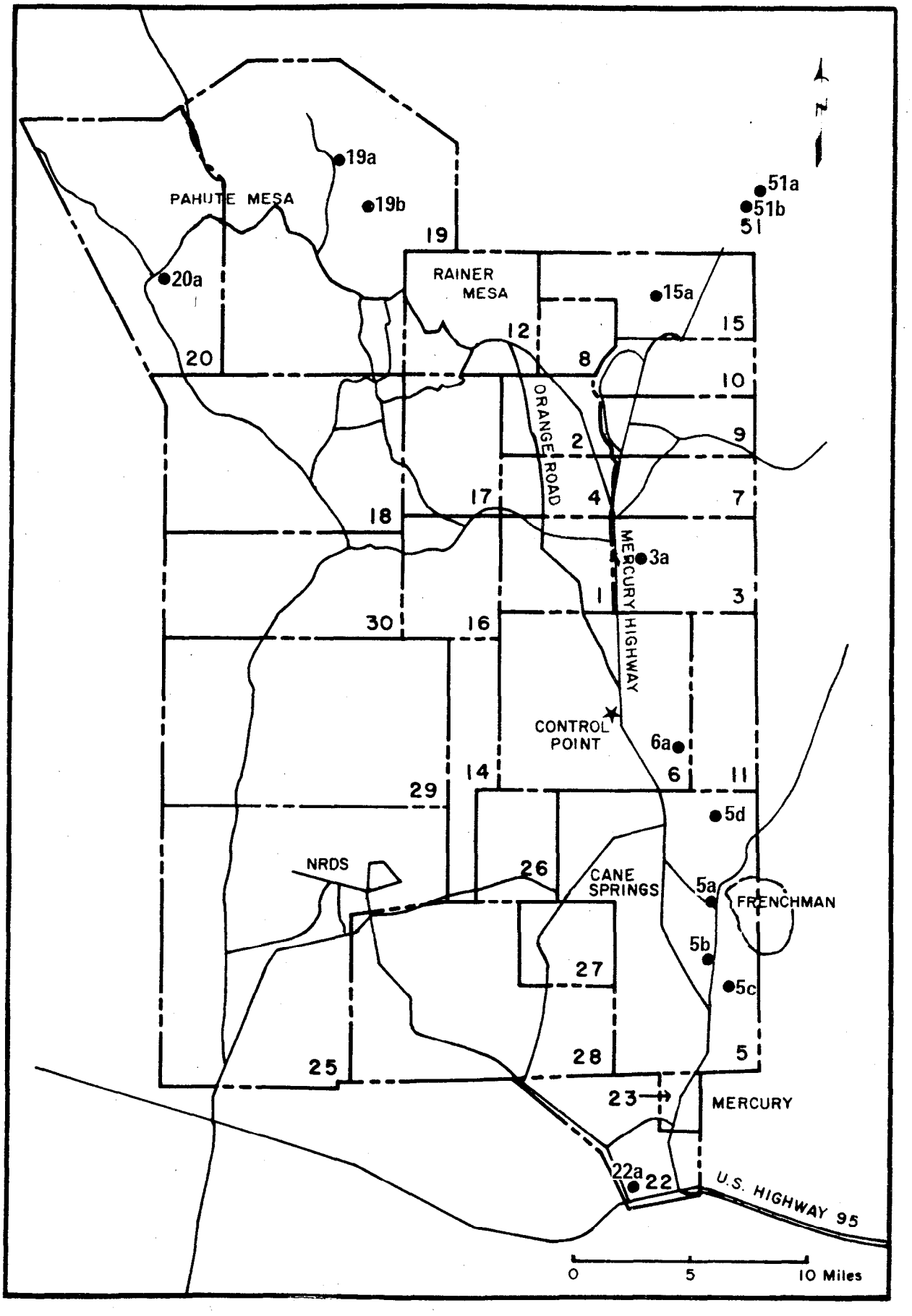

Fig. 13 NTS Environmental Surveillance Supply Well Sampling Locations

TABLE 14

MONTHLY MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
IN SUPPLY WELLS SAMPLES
FROM JULY, 1967 THROUGH JUNE, 1968

(Values in terms of $\mu Ci/cc$)

DATE (Monthly)	MEAN	RANGE	
		MAXIMUM	MINIMUM
07/67	8.88×10^{-9}	3.63×10^{-8}	1.70×10^{-9}
08/67	8.94×10^{-9}	2.26×10^{-8}	2.67×10^{-9}
09/67	1.02×10^{-8}	2.29×10^{-8}	4.73×10^{-9}
10/67	DATA	NOT	AVAILABLE
11/67	9.35×10^{-9}	6.18×10^{-8}	1.90×10^{-9}
12/67	1.16×10^{-8}	5.36×10^{-8}	2.42×10^{-9}
01/68	1.01×10^{-8}	4.07×10^{-8}	2.54×10^{-9}
02/68	8.81×10^{-9}	2.89×10^{-8}	2.11×10^{-9}
03/68	8.35×10^{-9}	2.68×10^{-8}	1.63×10^{-9}
04/68	7.77×10^{-9}	2.44×10^{-8}	1.36×10^{-9}
05/68	8.95×10^{-9}	2.56×10^{-8}	2.80×10^{-9}
06/68	9.27×10^{-9}	2.46×10^{-8}	4.20×10^{-9}

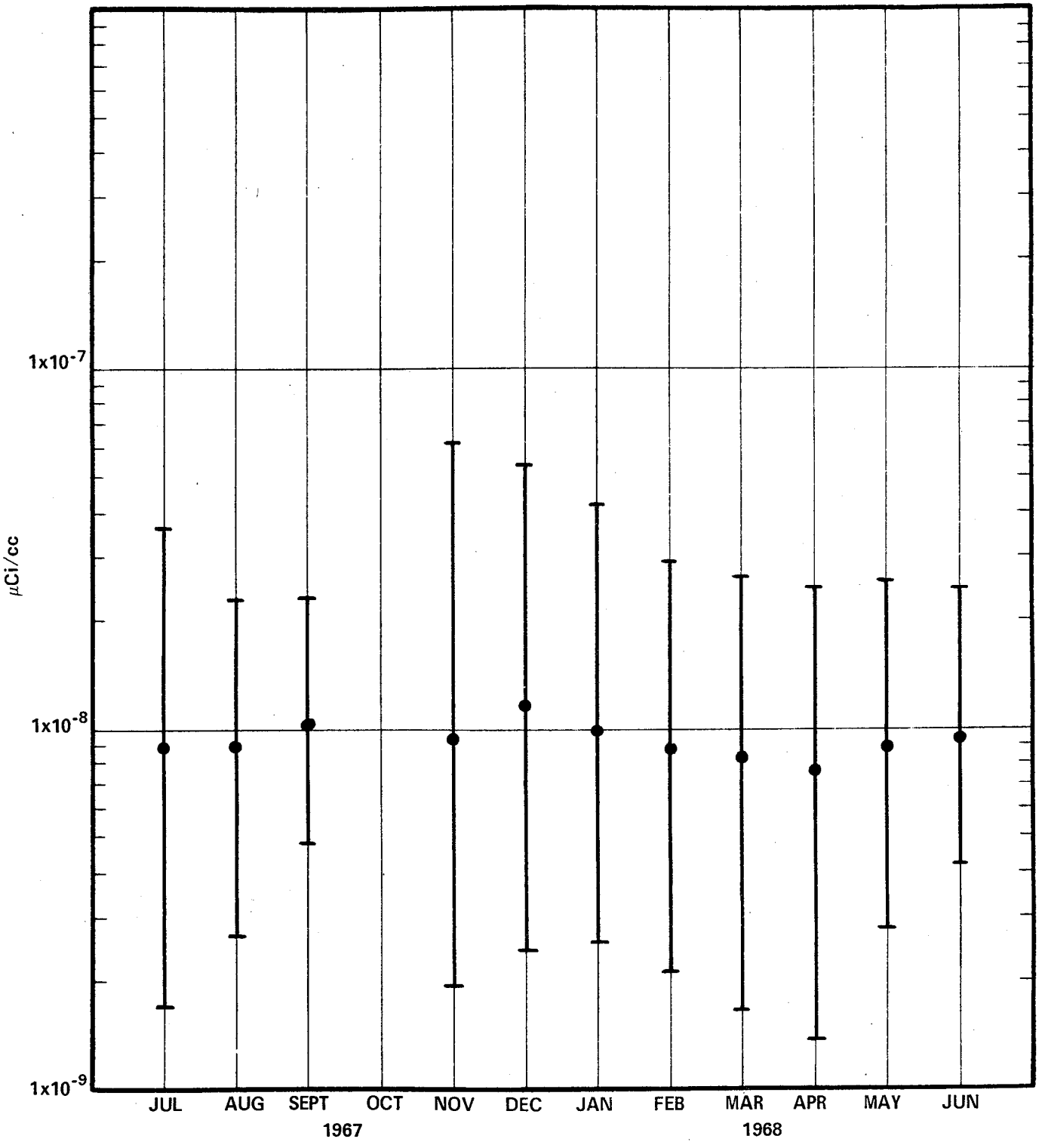

Fig. 14 Monthly Means and Ranges of Gross Radioactivity in Supply Well Samples from July, 1967 through June, 1968

TABLE 15

MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
AT NTS SUPPLY WELLS WATER SAMPLING STATION LOCATIONS
FROM JULY, 1967 THROUGH JUNE, 1968

(Values in terms of $\mu Ci/cc$)

STATION NUMBER AND LOCATION	MEAN	RANGE	
		MAXIMUM	MINIMUM
1. Area 3 Well A	1.15×10^{-8}	2.44×10^{-8}	5.38×10^{-9}
2. Area 5 Well 5A	8.59×10^{-9}	1.29×10^{-8}	5.25×10^{-9}
3. Area 5 Well 5B	1.22×10^{-8}	3.64×10^{-8}	4.95×10^{-9}
4. Area 5 Well 5C	7.68×10^{-9}	1.07×10^{-8}	3.38×10^{-9}
5. Area 5 Well Ue5C	1.50×10^{-8}	6.18×10^{-8}	4.74×10^{-9}
6. Area 6 Well C1	1.53×10^{-8}	5.36×10^{-9}	6.02×10^{-9}
7. Area 15 Well Ue15d	2.00×10^{-8}	4.07×10^{-8}	5.65×10^{-9}
8. Area 19 Well Ue19gs	4.57×10^{-9}	1.71×10^{-8}	2.11×10^{-9}
9. Area 19 Well Ue19e	2.29×10^{-9}	5.94×10^{-9}	1.36×10^{-9}
10. Area 20 Well U20a	5.40×10^{-9}	1.89×10^{-8}	2.80×10^{-9}
11. Area 22 Army Well #1	7.04×10^{-9}	2.46×10^{-8}	3.36×10^{-9}
12. Area 51 Well #3	6.02×10^{-9}	9.92×10^{-9}	3.08×10^{-9}
13. Area 51 Well #4	2.39×10^{-8}	3.63×10^{-8}	1.25×10^{-8}

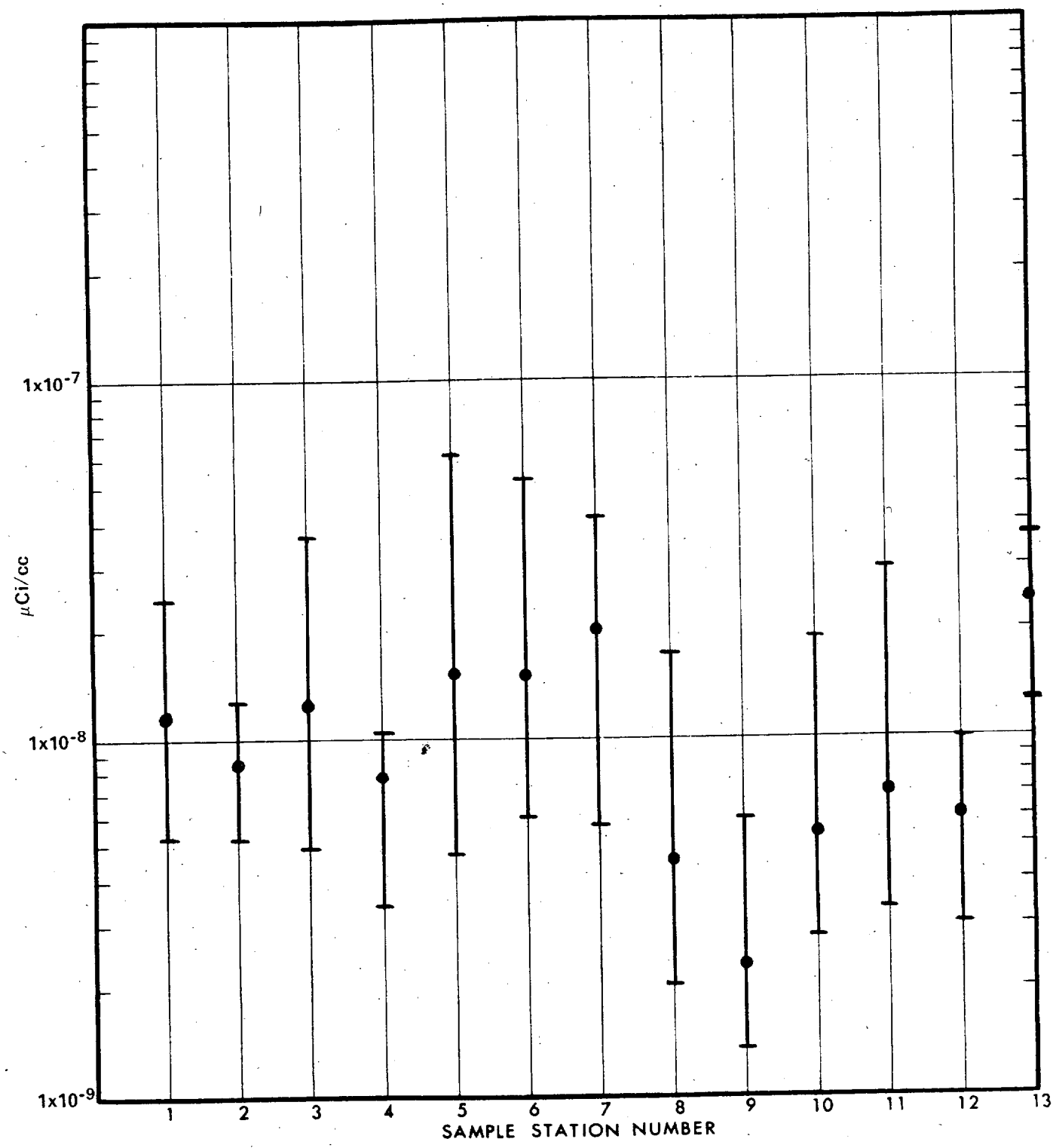

Fig. 15 Means and Ranges of Gross Beta Radioactivity at NTS Environmental Supply Well Sampling Locations from July, 1967 through June, 1968

TABLE 16

ENVIRONMENTAL SURVEILLANCE
FINAL EFFLUENT SAMPLING STATION LOCATIONS

AREA	SAMPLING STATION LOCATION	MAP CODE FOR FIGURE 16
6	Final Effluent Pond	6a
12	Final Effluent Pond	12a
23	Final Effluent Pond	23a
51	Final Effluent Pond	51a

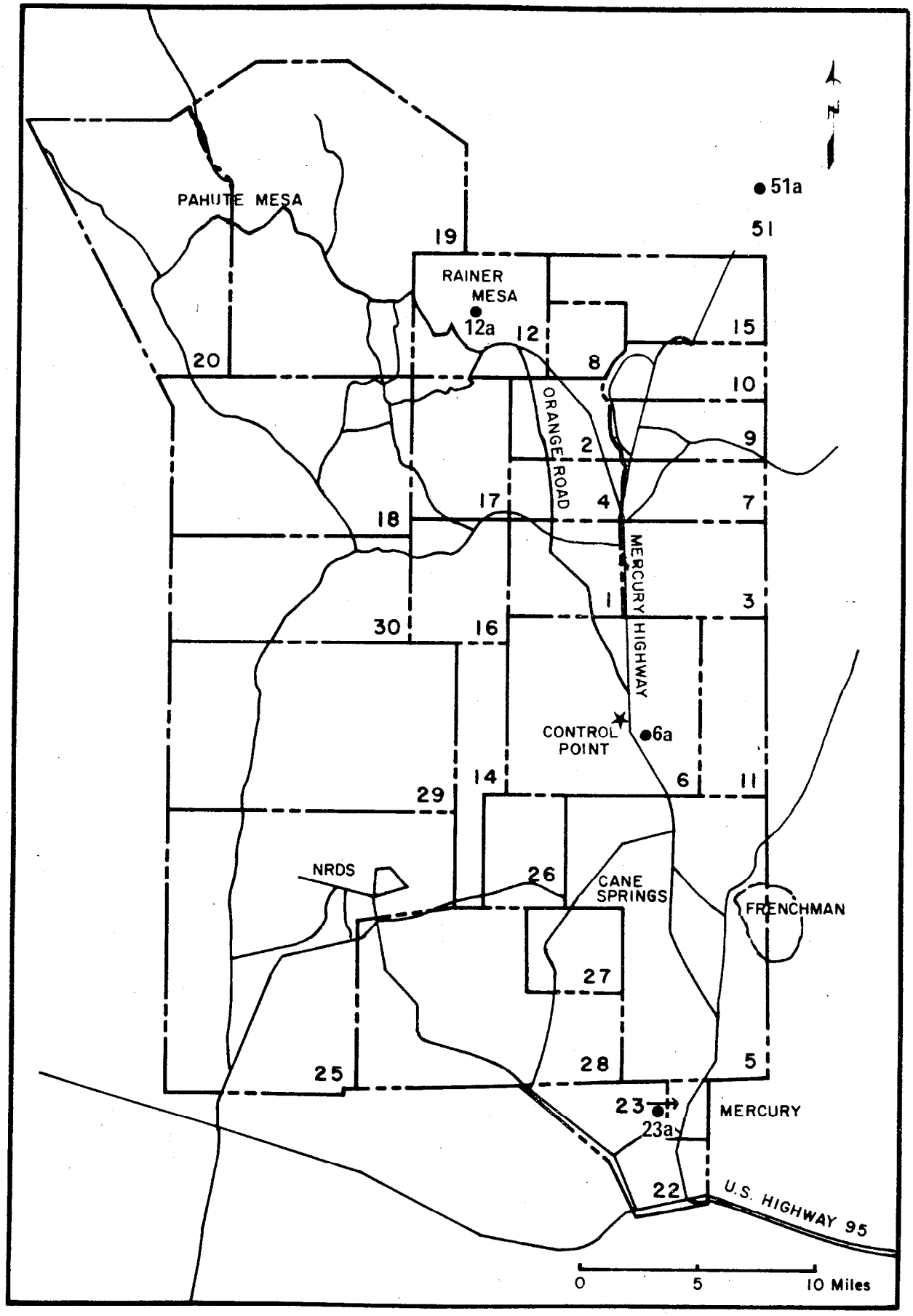

Fig. 16 NTS Environmental Surveillance Final Effluent Pond Sampling Locations

TABLE 17

ENVIRONMENTAL SURVEILLANCE
MISCELLANEOUS WATER SAMPLING STATION LOCATIONS

AREA	SAMPLING STATION LOCATIONS	MAP CODE FOR FIGURE
12	Upper Haines Lake	12a
	Lower Haines Lake	12b
23	Swimming Pool	23a
	Laboratory Sump	23b
51	Swimming Pool	51a
	Papoose Lake	51b
6	Decontamination Runoff Pond	6a

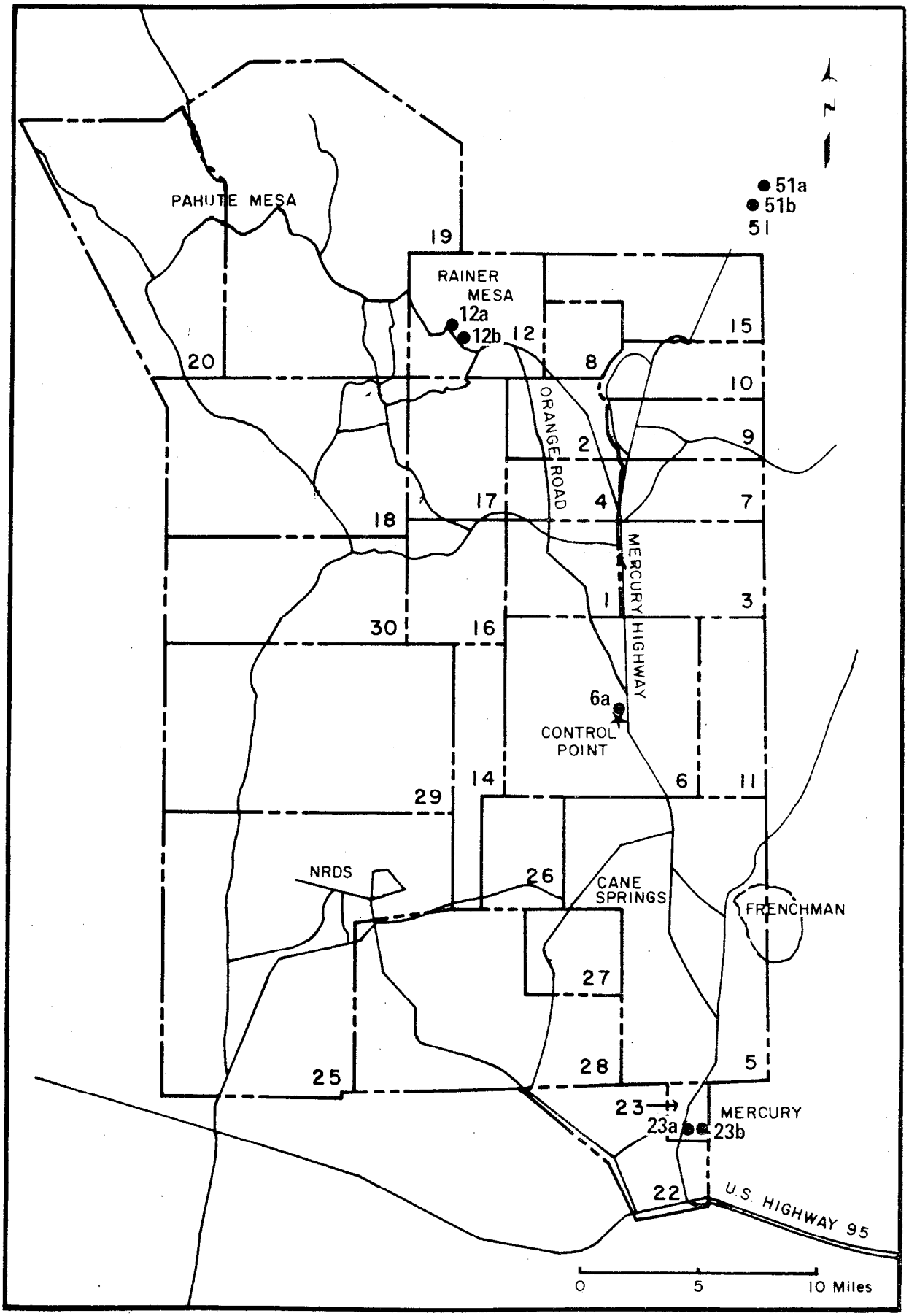

Fig. 17 NTS Environmental Surveillance Miscellaneous Water Sampling Locations

TABLE 18

MEANS AND RANGES OF GROSS BETA RADIOACTIVITY
AT NTS MISCELLANEOUS WATER SAMPLING STATION LOCATIONS
FROM JULY, 1967 THROUGH JUNE, 1968

(Values in terms of μCi/cc)

STATION NUMBER AND LOCATION	MEAN	RANGE	
		MAXIMUM	MINIMUM
1. Area 12 Upper Haines Lake	1.76×10^{-6}	2.45×10^{-4}	3.69×10^{-9}
2. Area 12 Lower Haines Lake	2.17×10^{-6}	2.38×10^{-4}	1.64×10^{-8}
3. Area 23 Swimming Pool	4.24×10^{-9}	5.35×10^{-9}	3.33×10^{-9}
4. Area 51 Swimming Pool	1.09×10^{-8}	1.77×10^{-8}	5.69×10^{-9}
5. Area 51 Papoose Lake	7.38×10^{-8}	1.52×10^{-7}	4.10×10^{-8}
6. Area 6, Decon Pond	DATA	NOT	AVAILABLE
7. Area 23 Laboratory Sump	2.47×10^{-8}	2.10×10^{-7}	1.70×10^{-9}

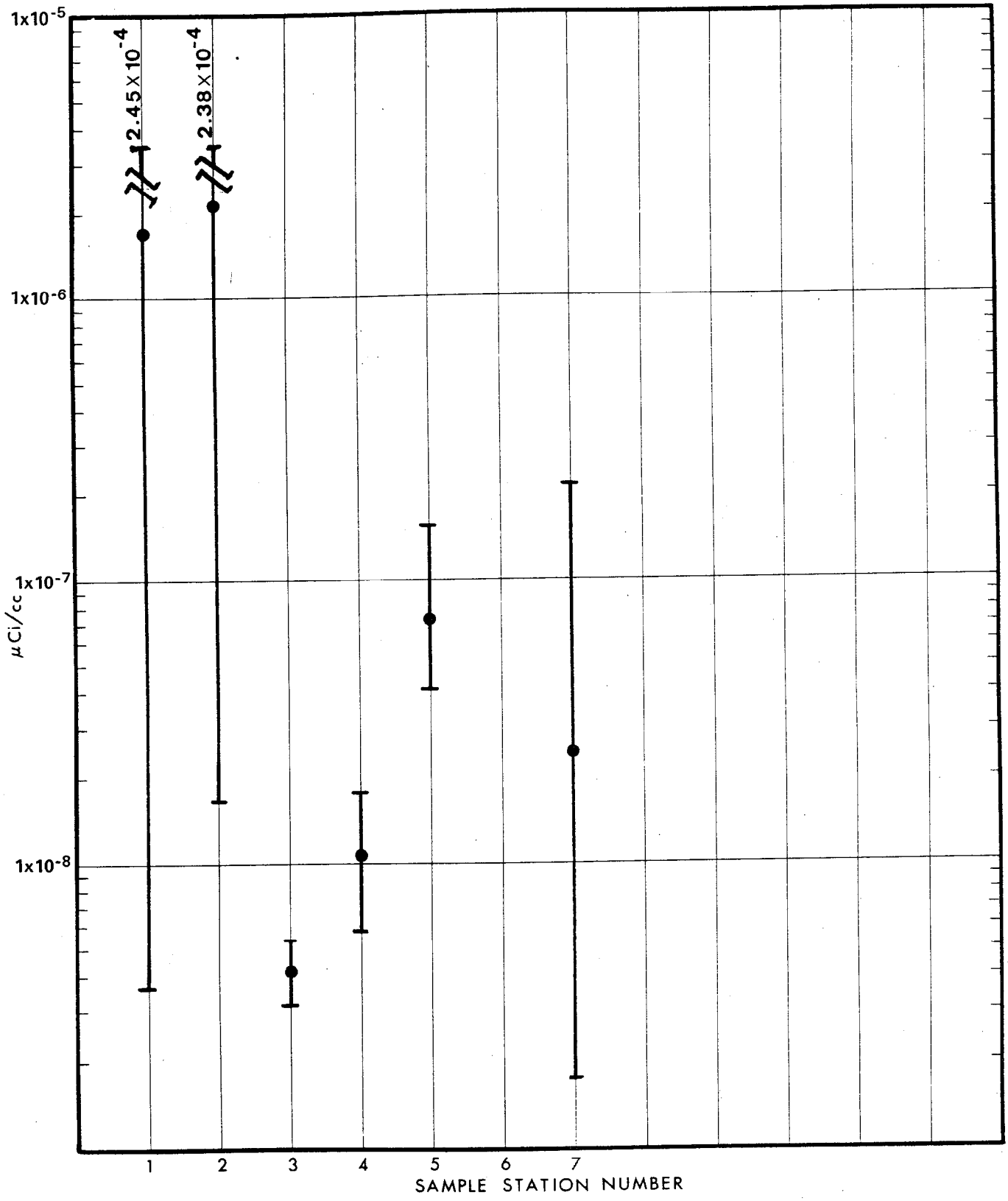

Fig. 18 Means and Ranges of Gross Beta Radioactivity from July, 1967 through June, 1968; Miscellaneous Water Sampling Locations

TABLE 19

ENVIRONMENTAL SURVEILLANCE
IONIZATION CHAMBER SAMPLING STATION LOCATIONS

AREA	SAMPLING STATION LOCATION	MAP CODE FOR FIGURE
3	North of Cafeteria	3a
5	West of Well 5B	5a
6	North of Icehouse	6a
12	East of Dispensary	12a
18	Heliport	18a
20	South of Dispensary	20a
23	South of Dispensary	23a
27	Security Gate 501	27a

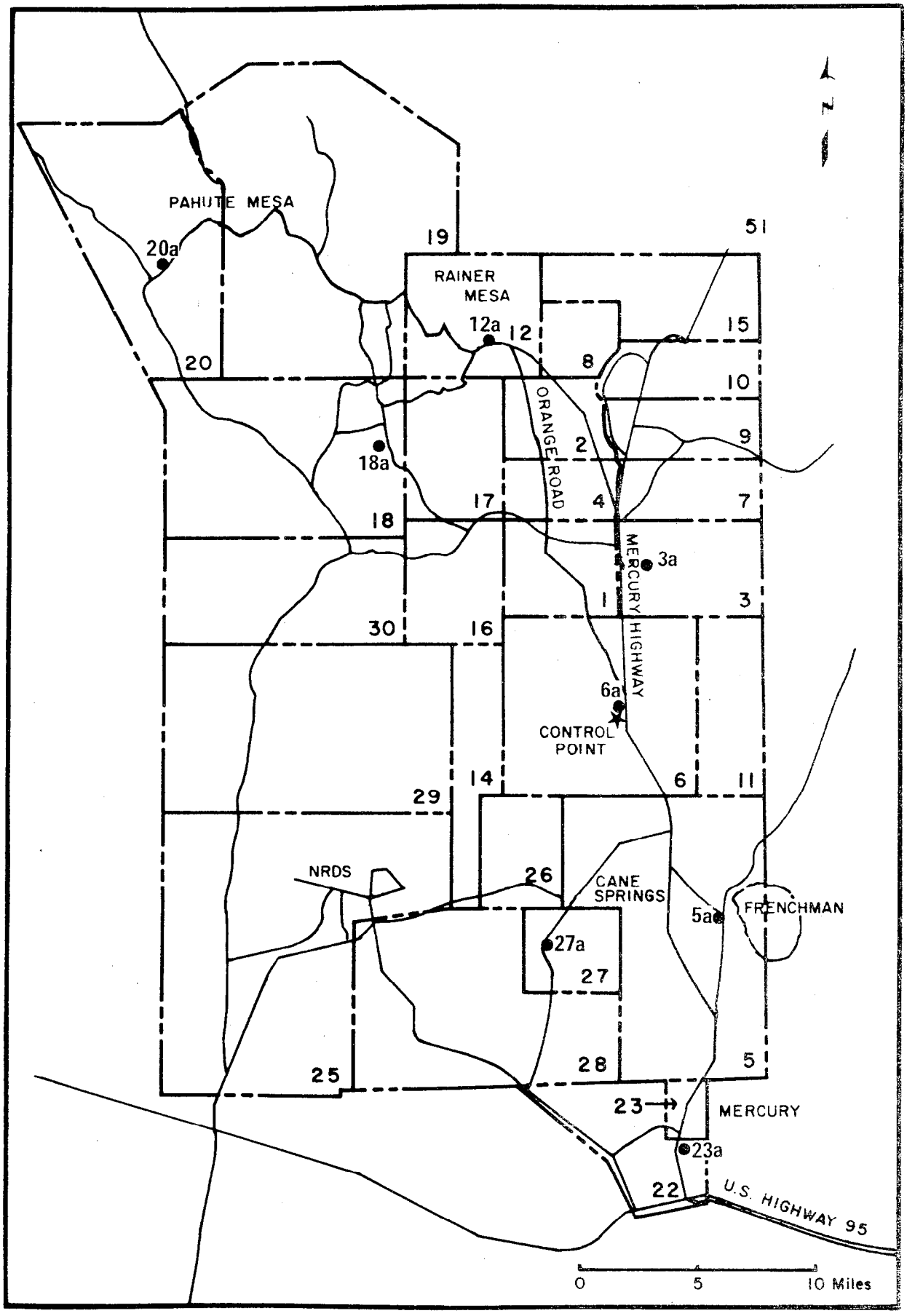

Fig. 19 NTS Environmental Surveillance Ionization Chamber Sampling Locations

TABLE 20

SUMMARY OF BACKGROUND RADIATION MEASUREMENTS (mR/day)

DATE (Week ending)	AREA 3 North of Cafe	AREA 5 West of Well 5B	AREA 6 North of Icehouse	AREA 12 East of Dispensary	AREA 18 Heliport	AREA 20 South of Dispensary	AREA 23 South of Dispensary	AREA 27 Security Gate 561	Remarks
07/02/67	0.74		0.46	0.57			0.36	0.46	
07/09/67	0.82		0.55	0.50			0.32	0.55	
07/16/67	0.81		0.54	0.51			0.35	0.54	
07/23/67	0.70		0.50	0.48			0.40	0.50	
07/30/67	0.73		0.46	0.51			0.31	0.46	
08/06/67	0.74		0.44	0.45			0.32	0.44	
08/13/67	0.71		0.47	0.50			0.34	0.47	
08/20/67	0.75		0.43	0.47			0.32	0.43	
08/27/67	0.70	0.43	0.43	0.45	0.50	0.48	0.30	0.43	
09/03/67	0.79	0.42	0.43	0.48	0.55	0.46	0.30	0.43	
09/10/67	0.81	0.45	0.44	>1.43	0.58	0.45	0.31	0.44	Door Mist, Area 1
09/17/67	0.77	0.50	0.45	0.51	0.48	0.48	0.35	0.45	
09/24/67	0.72	0.42	0.48	0.51	0.50	0.45	0.34	0.48	
10/01/67	0.77	0.45	0.45	0.48	0.49	0.59	0.34	0.45	
10/08/67	0.75	--	0.47	0.53	0.49	0.47	0.38	0.47	
10/15/67	0.77	0.51	0.45	0.48	0.48	0.48	0.36	0.45	
10/22/67	0.74	0.66	0.47	0.54	0.52	0.46	0.49	0.47	
10/29/67	1.02	0.36	0.45	0.46	0.50	0.50	0.31	0.45	
11/05/67	0.54	0.51	0.52	0.38	0.50	0.48	0.39	0.52	
11/12/67	0.77	0.53	0.45	0.49	0.49	0.47	0.32	0.45	
11/19/67	0.77	0.45	0.46	0.49	0.49	0.45	0.32	0.46	
11/26/67	0.74	0.49	0.47	0.46	0.50	0.49	0.32	0.47	
12/03/67	0.75	0.48	0.47	0.50	0.51	0.46	0.34	0.47	
12/10/67	0.85	0.61	0.47	0.49	0.61	0.50	0.37	0.47	
12/17/67	0.74	0.63	0.50	0.65	0.37	0.49	0.38	0.50	
12/24/67	0.93	0.35	0.68	0.48	0.49	0.38	0.49	0.68	
12/31/67	0.49	0.57	0.35	0.49	--	0.69	0.26	0.35	
01/07/68	0.89	0.58	0.56	0.48	0.49	0.45	0.43	0.56	
01/07/68	0.79	0.59	0.53	0.53	0.50	0.43	0.37	0.53	
01/14/68	0.85	0.50	0.48	0.47	0.51	0.46	0.42	0.48	
01/21/68	0.77	0.56	0.51	0.51	0.56	0.52	0.35	0.51	

TABLE 20 (Contd)

SUMMARY OF BACKGROUND RADIATION MEASUREMENTS (mR/day)

DATE (Week ending)	AREA 3 North of Cafe	AREA 5 West of Well 5B	AREA 6 North of Icehouse	AREA 12 East of Dispensary	AREA 18 Heliport	AREA 20 South of Dispensary	AREA 23 South of Dispensary	AREA 27 Security Gate 561	Remarks
01/28/68	1.04	0.48	0.49	0.50	0.46	0.46	0.42	0.49	
02/04/68	0.72	0.48	0.50	0.48	0.51	0.44	0.35	0.50	
02/11/68	0.81	--	0.49	0.51	0.46	--	0.34	0.49	
02/18/68	0.70	0.49	0.53	0.50	0.46	0.44	0.31	0.53	
02/25/68	0.75	0.45	0.45	0.46	0.48	0.46	0.34	0.45	
03/03/68	0.80	0.57	0.51	0.47	0.49	0.44	0.36	0.51	
03/10/68	1.02	0.47	0.59	0.49	0.61	>1.43	0.50	0.59	Area 30 (Bug
03/17/68	0.77	0.60	0.52	0.54	0.51	>1.43	0.40	0.52	Area 30 (Bug
03/24/68	0.81	0.48	0.53	0.50	0.49	>1.43	0.37	0.53	Area 30 (Bug
03/31/68	0.76	0.52	0.51	0.51	0.52	>1.43	0.36	0.51	Area 30 (Bug
04/07/68	0.77	0.42	0.43	0.47	0.50	>1.43	0.41	0.43	Area 30 (Bug
04/14/68	0.74	0.51	0.45	0.54	0.48	1.15	0.37	0.45	
04/21/68	0.76	0.46	0.50	0.48	0.60	1.32	0.44	0.50	

DISCONTINUED ON 4/25/68

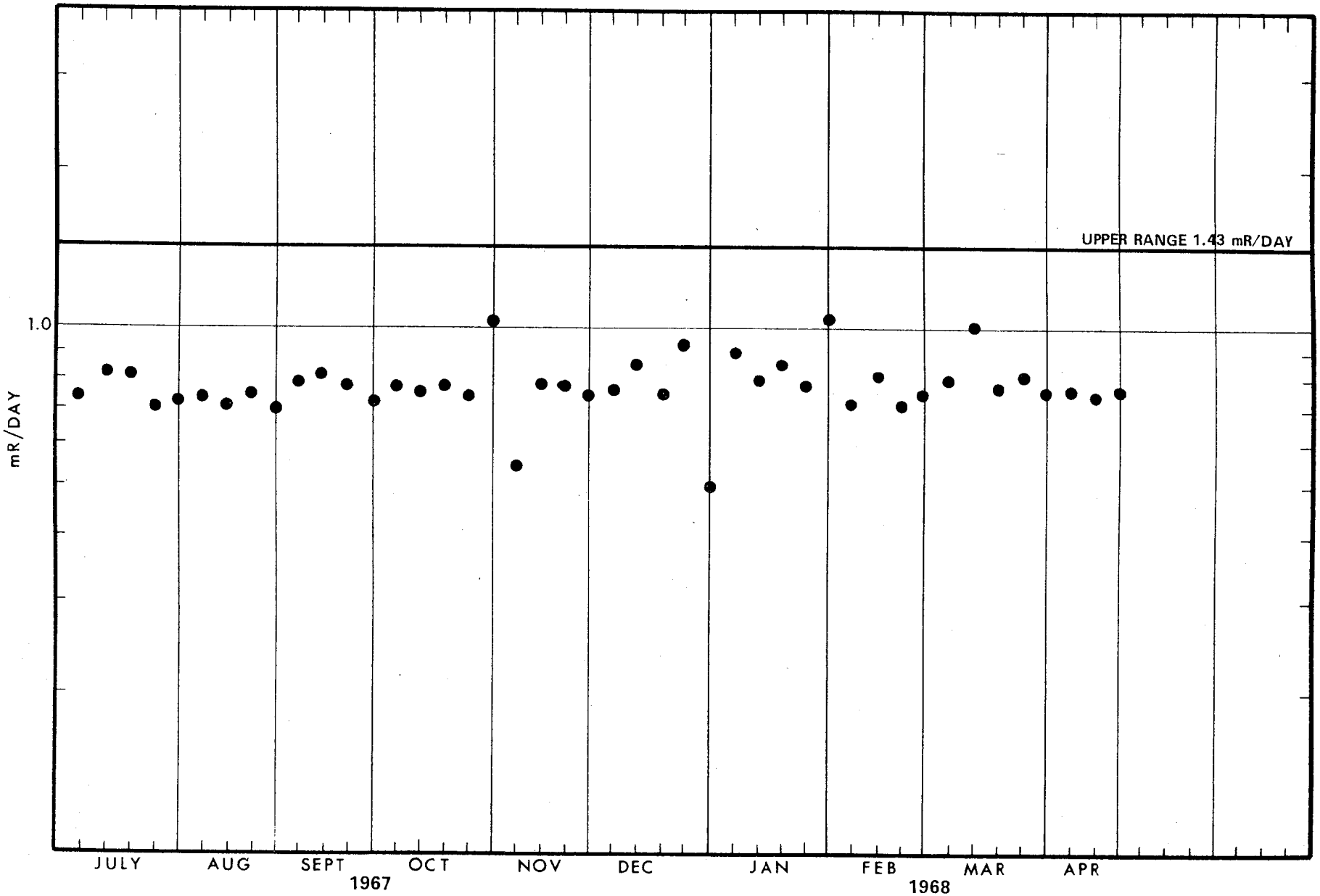

Fig. 20 Weekly Exposure Readings for Period July, 1967 through April, 1968 for Area 3 (North of Cafeteria); Ionization Chambers - Victoreen Model 239

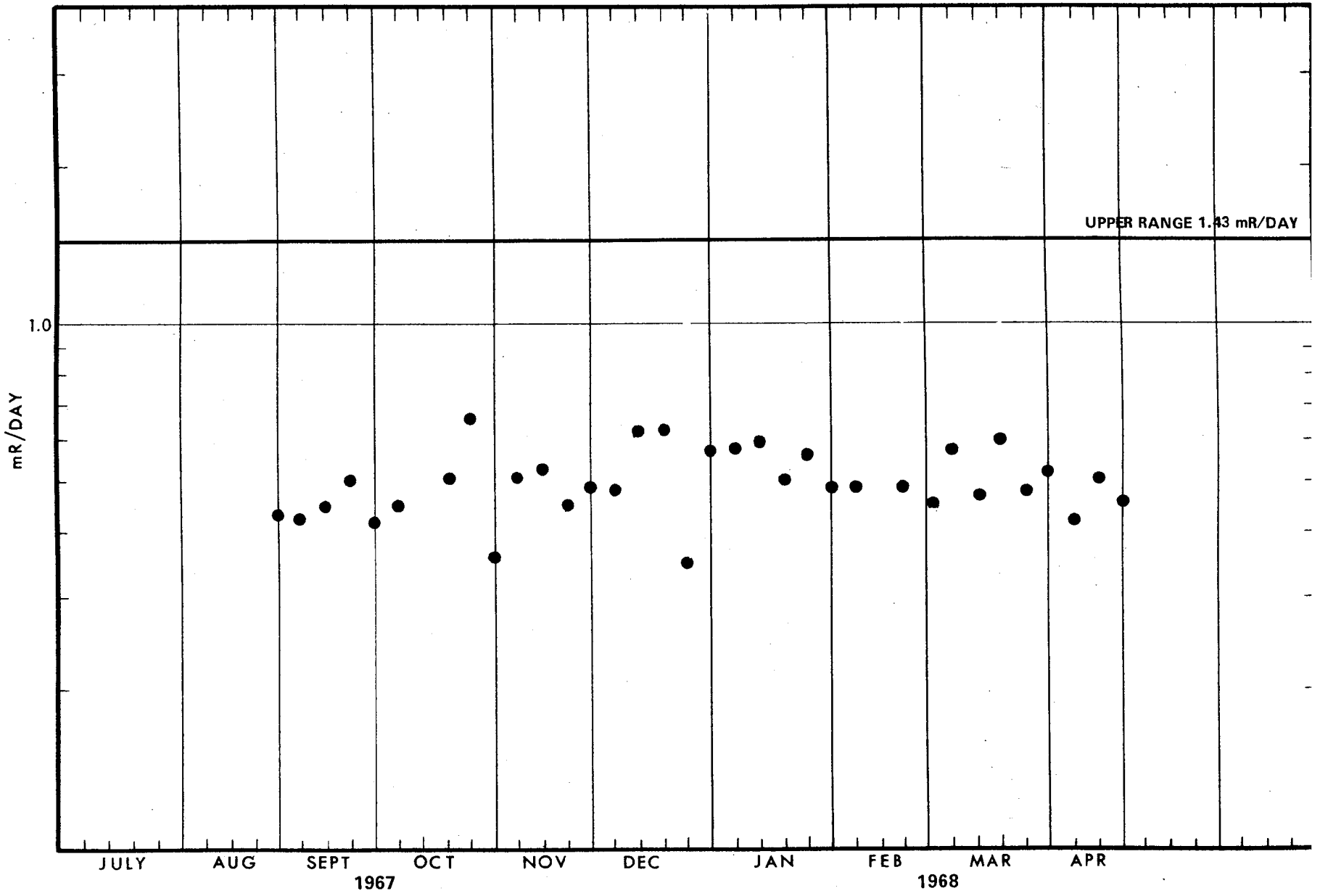

Fig. 21 Weekly Exposure Readings for Period August, 1967 through April, 1968 for Area 5 (West of Well 5B); Ionization Chambers - Victoreen Model 239

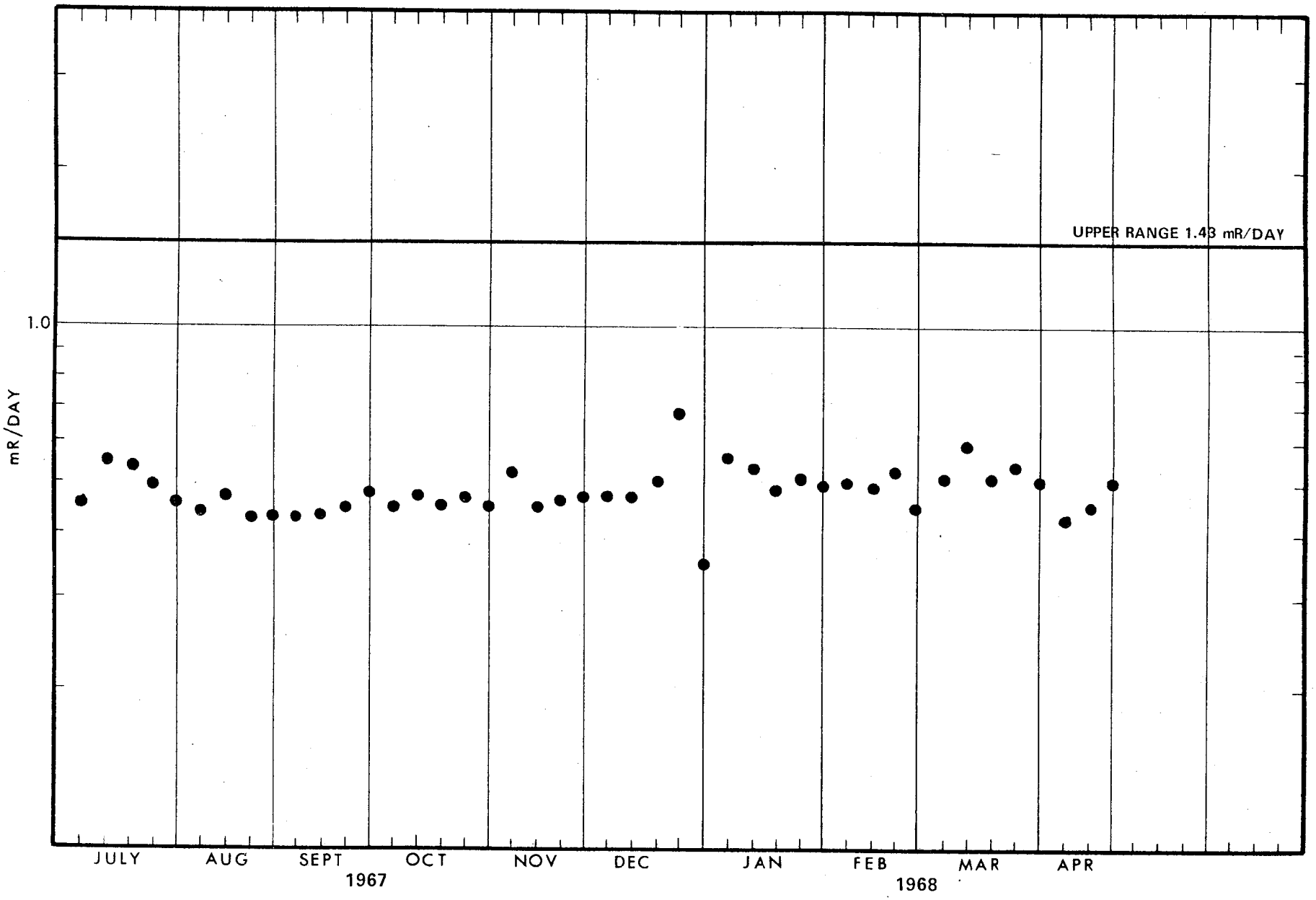

Fig. 22 Weekly Exposure Readings for Period July, 1967 through April, 1968 for Area 6 (North of Icehouse); Ionization Chambers - Victoreen Model 239

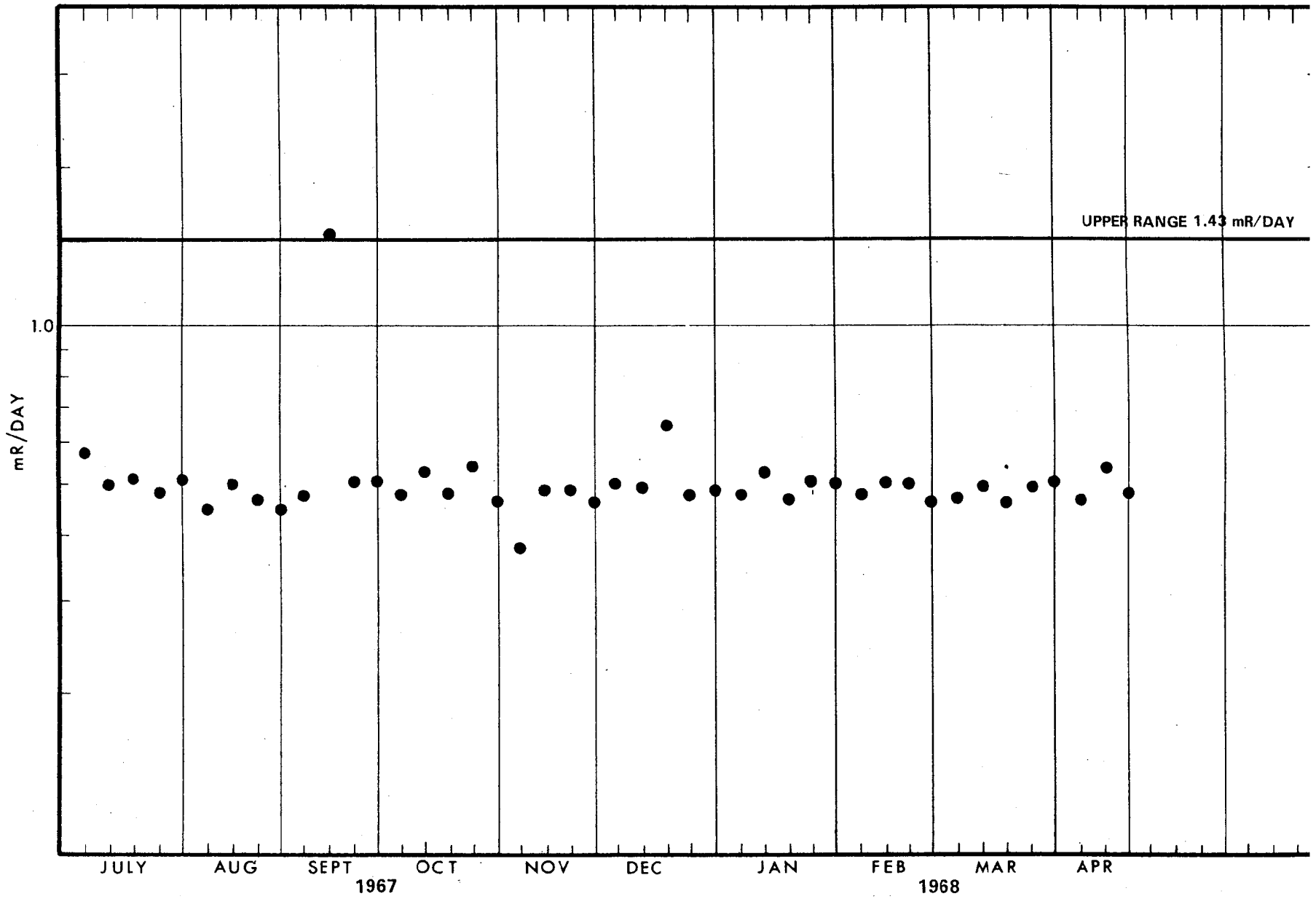

Fig. 23 Weekly Exposure Readings for Period July, 1967 through April, 1968 for Area 12 (East of Dispensar
Ionization Chambers - Victoreen Model 239

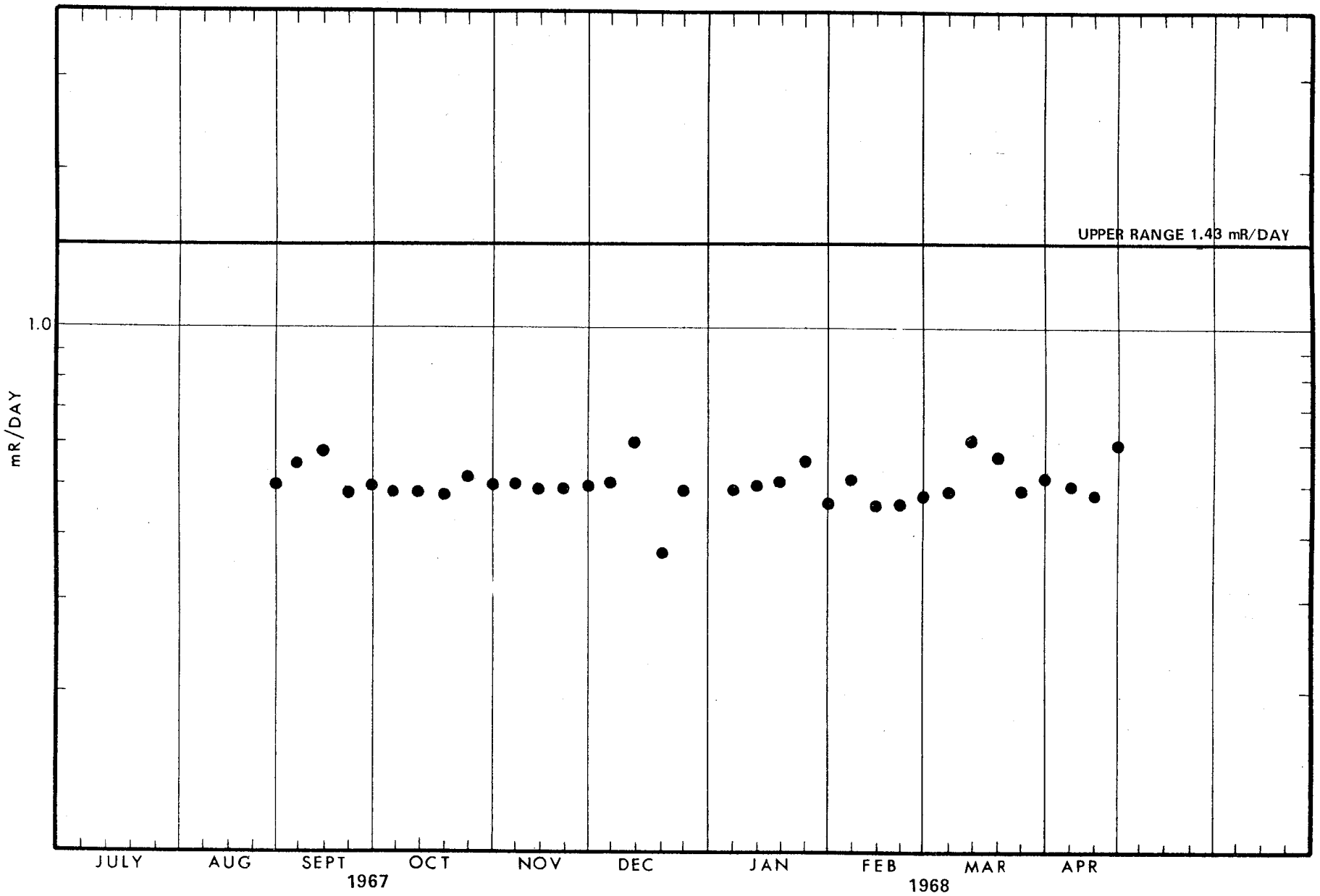

Fig. 24 Weekly Exposure for Period August, 1967 through April, 1968 for Area 18 (Heliport); Ionization Chambers - Victoreen Model 239

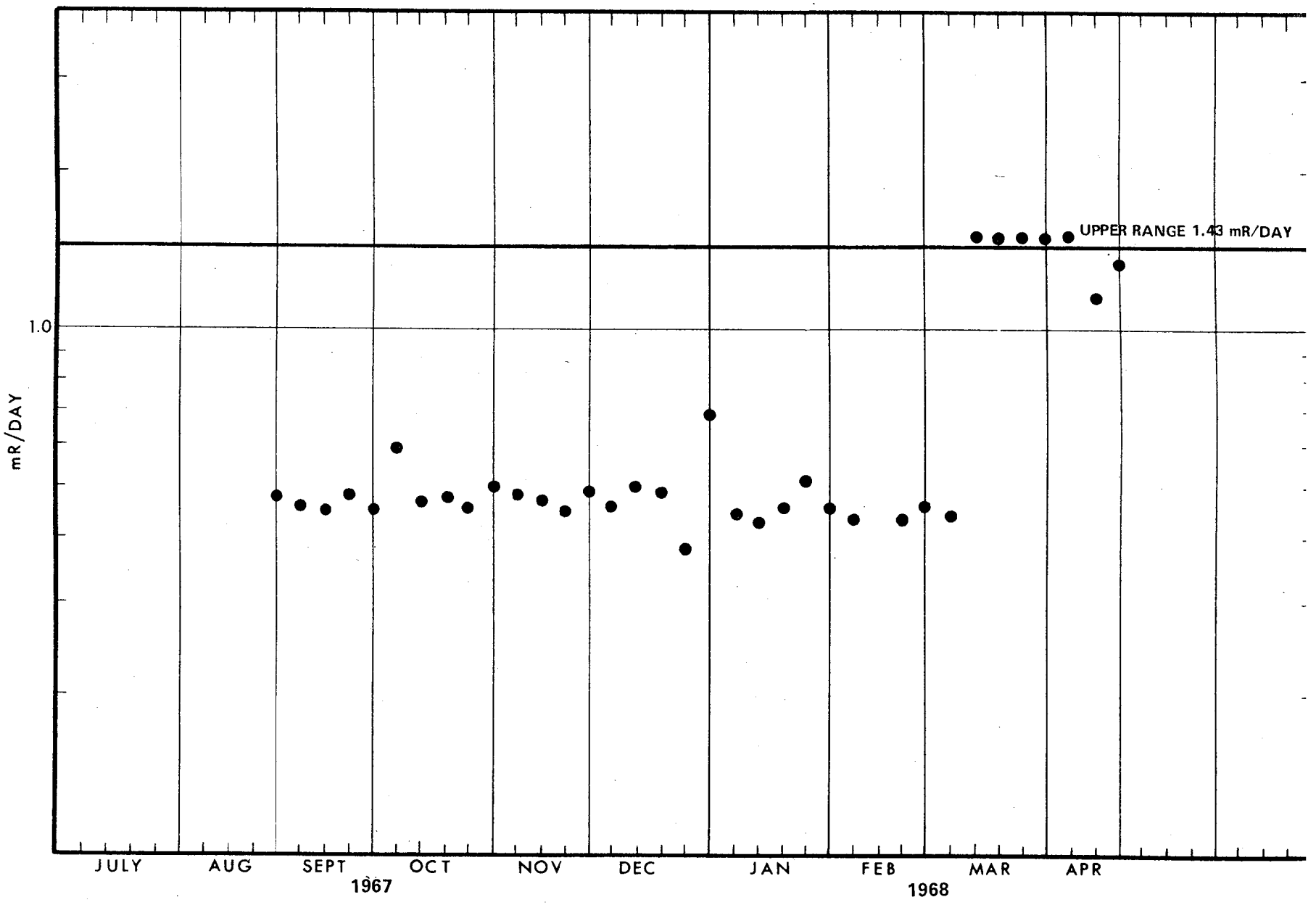

Fig. 25 Weekly Exposure Readings for Period August, 1967 through April, 1968 for Area 20 (South of Dispens
Ionization Chambers - Victoreen Model 239

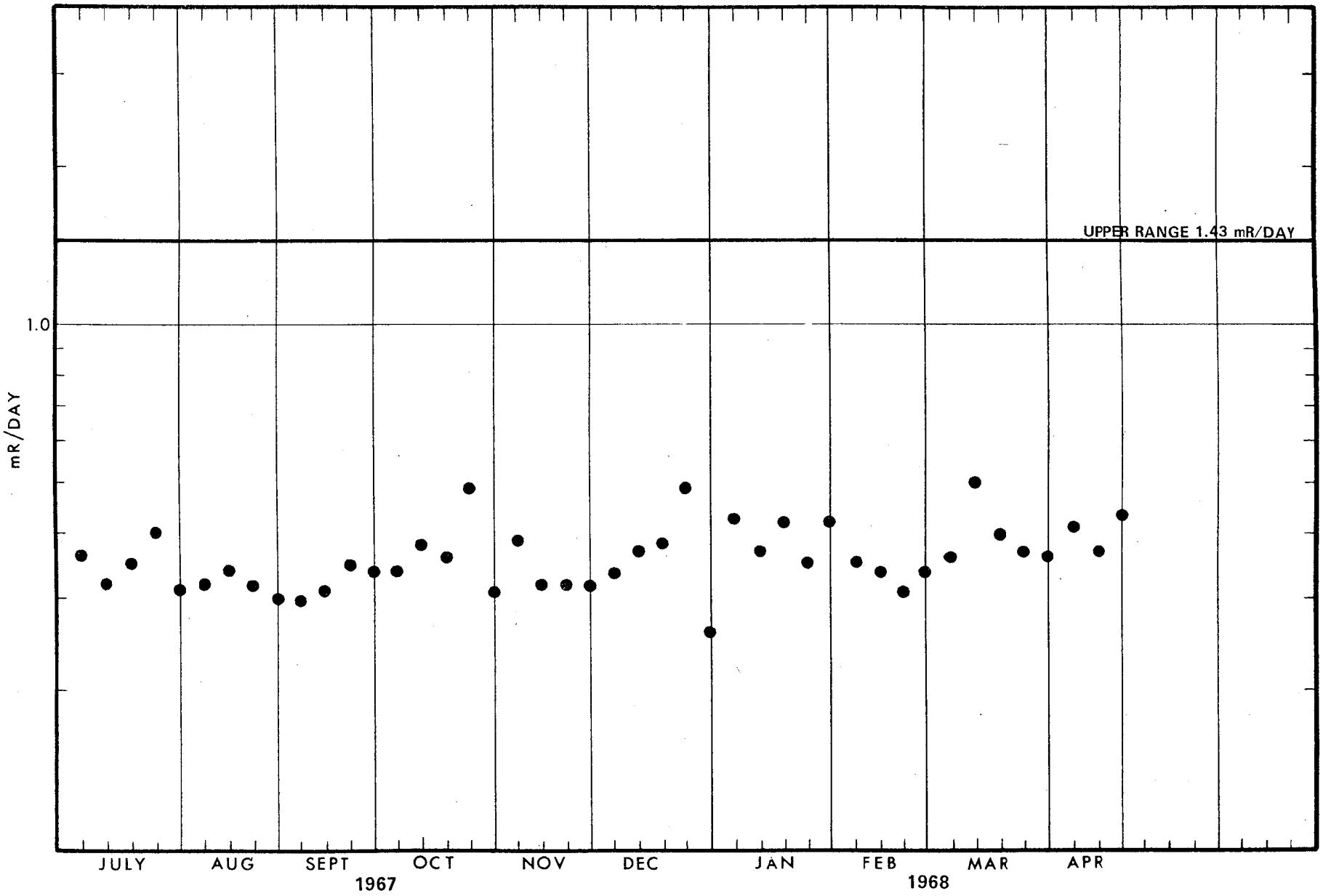

Fig. 26 Weekly Exposure Readings for Period July, 1967 through April, 1968 for Area 23 (South of Dispensary); Ionization Chambers - Victoreen Model 239

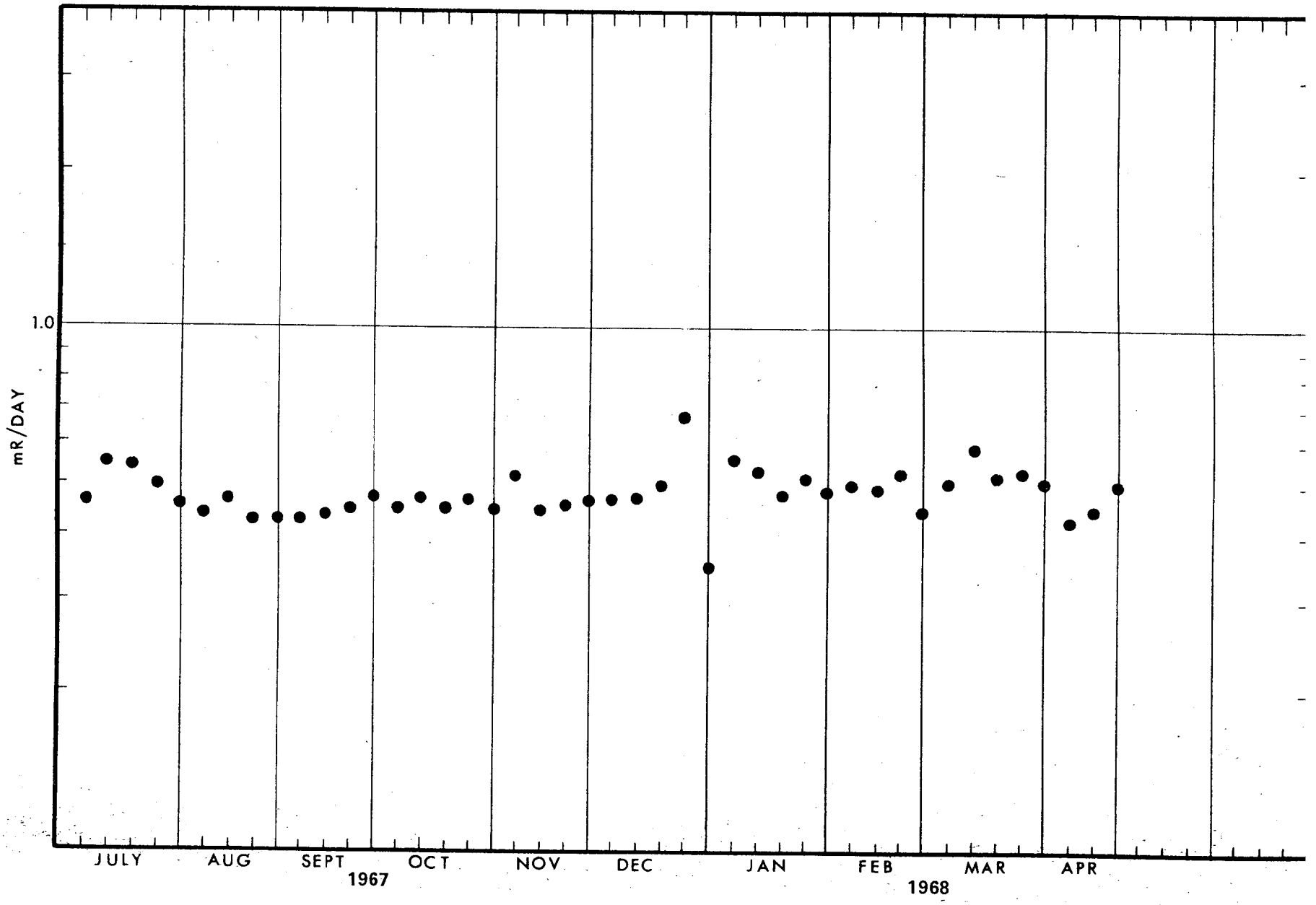

Fig. 27 Weekly Exposure Readings for Period July, 1967 through April, 1968 for Area 27 (Security Gate 561)
Ionization Chambers - Victoreen Model 239

TABLE 21

ENVIRONMENTAL SURVEILLANCE
VEGETATION SAMPLING LOCATIONS

AREA	SAMPLE STATION LOCATION	SPECIE	MAP CODE FOR FIGURE 28
2	Orange Road Stake 63-64	b	2a
5	Old Fallout Station	d	5a
11	Stake 11 W-4	c	11a
12	Campsite	a	12a
	ESSA Station	a	12b
14	Saddle Mtn. Road Barricade	a	14a
15	N.E. of USPHS Farm	b	15a
16	Campsite	a,b	16a
18	Stake 18 B-16	a	18a
19	Stake 19 F-13	a	19a
20	Stake 20 L-12	a	20a
23	Pistol Range Road	b	23a
28	Pan Am Stake 152	d	28a
	Project HENRE Site	d	28b
29	Shoshone Mountain Barricade	a	29a
51	South of Groom Lake	c	51a

CODE EXPLANATION FOR SPECIE:

(a) SAGEBRUSH - Artemesia spp.
(b) BLACKBRUSH - Coleogyne ramossisima
(c) WINTERFAT - Eurotia lanata
(d) CREOSOTE - Larrea divaricata

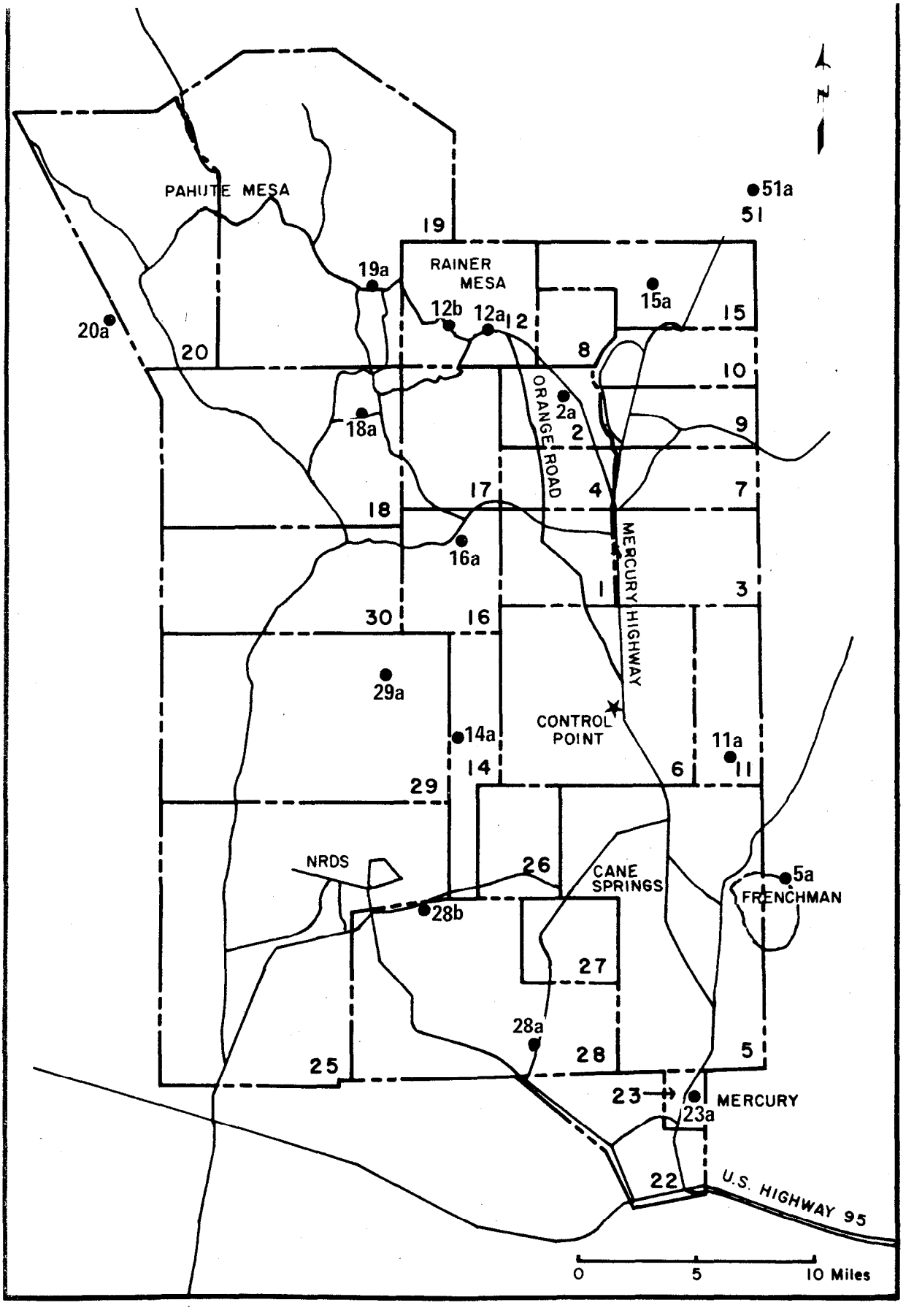

Fig. 28 NTS Environmental Surveillance Soil and Vegetation Sampling Locations

TABLE 22

MONTHLY MEANS AND RANGES OF GROSS GAMMA RADIOACTIVITY
AT NTS VEGETATION SAMPLING LOCATIONS
FROM JULY, 1967 THROUGH JUNE, 1968

(Values in terms of μCi/gm)

DATE (Monthly)	MEAN	RANGE	
		MAXIMUM	MINIMUM
07/67	5.45×10^{-6}	1.36×10^{-5}	2.83×10^{-6}
08/67	5.74×10^{-6}	2.43×10^{-5}	2.33×10^{-6}
09/67	6.08×10^{-6}	1.81×10^{-5}	3.00×10^{-6}
10/67	8.42×10^{-6}	1.83×10^{-5}	4.47×10^{-6}
11/67	6.88×10^{-6}	1.49×10^{-5}	4.03×10^{-6}
12/67	7.61×10^{-6}	1.61×10^{-5}	3.77×10^{-6}
01/68	4.01×10^{-5}	4.90×10^{-4}	9.59×10^{-6}
02/68	2.24×10^{-5}	4.42×10^{-5}	9.70×10^{-6}
03/68	3.09×10^{-5}	5.82×10^{-3}	8.45×10^{-6}
04/68	1.57×10^{-5}	3.29×10^{-4}	7.17×10^{-6}
05/68	1.09×10^{-5}	8.85×10^{-5}	4.00×10^{-6}
06/68	1.10×10^{-5}	9.85×10^{-5}	4.32×10^{-6}

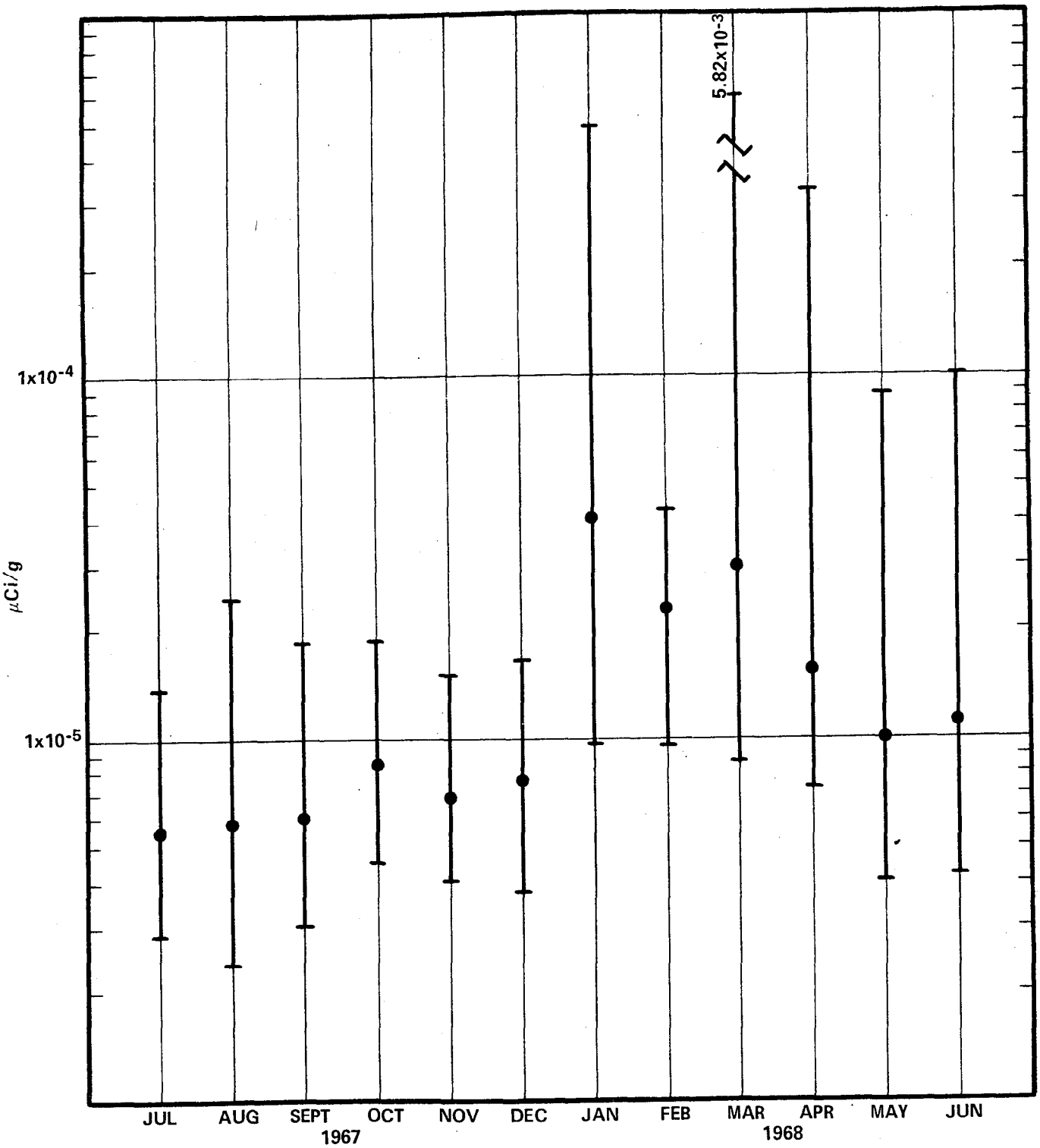

Fig. 29 Monthly Means and Ranges of Gross Gamma Radioactivity at NTS Vegetation Sampling Locations from July, 1967 through June, 1968

TABLE 23

MEANS AND RANGES OF GROSS GAMMA RADIOACTIVITY
AT NTS VEGETATION SAMPLING LOCATIONS
FROM JULY, 1967 THROUGH JUNE, 1968

(Values in terms of μCi/gm)

STATION NUMBER AND LOCATION	MEAN	RANGE	
		MAXIMUM	MINIMUM
1. Area 2 Orange Road Stake 63-64	1.24×10^{-5}	9.85×10^{-5}	3.96×10^{-6}
2. Area 5 Old Fallout Station	7.77×10^{-6}	1.15×10^{-5}	4.60×10^{-6}
3. Area 11 Stake 11 W-4	1.47×10^{-5}	6.87×10^{-5}	7.03×10^{-6}
4. Area 12 Campsite	1.42×10^{-5}	1.07×10^{-4}	4.62×10^{-6}
5. Area 12 ESSA Station	1.01×10^{-5}	6.47×10^{-5}	2.33×10^{-6}
6. Area 14 Saddle Mtn. Road Barricade	1.41×10^{-5}	4.90×10^{-4}	3.74×10^{-6}
7. Area 15 N.E. of USPHS Farm	8.86×10^{-6}	3.15×10^{-5}	4.11×10^{-6}
8. Area 16 Campsite	1.17×10^{-5}	3.72×10^{-5}	4.66×10^{-6}
9. Area 18 Stake 18 B-16	1.26×10^{-5}	1.24×10^{-4}	3.63×10^{-6}
10. Area 19 Stake 19 F-13	3.03×10^{-5}	5.82×10^{-3}	4.57×10^{-6}
11. Area 20 Stake 20 L-12	1.66×10^{-5}	9.97×10^{-5}	5.24×10^{-6}
12. Area 23 Pistol Range Rd.	7.50×10^{-6}	2.10×10^{-5}	3.81×10^{-6}
13. Area 28 Pan Am Stake 152	6.45×10^{-6}	1.84×10^{-5}	2.83×10^{-6}
14. Area 28 Project HENRE Site	8.47×10^{-6}	1.55×10^{-4}	3.00×10^{-6}
15. Area 29 Shoshone Mtn.	8.27×10^{-6}	3.31×10^{-5}	3.74×10^{-6}
16. Area 51 South of Groom Lake	1.23×10^{-5}	4.18×10^{-5}	4.07×10^{-6}

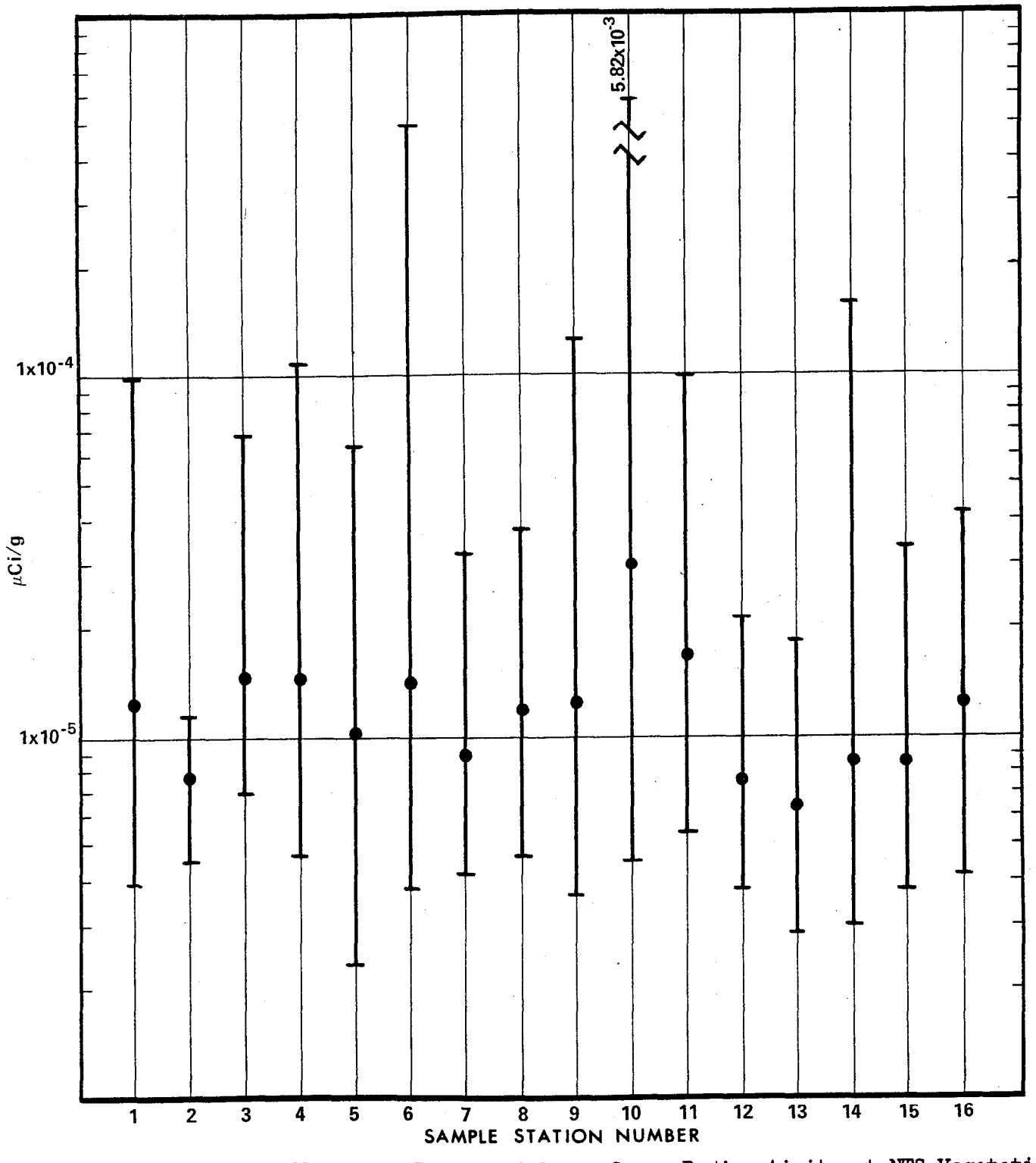

Fig. 30 Means and Ranges of Gross Gamma Radioactivity at NTS Vegetation Sampling Locations from July, 1967 through June, 1968

TABLE 24

ENVIRONMENTAL SURVEILLANCE
SOIL SAMPLING LOCATIONS

AREA	SAMPLE STATION LOCATION	MAP CODE FOR FIGURE 28
2	Orange Road Stake 63-64	2a
5	Old Fallout Station	5a
11	Stake 11 W-4	11a
12	Campsite	12a
	ESSA Station	12b
14	Saddle Mtn. Road Barricade	14a
15	N.E. of USPHS Farm	15a
16	Campsite	16a
18	Stake 18 B-16	18a
19	Stake 19 F-13	19a
20	Stake 20 L-12	20a
23	Pistol Range Road	23a
28	Pan Am Stake 152	28a
	Project HENRE Site	28b
29	Shoshone Mtn. Barricade	29a
51	South of Groom Lake	51a

TABLE 25

MONTHLY MEANS AND RANGES OF GROSS GAMMA RADIOACTIVITY
IN NTS SOIL SAMPLES
FROM JULY, 1967 THROUGH JUNE, 1968

(Values in terms of $\mu Ci/gm$)

DATE (Monthly)	MEAN	RANGE	
		MAXIMUM	MINIMUM
07/67	1.38×10^{-5}	9.13×10^{-5}	2.45×10^{-6}
08/67	1.40×10^{-5}	4.86×10^{-5}	2.75×10^{-6}
09/67	1.28×10^{-5}	4.84×10^{-5}	3.66×10^{-6}
10/67	1.72×10^{-5}	4.40×10^{-5}	1.03×10^{-5}
11/67	1.39×10^{-5}	4.22×10^{-5}	4.40×10^{-6}
12/67	1.56×10^{-5}	1.26×10^{-4}	5.45×10^{-6}
01/68	1.21×10^{-5}	4.21×10^{-5}	2.30×10^{-6}
02/68	1.16×10^{-5}	3.92×10^{-5}	2.94×10^{-6}
03/68	1.75×10^{-5}	8.32×10^{-5}	4.73×10^{-6}
04/68	1.47×10^{-5}	5.30×10^{-5}	4.02×10^{-6}
05/68	1.66×10^{-5}	5.60×10^{-5}	5.08×10^{-6}
06/68	1.46×10^{-5}	9.00×10^{-5}	1.85×10^{-6}

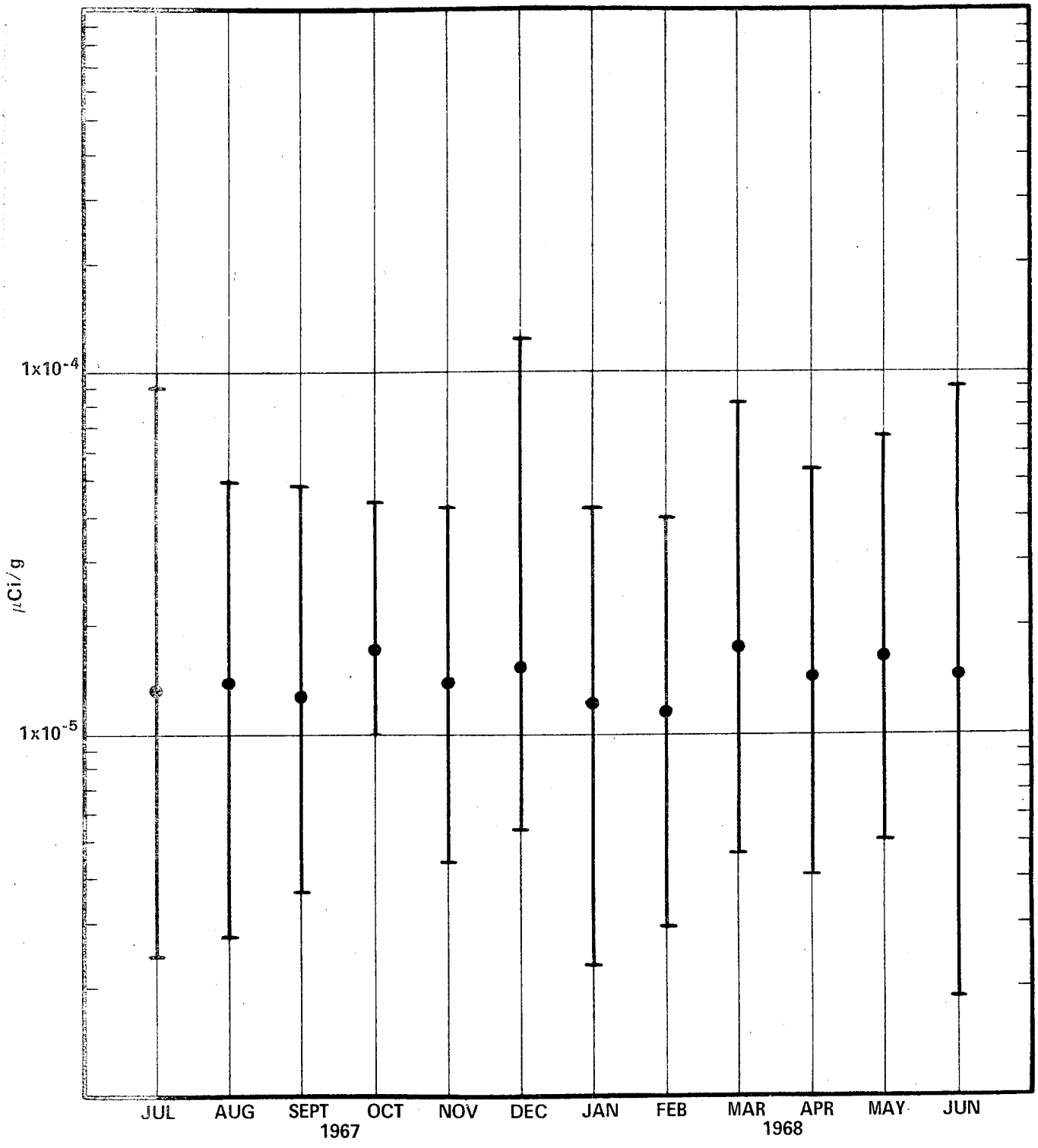

Fig. 31 Monthly Means and Ranges of Gross Gamma Radioactivity in NTS Soil Samples from July, 1967 through June, 1968

TABLE 26

MEANS AND RANGES OF GROSS GAMMA RADIOACTIVITY
AT NTS SOIL SAMPLING LOCATIONS
FROM JULY, 1967 THROUGH JUNE, 1968

(Values in terms of μCi/gm)

STATION NUMBER AND LOCATION	MEAN	RANGE	
		MAXIMUM	MINIMUM
1. Area 2 Orange Road Stake 63-64	1.78×10^{-5}	5.30×10^{-5}	6.68×10^{-6}
2. Area 5 Old Fallout Station	3.53×10^{-5}	1.26×10^{-4}	6.06×10^{-6}
3. Area 11 Stake 11 W-4	1.34×10^{-5}	1.60×10^{-5}	1.03×10^{-5}
4. Area 12 Campsite	1.51×10^{-5}	3.40×10^{-5}	9.93×10^{-6}
5. Area 12 ESSA Station	3.32×10^{-5}	5.03×10^{-5}	1.85×10^{-5}
6. Area 14 Saddle Mtn. Rd.	1.17×10^{-5}	1.51×10^{-5}	8.41×10^{-6}
7. Area 15 N.E. of USPHS Farm	3.14×10^{-5}	9.13×10^{-5}	1.37×10^{-5}
8. Area 16 Campsite	1.08×10^{-5}	3.10×10^{-5}	7.71×10^{-6}
9. Area 18 Stake 18 B-16	1.69×10^{-5}	3.38×10^{-5}	1.18×10^{-5}
10. Area 19 Stake 19 F-13	2.35×10^{-5}	8.32×10^{-5}	1.03×10^{-5}
11. Area 20 Stake 20 L-12	1.14×10^{-5}	1.92×10^{-5}	2.45×10^{-6}
12. Area 23 Pistol Range Rd.	3.62×10^{-6}	5.45×10^{-6}	1.85×10^{-6}
13. Area 28 Pan Am Stake 152	7.05×10^{-6}	9.27×10^{-6}	3.55×10^{-6}
14. Area 28 Project HENRE Site	9.25×10^{-6}	1.15×10^{-5}	6.29×10^{-6}
15. Area 29 Shoshone Mtn.	1.20×10^{-5}	1.34×10^{-5}	9.64×10^{-6}
16. Area 51 South of Groom Lake	1.15×10^{-5}	1.51×10^{-5}	9.08×10^{-6}

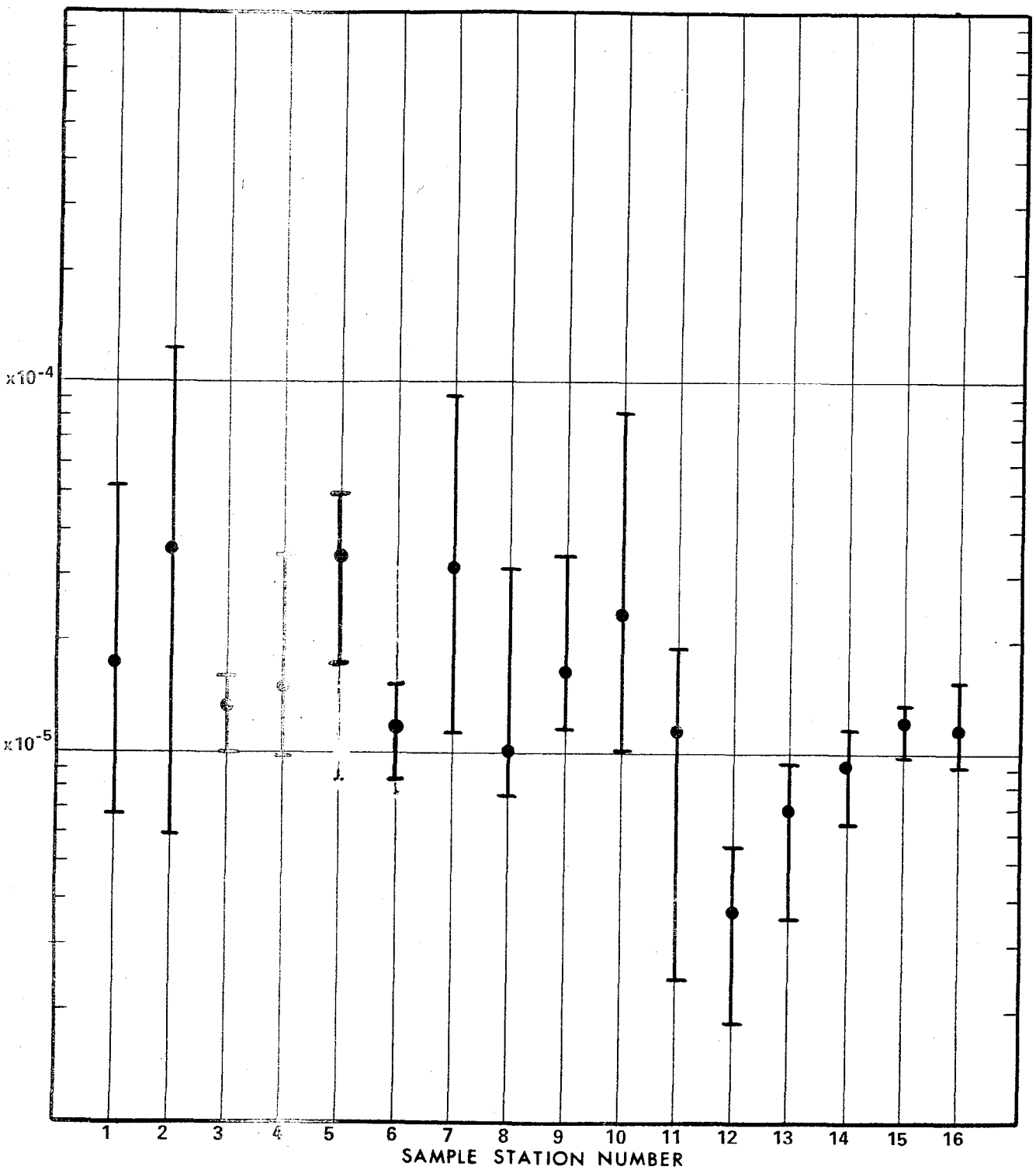

Fig. 32 Means and Ranges of Gross Gamma Radioactivity at NTS Soil Sampling Locations from July, 1967 through June, 1968

APPENDIX A

STATISTICAL TREATMENT OF DATA

A. 1 Geometric Mean

The frequency distribution of radioactivity results for air and water samples indicated a positive skew, a degree of distortion from symmetry of a normal curve. This type of asymmetrical distribution is caused by the extremes in the higher values distorting the curve towards the right.

The data must therefore be handled by logarithmic transformation to obtain normality, and treated as normally distributed random variables.

Hence, an estimate of the true mean of a sample type is calculated by:

$$\overline{X} = \log^{-1} \left[\frac{\sum \log X_i}{N} + \frac{S^2}{2} \right]$$

where: X_i = observed value
N = number of observations
S^2 = variance of log value

Though the geometric mean is not widely known and is relatively tedious to compute, its relative advantage is that it is a more typical average than the arithmetic mean since it is less affected by extremes.

A. 2 Radioactivity of a Sample

The radioactivity of a sample (X) is indicated in the equation:

$$X = \frac{R_s - R_b}{A \ B \ C}$$

where: R_s = gross count rate of sample, c/m
R_b = background count rate, c/m
A = counting efficiency for a particular counter (cpm/dpm)
B = conversion factor (2.22 dpm / pCi or 2.22×10^6 dpm / μCi)
C = subsample amount, cc, liter, or gram

The associated percent counting error at the 2-sigma confidence level ($\%E_{2\sigma}$) for each radioactivity value (X) was:

$$\%E_{2\sigma} = \frac{100Z}{R_s - R_b}\left[\frac{R_s}{T_s} + \frac{R_b}{T_b}\right]^{1/2}$$

where: Z = 2, the number of standard deviations for the confidence interval (95.4%)

T_s = sample count interval, minutes

T_b = background count interval, minutes

The radioactivity of a sample was considered statistically significant if the net count rate of the sample was greater than the detection limit, i.e., two times the net count for which the 2-sigma error was 100 percent.

The detection limit was computed by formula:

$$DL = \frac{2Z}{A\ B\ C}\left[\frac{d + R_b}{T_s} + \frac{R_b}{T_b}\right]^{1/2}$$

where: d = net count rate for which the 2-sigma error is 100.

Any activity value which was equal to or less than the detection limit was recorded as zero.

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