GENERAL ATOMICS'

FINAL RADIOLOGICAL SURVEY REPORT

FOR THE LINAC NORTH LAND AREA

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Introduction

General Atomics (GA) is continuing its efforts directed at decontaminating, as appropriate, and obtaining the release to unrestricted use of selected facilities and land areas at General Atomics. GA has recently completed the Final Radiological Survey of the LINAC North Land Area located northeast of the Building 30/31 LINAC complex on GA's Main Site. The LINAC North Land Area surrounds Buildings 31-1 and 31-2 and includes the site where Building 31-3 was located. Buildings 31-1 and 31-2 have been released to unrestricted use by the NRC and the State of California. Building 31-3 was dismantled and disposed of as radioactive waste. The total land area to be released to unrestricted use is approximately 26,000 ft^2 (~2,400 m^2).

Elevated radiation levels and elevated U-235 concentrations in the soil were identified in several locations within the LINAC North Land Area including the soil outside (and West) of Building 31-2 and two areas adjacent to the former site of Building 31-3. Uranium isotopic analyses performed by an outside laboratory confirmed enriched uranium contamination (results ranged from 44-60% U-235 enrichment). Contaminated soil was removed until radiation levels and soil samples demonstrated that radiation levels and uranium concentrations were below the approved NRC and State release criteria.

GA is requesting both the Nuclear Regulatory Commission (NRC) and the State of California (DOHS/RHB) to release this parcel of land to unrestricted use.

This report documents the results of GA's radiological measurements and soil sampling and analyses completed on the LINAC North Land Area. The results of these surveys and analyses demonstrate that this land area meets the NRC and State approved criteria for release to unrestricted use.

Site Description

The LINAC North Land Area is located on General Atomics' Main Site as shown in Figure 1A. The location of the LINAC North Land Area in relation to other facilities at GA's Main Site is shown in Figure 1B. A diagram of the open LINAC North Land Area to be released to unrestricted use is shown in Figure 2.

The LINAC North Land Area is located northeast of the Building 30/31 LINAC complex. The LINAC North Land Area surrounds Buildings 31-1 and 31-2 and includes the site where Building 31-3 was located. Buildings 31-1 and 31-2 have been released to unrestricted use by the NRC and the State of California. Building 31-3 was dismantled and disposed of as radioactive waste. See Figure 2 for the boundary of LINAC North Land Area.

Following the dismantling of Building 31-3 (which included the removal and disposal of the concrete pad), GA performed a Final Survey on the soil. In August 1999, the NRC also collected soil samples in this location. NRC Inspection Report 99-01 which documents the results of the NRC survey is provided in Appendix D.

This report does not include sewer systems which will be addressed in a future report, but does include a buried Beam Tube (from the former Building 30/31 LINAC facility's room 128) that traverses the Non-Impacted Area between Building 30 and Building 31-2.

In addition to the final surveys conducted on the LINAC North Land boundary, surveys were taken on the hillside north of the boundary in apparent drainage areas. This hillside is not part of the LINAC North Land Area (it is part of the Torrey Pines North Land Area) and is not being requested to be released at this time. The data was collected in order to determine if soil contamination was present in the drainage areas from LINAC North Land Area.

Criteria for Release to Unrestricted Use

The primary radionuclide of concern for this area is enriched uranium (up to 93% enriched with U-235) which was used in Buildings 31-1, 31-2, and 31-3. Although other radioactive materials were used in these buildings (including thorium, mixed fission products and mixed activation products), the soil was contaminated *only* with enriched uranium.

Facilities and Equipment (and Asphalt or Concrete Surfaces)

The U.S. NRC's and the State of California's criteria for releasing facilities and equipment to unrestricted use are shown in Tables 1 and 2, respectively. The applicable guidelines for enriched uranium (and beta/gamma emitters including Cs-137 and Co-60) are as follows:

5,000 dpm/100 cm^2, averaged over a 1 m^2 area
15,000 dpm/100 cm^2, maximum in a 100 cm^2 area if the average over 1 m^2 is met
1,000 dpm/100 cm^2, removable activity

Soil Release Criteria

The predominant and other radionuclides found in the soil at GA and the approved release criteria in pCi/g (above natural background concentrations) for these radionuclides are provided as follows:

Enriched Uranium (U-234 + U-235)	30 pCi/g
Thorium (Th-228 + Th-232)	10 pCi/g
Depleted Uranium	35 pCi/g
Cs-137	15 pCi/g
Co-60	8 pCi/g

If more than one radionuclide exists, the sum of the fractions of the concentrations is calculated as follows:

$$\sum_{i=1}^{n} \frac{C_i}{L_i} = <1$$

Where: C_i = The average concentration levels of radionuclide *i* in the sample (above background).
L_i = The release criteria for radionuclide *i*.

Exposure Rate Guideline

Exposure rates measured at 1 m above the surface are not to exceed 10 μR/hr above natural background levels.

Instrumentation and Background Measurements

A list of instruments used during the radiological surveys is shown in Table 3. The table includes: (1) a description of the instrument, model number and its serial number, (2) a description of the detector (if applicable) and its serial number, (3) instrument ranges, (4) calibration due dates, (5) typical background readings and (6) calibration efficiencies (if applicable). All of the instruments used were calibrated semiannually and after repair, except for exposure rate meters which were calibrated quarterly.

Background Measurements for Instruments/Detectors

Building 13 on GA's main site was used for conducting background measurements with instruments used for the final survey because: (1) there is no history involving radioactive materials or storage of radioactive materials in Building 13, and (2) the various surfaces and construction materials found at the LINAC North Land Area could also be found within and outside of Building 13. Background information, where appropriate, is included in Table 3.

Minimum detectable activities (MDA's) for instruments used for fixed measurements, for each

Minimum detectable activities (MDA's) for instruments used for fixed measurements, for each type of surface (see Table 3), were calculated using equation (5-2) from the NUREG/CR-5849 as shown below:

Equation (5-2)

$$MDA = \frac{2.71 + 4.65\sqrt{B_R \times t}}{t \times E \times \frac{A}{100}} (dpm/100cm^2)$$

Where:

B_R =background rate (cpm)
t = count time (min)
E = efficiency
A = area of the detector (cm^2)

Background Soil Concentrations of Concern

Typical background concentrations measured by gamma spectroscopy in soil near the GA site have been established (at the 95% confidence level) and are provided in Table 4 along with the locations where these samples were taken.

Exposure Rate Background

Typical exposure rate background for GA's site using a Ludlum Model 19 micro R meter is 12-18 μR/hr measured at 1 m from the surface of soil. This range of exposure rates can be measured south of Building 15 (an office building on the eastern portion of the GA site). Measurements taken offsite in 10 different locations (9 offsite and 1 onsite at a non-impacted area near Building 15) over a period of 15 months also averaged ~ 15 μR/hr (measured at 1 m from the surface). The range of 12-18 μR/hr is typical at the GA site for the external dose rates measured at 1 meter above the surface. Background measurements @ 1 m above asphalt surfaces are generally higher due to the higher concentrations of naturally occurring radioactive material (NORM). This background fluctuates depending upon the asphalt batch used and the date applied.

Previous Activities (History of Use) & Classification

Building 31-1

Building 31-1 was constructed in the late 1950's to support experimental reactor activities conducted in Building 31-2. This building was used to perform chemical separation activities and the storage of enriched (up to 93%) uranium. Building 31-1 was released to unrestricted use

by the NRC on December 22, 1999 (license amendment #63) and the State of California on January 21, 2000 (license amendment #141).

Building 31-2

Building 31-2 was constructed in the late 1950's to perform various experimental reactor activities. This building was released to unrestricted use by the NRC on August 18, 1992 (license amendment #22) and by the State of California on August 24, 1992 (license amendment #106).

Building 31-3

Building 31-3 was a small metal storage building constructed in the early 1960's and used for the assembly of thermionics fuel elements and fast reactor fuel elements. In the 1960's and 1970's, enriched uranium (~20%) was machined for critical test assemblies. In the 1980's, the building was used for the storage of packaged radioactive material. This building was constructed on a concrete slab with corrugated steel panel walls and roof. Initial surveys conducted in this building identified contamination on the walls and concrete floor. Due to the difficulty in decontaminating these surfaces, the building was dismantled and disposed of as radioactive waste.

Land Area

The area located north of Building 31-2 was used to store radioactive waste packages (boxes and drum) awaiting shipment to a low-level radioactive waste site. No radioactive contamination was expected from this activity.

Survey Classification

This parcel of land was divided into four (4) different survey classifications as shown in Figure 3. The classifications were established based upon the previous history of use of the land, the previous history of use of Buildings 31-1, 31-2 and 31-3, the radionuclides of concern for this land area, and the potential for contamination.

A large portion of the LINAC North Land Area was classified as "Non-Impacted". This Non-Impacted Area had no history of use involving radioactive material. The portion of land which begins north of Building 25 to Building 31-1 was classified as an "Unaffected Area" because there was no history of use involving radioactive materials, however, the land potentially could be contaminated as a result of activities conducted in nearby buildings so surveys were performed to demonstrate that the area was not contaminated. The portion of land directly adjacent to Building 31-2 and the land previously occupied by Building 31-3 were classified as "Non-Suspect Affected Areas" because radioactive contamination was possible due to the

activities inside the buildings and the storage of radiative materials outside of Building 31-2. A portion of this area was re-classified as a "Suspect Affected Area" after soil contamination and fixed contamination levels on concrete were found to exceed the release criteria. Additional surveying (as required for "suspect affected areas") was performed after remediation.

Decontamination Activities

Asphalt was removed from the area north of Building 31-2 to allow soil sampling and remediation. Concrete surfaces were scabbled in areas where radioactivity was found. The shaded areas shown on Figures 16 and 19 approximates the areas of remediation. Approximately 1,152 ft^3 of contaminated material (mostly soil) was removed. The total weight of material removed was ~ 67,480 pounds. This material was packaged into 9 standard metal low specific activity (LSA) radioactive waste boxes.

Building 31-3 Site

Following the dismantling and removal of Building 31-3, GA conducted a Final Survey on the land area which had been occupied by this building. Contaminated soil above the release criteria for enriched uranium (based on the U-235 concentration) was detected in a few soil samples analyzed by gamma spectroscopy in the Health Physics Lab. Uranium isotopic analyses performed by an outside laboratory on one of the contaminated soil samples confirmed that the contaminate enriched uranium (enriched to ~ 60% U-235). The U-234:U-235 ratio was measured to be 26:1. GA removed the contaminated soil and disposed of it as radioactive waste. The uranium isotopic results and the enrichment calculations are provided in Appendix C.

In August 1999, the NRC performed a confirmatory survey including the collection of soil samples. The GA analysis and the NRC analysis of the soil samples collected by the NRC (and counted by both GA and the NRC) were in agreement. NRC Inspection Report 99-01 which documents the results of the NRC survey is provided in Appendix D. Additional review and auditing of GA's soil sample data resulted in the identification of one additional area needing remediation. Decontamination was performed and additional soil samples were taken. The results demonstrated that the release criteria were met. The areas remediated are shown in Figure 19.

Outside Building 31-1

While scanning the concrete outside Building 31-1 for beta contamination, elevated radiation levels (~6,000 cpm) were noted in a small area of concrete (< 0.3 m^2) on the northwest concrete pad north of Building 31-1. A sample of concrete was collected and analyzed by gamma

spectroscopy. The results indicated Co-60 contamination. Fixed beta measurements showed activity levels were below the Co-60 release limit (all measurements $\leq$3,220 dpm/100 cm^2) . No alpha contamination was identified. See Figures 21, 22 and 25. The section of concrete (< 1m^2) was removed in order to access and sample the soil underneath. A soil sample was collected and analyzed by gamma spectroscopy. The results showed only trace concentrations of Cs-137 (0.14 ± 0.06 pCi/g); no Co-60 was detected (see Table 6). The U-235 concentration was not discernable from normal background levels. The section of concrete will be either re-surveyed and/or decontaminated for release to unrestricted use (if the levels are verified to be below the applicable release criteria) or will be disposed of as radioactive waste.

Outside Building 31-2

Elevated radiation levels were also found in the hillside area outside and immediately west of Building 31-2. Soil samples were taken and analyzed by gamma spectroscopy. Elevated levels of U-235 were identified. Uranium isotopic analyses performed by an outside laboratory on one of the contaminated soil samples identified the contaminate as enriched uranium (enriched to ~ 44-45% U-235). The U-234:U-235 ratio was measured to be 26:1. These results are provided in Appendix C. GA removed soil until soil concentrations demonstrated that the levels were below the approved release criteria. The contaminated soil was disposed of as low-level radioactive waste. The area remediated is the shaded area shown on Figure 16.

A few other localized areas of contamination were identified north of Building 31-2 which were also remediated (see Figures 16, 21 and 22).

Hillside Drainage Area

In addition to the surveys conducted on the LINAC North Land boundary, surveys were taken in drainage areas north of the LINAC North Land Area boundary. The hillside is not part of the LINAC North Land Area and is not being requested to be released at this time. (This hillside is part of the Torrey Pines North Land Area). The data was collected in order to determine if soil contamination was present in the drainage areas from LINAC North Land Area. U-235 concentrations were found to be above background levels in some of the soil samples. One sample result measured 98% of the approved soil release criteria for enriched uranium (based on the U-235 concentration). This area was remediated and additional samples taken. Figure 16 shows the approximate location where the contaminated soil was found and remediated.

The surveys conducted on the hillside drainage area (following remediation) consisted of collecting and analyzing 38 surface (0-6") soil samples and 35 fixed exposure rate measurements as well as a 100% surface scan of the drainage area. The results, which demonstrate that the

release criteria are met, are provided in this report. They will also be provided in the Torrey Pines North Land Area report to be completed sometime in the future.

Final Surveys Performed

Objectives and Responsibilities

The objectives of the final survey plans were: (1) to demonstrate that the average surface contamination levels for each survey unit were below the approved release criteria, (2) to show that the maximum residual activity did not exceed three times the approved release criteria for average surface contamination value in an area up to 100 cm^2, (3) to demonstrate soil sample results at the surface were well below GA's approved release criteria for unrestricted use, and, (2) that the exposure rate measurements taken in these areas, measured at 1 meter above the surface, were less than 10 μR/hr above background.

Survey Plans

Final Survey Plans were developed based on the previous history of the adjacent Buildings, the LINAC North Land Area site, the radionuclides of concern for this area, the potential for contamination, the various types of surfaces encountered and the classification of the various areas. See Appendix A for the Final Survey Plans prepared for the LINAC North Land Area.

Surveys were taken in accordance with an approved survey plan(s) by qualified Health Physics Technicians having a minimum of three years health physics experience. Soil samples were counted in GA's Health Physics Laboratory which maintains an effective QA program.

Every survey taken was documented on a daily basis to a worksheet/drawing showing the approximate locations surveyed/sampled. The documentation included the results of the measurements (including units), the technician's signature, date, instrument(s) used (including the model and serial number of both the ratemeter and detector), calibration due date, % efficiency, background readings (if applicable) and any other pertinent information.

Soil Sampling

Soil samples were collected in approximate locations as indicated on Figures 4, 10, 16, 19, 25 and 26.

Each soil sample collected was properly logged, sealed, labeled, packaged and tracked. The sampling locations were documented on a drawing. Each of the soil samples taken was approximately 1 kilogram in mass. The samples were properly logged, labeled, tracked and

packaged into plastic bags. All debris (i.e., grass, rocks, sticks, asphalt and foreign objects) was removed from each sample. Each soil sample was individually crushed to reduce large lumps, dried, placed into tared marinelli beakers (filled to the top), weighed, sealed and transported to GA's Health Physics Laboratory where they were analyzed using a Gamma Spectroscopy System which uses a high purity germanium detector. The system is calibrated using NIST traceable standards and performance checked daily. Soil samples were counted for a minimum of 30 minutes each. A 30 minute count was sufficient to detect the radionuclides of concern at levels below GA's approved soil release criteria.

Survey Summary

Comparisons of the Site Decommissioning Plan requirements with the Final Surveys performed in relation to the percentage of surface area scanned, number of measurements (i.e., number of fixed radiation measurements), exposure rate measurements (μR/hr) and soil samples taken are provided as follows:

Comparisons of Site Decommissioning Plan Requirements with Final Surveys Performed on the LINAC North Land Open Land Areas

Survey Area*	Gridding Required ?	# of Direct Measurements Fixed α, β, or Swipes on Concrete or Asphalt	# of Exposure Rate Measurements (μR/hr)	Surface Scans on Asphalt or Concrete	# of Soil Samples Taken and Analyzed
D- Plan** Non-Impacted Area	No	Not Required	Not Required	Not Required	Not Required
Final Surveys Non-Impacted Area	No	None Taken	23 contact and 23 at 1 meter	None Taken	5 Surface (0-6") soil samples
D-Plan** Unaffected Area	No	1 per 50 m^2 or 1 every ~ 7 m (6 measurements)	1 per 10 m^2 or 1 per ~ 3 m (28 measurements)	10% of asphalt or concrete surfaces	Not Required
Final Surveys Unaffected Area	No	9 Fixed α 9 Fixed β & 8 Swipes (26 measurements)	1 per 10 m^2 or 1 per ~ 3 m (116 measurements and plus 25% scan)	10% of asphalt or concrete surfaces	49 surface (0-6") soil samples taken
D-Plan** Non-Suspect Affected Area	No	1 per 50 m^2 or 1 every ~ 7 m	1 per 10 m^2 or 1 per ~ 3 m (17 measurements)	10% of asphalt or concrete surfaces	Not Required
Final Surveys Non-Suspect Affected Areas	No	9 Fixed α 9 Fixed β & 10 Swipes	1 per 10 m^2 or 1 per ~ 3 m (26 measurements and 100% scan)	100% of asphalt or concrete surfaces	5 surface (0-6") soil samples taken
D- Plan** Suspect Affected Area	Yes	1 every 4m^2 (1 measurement)	1 per 4 m^2 or 1 every 2m (12 measurements)	100% of asphalt or concrete surfaces	5 soil samples based on a 5m triangular grid
Final Surveys Suspect Affected Areas	Yes 1m x 1m grids	7 fixed α 6 fixed β & 6 swipe (19 measurements)	131 measurements plus 100% scan	100% of asphalt or concrete surfaces	161 samples taken (142 surface & 19 subsurface)

* The total surface area to be released is approximately 2,400 m^2. The "Non-Impacted Area" is approximately 1,400 m^2, the"Unaffected Area" is approximately 664 m^2, the "Non-Suspect Affected Area" is approximately 96 m^2, and the "Suspect Affected Area" is approximately 240 m^2.

** D-Plan = GA Site Decommissioning Plan

In addition to the final surveys conducted on the LINAC North Land boundary, surveys were taken on the hillside north of the boundary in apparent drainage areas. The hillside is not part of the LINAC North Land Area (it is part of the Torrey Pines North Land Area) and is not being requested to be released at this time. The data was collected in order to determine if soil contamination was present in the drainage areas from LINAC North Land Area. U-235 concentrations were found to be above background levels in some of the soil samples. One soil sample contained enriched uranium (~98% of the approved soil release criteria for enriched uranium). This area was remediated and re-sampled. The samples were all well below the approved release criteria. The surveys on the hillside drainage area (following remediation) consisted 38 surface (0-6") soil samples, and 35 fixed exposure rate measurements plus 100% surface scan of the drainage area.

Results of the Final Surveys for LINAC North Land Area

The results of the LINAC North Land Area Final Surveys are provided in figures and tables as noted below:

Scanning

About 10% of the asphalt and concrete surfaces in "unaffected areas" and 100% of the asphalt and concrete surfaces in "non-suspect affected" and "suspect affected areas" were scanned for alpha and beta radioactivity. The results of these scans are provided in Figures 5, 11 and 20 (for α) and Figures 7, 12 and 21 (for β). All areas with elevated radioactivity were investigated, and if found to be over the limits, were remediated.

Fixed Measurements (α and β)

There were 25 fixed α and 24 fixed β, measurements taken. All results (after any required remediation) were well below the release criteria. See Figures 6, 13, and 22 for approximate α and β measurement locations and results.

Removable Activity

A total of 24 wipe measurements were taken and analyzed for α and β activity. The highest α activity was <10 dpm/100 cm^2, the highest β activity was <10 dpm/100 cm^2. These results are far below the approved release criteria. See Table 5 for results and Figures 6, 13 and 22 for appropriate sample locations.

Soil Samples

A total of 220 soil samples, including the hillside drainage areas, were collected from the exposed ground areas. The approximate soil sample locations are shown in Figures 4, 10, 16, 19, 25 and 26. Gamma spectroscopy results are provided for these samples in Table 6. The isotopic results (pCi/g) indicated that ^{238}U, ^{235}U, ^{137}Cs, and ^{60}Co were detected in some of the soil samples, but the levels were all well below the approved soil release criteria as summarized below.

	^{238}U in pCi/g	^{235}U in pCi/g	^{137}Cs in pCi/g	^{228}Th in pCi/g	^{232}Th in pCi/g	^{60}Co in pCi/g
High	5.01	0.62	0.35	3.23	3.54	0.06
Low	ND	0.11	ND	0.99	1.37	ND
Average	1.95	0.28	0.04	1.79	2.29	0.0006
Nominal Background	2.26	0.18	0.09	1.28	1.72	ND

Notes:

1. ND means not detected, <0.1 pCi/g Cs-137, <0.1 pCi/g Co-60, <3.0 pCi/g U-238, <0.3 pCi/g U-235.
2. The "high" concentrations for each isotope did not occur in the same sample. No sample had a sum of fractions greater than 1.0.

Three (3) soil samples were sent to an independent laboratory (Quanterra) for uranium isotopic analyses. From these results, the U-234:U-235 ratio and the approximate U-235 enrichment was calculated. For two (2) samples collected along the hillside west of Building 31-2, the U-234:U-235 ratio was calculated to be 24:1 and enrichment was ~ 45%. For a soil sample collected near the former Building 31-3 location, the U-234:U-235 ratio was calculated to be 26:1 and the enrichment was ~60% (see Appendix C).

The highest U-235 result was detected in a surface (0-6") soil sample collected at location #72 which measured 0.62 pCi/g (see Table 6). The total enriched uranium calculated using this value is 23 pCi/g which is ~77% of the 30 pCi/g enriched uranium limit. The subsurface (6"-12") soil sample result (sample # 72A on Figure 16), at this location was 0.38 pCi/g (see Figure 16 and Table 6).

Thorium contamination was not present (as determined by process knowledge and gamma spectroscopy analyses of soil samples). All thorium results were at, or near, background levels and well below the release limit of 10 pCi/g.

The activation product, ^{60}Co was detected in trace concentrations in 2 out of 200 soil samples. Both results were 0.06 pCi/g, which is, far below the release limit of 8.0 pCi/g.

In a few of the soil samples, trace concentrations of the fission product ^{137}Cs was identified. The maximum concentration detected in the soil was 0.35 pCi/g, well below the release limit of 15 pCi/g.

Exposure Rate Scans

Exposure rate scans were performed in 25% of accessible unaffected area surfaces using a NaI(Tl) detector held approximately 1" from the surface. The results ranged from 10-30 μR/hr. Approximately 100% of the affected area surface was scanned (approximately 1" from the surface) with a NaI(Tl) detector. The exposure rate ranged from 17-29 μR/hr. See Figures 8, 14, 17 and 23 for scan results.

Fixed Exposure Rate Measurements

Direct radiation levels were measured at 1 m from the surface at about 301 locations using a 2"x2" NaI(Tl) detector. The maximum result was 27 μR/hr, which is less than 10 μR/hr above background (~12-18 μR/hr at 1 m). Thus, all readings were less than the approved release criteria. See Figures 4, 9, 15, 18 and 24 for locations and results.

Beam Tube Survey

There is a beam tube that originates at Building 31, traverses (underground) the non-impacted area between Building 30 and Building 31-2, and terminates at a hillside west of Building 31-2. Approximately 7.5 m of the internal surface of this tube was surveyed with a NaI(Tl) detector from the Building 31 opening, and 5.5 m of the internal surface from the Building 31-2 opening was surveyed. The exposure rates decreased the further the detector was placed into the tube. The exposure rates were initially about ~19 μR/hr and decreased to ~ 7-8 μR/hr at a depth of one meter at both ends of the beam tube, as shown in Figure 27.

Hillside Drainage Survey Results

In addition to the final surveys conducted on the LINAC North Land footprint, surveys were taken on the hillside north of the footprint in apparent drainage areas. The hillside is not part of the LINAC North Land Area (it is part of the Torrey Pines North Land Area) and is not being requested to be released at this time. The data was collected in order to determine if soil contamination was present in the drainage areas from LINAC North Land Area. U-235 concentrations were found to be above background levels in some of the soil samples. One

sample contained U-235 at 98% of the approved release criteria. This area was remediated and re-sampled. The subsequent soil sample results were all well below the approved release criteria. The surveys on the hillside drainage area (following remediation) consisted of ~38 surface (0-6") soil samples, and 35 fixed exposure rate measurements plus 100% surface scan of the drainage area.

Soil Sample Results

A total of thirty-nine (39) surface soil samples were collected. (See Figures 16 and 26). The highest ^{235}U concentration, (the isotope of concern in this area), was 0.62 ± 0.15 pCi/g and the sum of fractions, not subtracting background, was less than 1. The results of the thirty-eight (38) *post remediation* soil samples are provided in Table 6 (shaded results).

Exposure Rate Scan Results

Scans using an exposure rate meter (μR meter) were taken along the surface of the soil along a natural drainage channel which runs north of the LINAC North Land Area (See Figure 14). The depth of the channel varies the entire length. About 100% of this drainage channel was scanned using a NaI(Tl) detector held within ~ 1" of the soil surface. The results (shown in Figure 14) ranged from 20-27 μR/hr.

In addition, *accessible* soil surface areas along the LINAC North Land Area boundary were also scanned using a NaI(Tl) detector. The results ranged from 17-22 μR/hr (see Figure 14).

Fixed Exposure Rate Measurements

A total of thirty-five (35) fixed exposure rate measurements were taken at 1 meter from the surface. Eighteen (18) measurements were taken along the hillside (see Figure 15); the maximum reading was 20 μR/hr. Seventeen (17) measurements were taken along the drainage channel (see Figure 26); the maximum reading was 24 μR/hr.

Confirmatory Survey

Following the completion of the Final Survey, a GA Internal Confirmatory Survey was performed by a GA Health Physics Technician who was not involved with the Final Survey. The Confirmatory Survey was conducted in accordance with an approved survey plan. This survey consisted of:

(1) The collection and gamma spec analysis of five (5) surface soil samples,
(2) The taking of nine (9) fixed α measurements,

(3) The taking of ten (10) fixed β measurements,
(4) The collection of five (5) swipe surveys (analyzed for gross α and gross β activity), and
(5) The collection of twelve (12) exposure rate measurements at both contact and 1 meter from the surface.

All measurements and results were in agreement with the final survey results and all measurements were below the applicable release criteria. See Appendix B for the Survey Plan and the results of the survey.

Conclusion

Final contamination and radiation surveys, as well as the results of analyses of soil samples, as documented in this report, demonstrate that the LINAC North Land Area meets the approved criteria for release to unrestricted use.

Table 1: USNRC'S ACCEPTABLE SURFACE CONTAMINATION LEVELS [1]			
Nuclides	**Average[b,c,f] (dpm/100cm²)**	**Maximum[b,d,f] (dpm/100 cm²)**	**Removable[b,e,f] (dpm/100cm²)**
U-nat, ^{235}U, ^{238}U, & associated decay products	5,000 α	15,000 α	1,000 α
Transuranics, ^{226}Ra, ^{228}Ra, ^{230}Th, ^{228}Th, ^{231}Pa, ^{227}Ac, ^{125}I, ^{129}I	100	300	20
Th-nat, ^{232}Th, ^{90}Sr, ^{223}Ra, ^{224}Ra, ^{232}U, ^{126}I, ^{133}I, ^{131}I	1,000	3,000	200
Beta/gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except ^{90}Sr and other noted above.	5,000	15,000	1,000

a Where surface contamination by both alpha- and beta/gamma-emitting nuclides exists, the limits established for alpha- and beta/gamma-emitting nuclides should apply independently.

b As used in this table dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, an geometric factors associated with the instrumentation.

c Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

d The maximum contamination level applies to an area of not more than 100 cm^2.

e The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, then pertinent levels should be reduced proportionally and the entire surface should be wiped.

f The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mRad/hr at 1 cm^2 and 1.0 mRad/hr at 1 cm^2, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

Table 2: STATE OF CA ACCEPTABLE SURFACE CONTAMINATION LEVELS [1]

Nuclides[a]	Average[b,c,f] (dpm/100cm^2)	Maximum[b,d,f] (dpm/100cm^2)	Removable[b,e,f] (dpm/100cm^2)
U-nat, ^{235}U, ^{238}U, & associated decay products	5,000	15,000	1,000
Transuranics, ^{226}Ra, ^{228}Ra, ^{230}Th, ^{228}Th, ^{231}Pa, ^{227}Ac, ^{125}I, ^{129}I	100	300	20
Th-nat, ^{232}Th, ^{90}Sr, ^{223}Ra, ^{224}Ra, ^{232}U, ^{126}I, ^{133}I, ^{131}I	1,000	3,000	200
Beta/gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except ^{90}Sr and other noted above	5,000	15,000	1,000

a Where surface contamination by both alpha- and beta/gamma-emitting nuclides exists, the limits established for alpha- and beta/gamma-emitting nuclides should apply independently.

b As used in this table dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, an geometric factors associated with the instrumentation.

c Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

d The maximum contamination level applies to an area of not more than 100 cm ^{2}.

e The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, then pertinent levels should be reduced proportionally and the entire surface should be wiped.

f The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at 1 cm^2 and 1.0 mrad/hr at 1 cm^2, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

1 Guidelines For Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses For byproduct, Source, or Special Nuclear Material, also known as "Decon-1" incorporated into GA's State of CA Radioactive Materials License.

Table 3: LINAC North Land Area List Of Instruments

Instrument	Detector	Range (cpm)	Calibration Due Date	Efficiency	Background	Description
Ludlum Model 2221 S/N **97287**	Ludlum Model 43-37 gas proportional (434 cm^2) **Alpha detector** S/N 148926	Four Linear Ranges 0-500,000 & one Log 50-500,000	02-22-01 09-13-00	21.25% 21.25%	0-20 cpm (concrete) 0-20 cpm (asphalt)	Active Probe Area = 434 cm^2. The detector and rate meter are combined and mounted on a roll around cart. The instrument features a static-flow system, quick connects, a portable gas bottle and a means to adjust the height of the detector from the floor for optimum performance.
Ludlum Model 2221 S/N **154202**	Ludlum Model 43-37 gas proportional (434 cm^2) **Beta detector** S/N 149071	Four Linear Ranges 0-500,000 & one Log 50-500,000	04-09-01	22.72%	1600-1995 cpm (concrete) 2175-2460cpm (asphalt)	Active Probe Area = 434 cm^2. The detector and rate meter are combined and mounted on a roll around cart. The instrument features a static-flow system, quick connects, a portable gas bottle and a means to adjust the height of the detector from the floor for optimum performance.
Ludlum Model 2221 S/N **148436**	Ludlum Model 43-68 100 cm^2 proportional **Beta detector** S/N 120477	Four Linear Ranges 0-500,000 & one Log 50-500,000	12-7-00 09-26-01	27.40% 24.13%	(concrete) 933 ± 38 cp2m MDA = 268 dpm/100 cm^2 (asphalt) 1227 ± 42 cp2m MDA = 315 dpm/100 cm^2	100 cm^2 gas flow proportional counter.
Ludlum Model 19 Micro-R Meter S/N **123930**	RCA 6199 coupled to a NaI (Tl) Scintillator	Five Ranges 0-5 mR/hr	10-17-00	N/A	10-18 µR/hr	1 inch x 1 inch NaI (Tl) scintillator is mounted internally. Used for initial survey on ground floor and for measuring external dose rates on the surface and at one meter.
Ludlum Model 19 Micro-R Meter S/N **144746**	RCA 6199 coupled to a NaI (Tl) Scintillator	Five Ranges 0-5 mR/hr	07-23-99	N/A	10-18 µR/hr	1 inch x 1 inch NaI (Tl) scintillator is mounted internally. Used for initial survey on ground floor and for measuring external dose rates on the surface and at one meter.
Ludlum Model 3 S/N **153590**	Ludlum Model 44-10 NaI (Tl) Scintillator **Gamma detector** S/N 155190	Five Ranges 0-500 µR/hr	12-07-00 09-08-00	N/A	10-18 µR/hr	2 inch x 2 inch NaI (Tl) scintillator.Used for initial survey on ground floor and for measuring external dose rates on the surface and at one meter.
Ludlum Model 3 S/N **153311**	Ludlum Model 44-10 NaI (Tl) Scintillator **Gamma detector** S/N 155594	Five Ranges 0-500 µR/hr	11-10-00	N/A	10-18 µR/hr	2 inch x 2 inch NaI (Tl) scintillator.Used for initial survey on ground floor and for measuring external dose rates on the surface and at one meter.

Table 3: LINAC North Land Area List Of Instruments

Instrument	Detector	Range (cpm)	Calibration Due Date	Efficiency	Background	Description
Ludlum Model 3 S/N **147819**	Ludlum Model 44-10 NaI (Tl) Scintillator **Gamma detector** S/N 153765	Five Ranges 0-500 µR/hr	11-08-00	N/A	10-18 µR/hr	2 inch x 2 inch NaI (Tl) scintillator.Used for initial survey on ground floor and for measuring external dose rates on the surface and at one meter.
Ludlum Model 12 S/N **73924**	Ludlum Model 43-65 Alpha Scintillator ZnS(Ag) S/N 089927	Four Ranges 0-500,000	01-17-01	21.58%	0-20 cpm (all) MDA = 218 dpm/100 cm^2	Active Probe Area = 50 cm^2
Ludlum Model 12 S/N **91051**	Ludlum Model 43-65 Alpha Scintillator ZnS(Ag) S/N 094053	Four Ranges 0-500,000	04-05-01	21.58%	0-20 cpm (all) MDA = 218 dpm/100 cm^2	Active Probe Area = 50 cm^2
Ludlum Model 12 S/N **138739**	Ludlum Model 43-65 Alpha Scintillator ZnS(Ag) S/N145699	Four Ranges 0-500,000	08-31-01	21.58%	0-20 cpm (all) MDA = 218 dpm/100 cm^2	Active Probe Area = 50 cm^2
Canberra Low Level α/β Counter Model 2404	Gas Flow Proportional Detector	N/A	As needed	~26-30%	Varies with Sample	Canberra Model 2404 Low Level α/β gas proportional counting system used to count wipes for removable contamination. Results are usually reported as dpm/100 cm^2.
Canberra Gamma Spectroscopy System	High Purity Germanium Detector	N/A	As needed	Varies with Sample	Varies with Sample	Gamma Spectroscopy MCA system using a high purity Germanium detector.

Table 4 : Gamma Spectroscopy Results of Background Soil (Surface) Samples

Radionuclide Concentrations (pCi/gm) - Results ± 2σ - 30 Minute Counts

Sample ID	^{137}CS 661.6 keV peak	^{60}Co 1173 keV peak	^{228}Th 238 keV peak	^{232}Th 911 keV peak	Total Thorium ^{228}Th + ^{232}Th	^{238}U 63.3 (92.7) keV peak	^{235}U 144 (186) keV peak
X-1	ND	ND	0.71± 0.07	0.97 ± 0.25	1.69	1.17 ± 0.77	(0.13 ± 0.06)
X-2	ND	ND	0.90 ± 0.13	1.49 ± 0.31	1.49	1.91 ± 1.18	(0.13 ± 0.08)
X-3	0.06 ± 0.04	ND	1.49 ± 0.10	1.56 ± 0.25	3.05	1.45 ± 0.80	(0.23 ± 0.09)
X-4	ND	ND	1.52 ± 0.23	3.22 ± 0.61	4.74	3.74 ± 2.18	(0.28 ± 0.17)
X-5	ND	ND	1.92 ± 0.17	2.41 ± 0.53	4.33	(4.49 ± 1.64)	(0.32 ± 0.16)
X-6	ND	ND	1.02 ± 0.08	0.96 ± 0.23	1.99	1.31 ± 0.80	(0.14 ± 0.06)
X-7	0.13 ± 0.08	ND	1.59 ± 0.14	2.40 ± 0.38	3.98	2.16 ± 1.48	(0.18 ± 0.10)
X-8	ND	ND	1.44 ± 0.28	1.40 ± 0.28	2.84	2.30 ± 1.16	(0.14 ± 0.09)
X-9	0.09 ± 0.08	ND	0.89 ± 0.10	1.27 ± 0.31	2.15	1.59 ± 1.05	(0.10 ± 0.08)
X-10	ND	ND	1.29 ± 0.11	1.52 ± 0.36	2.80	1.10 ± 0.96	(0.16 ± 0.08)

Notes:

1. **Soil samples were collected on 06/05/00 and 06/06/00 By Ed Rudgers off GA's site but close to GA.**
2. **Samples were counted 7/20/00 through 7/24/00 for 30 minutes (same count as the soil samples).**
3. **ND means: < 0.1 pCi/g for Cs-137**
   < 0.1 pCi/g for Co-60

Table 5: LINAC North Land Area Swipe Survey Results		
Swipe No.	Gross α in dpm/100 cm^2	Gross β in dpm/100 cm^2
Non-Suspect Affected Area - 1	<10	<10
Non-Suspect Affected Area - 2	<10	<10
Non-Suspect Affected Area - 3	<10	<10
Non-Suspect Affected Area - 4	<10	<10
Non-Suspect Affected Area - 5	<10	<10
Non-Suspect Affected Area - 6	<10	<10
Non-Suspect Affected Area - 7	<10	<10
Non-Suspect Affected Area - 8	<10	<10
Non-Suspect Affected Area - 9	<10	<10
Suspect Affected Area - 10	<10	<10
Non-Suspect Affected Area - 11	<10	<10
Unaffected Area - 1	<10	<10
Unaffected Area - 2	<10	<10
Unaffected Area - 3	<10	<10
Unaffected Area - 4	<10	<10
Unaffected Area - 5	<10	<10
Unaffected Area. - 6	<10	<10
Unaffected Area - 7	<10	<10
Unaffected Area - 8	<10	<10
B31-1 Suspect affected Area-1	<10	<10
B31-1 Suspect affected Area-2	<10	<10
B31-1 Suspect affected Area-3	<10	<10
B31-1 Suspect affected Area-4	<10	<10
B31-1 Suspect affected Area-5	<10	<10

Table 6: LINAC North Land Area Soil Sample Results

#	Sample ID	Radionuclide Concentrations (pCi/g) *Background Not Subtracted*																
		U-238 (63Kev, 93 Kev used when 63 not present)			**U-235** (144Kev,186 Kev used when 144 not present)			**Cs-137** (662 Kev)			**Co-60** {(1170+1330) /2} Kev			**Th-228** (238 Kev)			**Th-232** (911 Kev)		
		pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g
1	LNLAS-35	2.72	30.3	0.82	0.18	59.6	0.11	ND	–	0.00	ND	–	0.00	1.67	7.4	0.12	2.16	19.4	0.42
2	LNLAS-36	2.08	67.2	1.40	0.24	44.5	0.11	ND	–	0.00	ND	–	0.00	1.64	9.6	0.16	2.08	16.4	0.34
3	LNLAS-37	1.33	69.8	0.93	0.23	43.1	0.10	0.26	37.1	0.10	ND	–	0.00	1.57	7.6	0.12	1.91	23.1	0.44
4	LNLAS-38	2.59	54.4	1.41	0.34	33.9	0.12	ND	–	0.00	ND	–	0.00	1.57	8.4	0.13	2.45	16.0	0.39
5	LNLAS-56	2.34	54.8	1.28	0.27	36.3	0.10	ND	–	0.00	ND	–	0.00	1.81	7.0	0.13	2.43	15.9	0.39
6	LNLAS-57	1.61	74.4	1.20	0.13	72.0	0.09	ND	–	0.00	ND	–	0.00	1.81	7.4	0.13	2.45	13.9	0.34
7	LNLAS-58	2.08	65.6	1.36	0.31	32.7	0.10	ND	–	0.00	0.06	90.9	0.05	1.79	7.0	0.13	2.18	15.0	0.33
8	LNLAS-59	2.93	58.5	1.71	0.32	35.9	0.11	ND	–	0.00	ND	–	0.00	2.17	7.4	0.16	2.94	16.7	0.49
9	LNLAS-60	1.21	96.2	1.16	0.33	33.0	0.11	ND	–	0.00	ND	–	0.00	1.74	8.4	0.15	2.38	16.9	0.40
10	LNLAS-61	1.45	72.9	1.06	0.40	26.5	0.11	ND	–	0.00	ND	–	0.00	1.87	7.8	0.15	2.44	20.0	0.49
11	LNLAS-62	1.50	70.2	1.05	0.40	26.3	0.11	ND	–	0.00	ND	–	0.00	1.78	7.4	0.13	2.23	15.3	0.34
12	LNLAS-63	1.98	56.6	1.12	0.20	43.3	0.09	ND	–	0.00	ND	–	0.00	1.49	8.5	0.13	2.31	18.0	0.42
13	LNLAS-64	1.45	41.2	0.60	0.30	59.6	0.18	0.11	32.6	0.04	ND	–	0.00	1.77	3.5	0.06	2.20	7.9	0.17
14	LNLAS-65	1.87	64.1	1.20	0.40	26.8	0.11	ND	–	0.00	ND	–	0.00	1.85	7.1	0.13	2.44	15.4	0.38
15	LNLAS-66	2.66	56.8	1.51	0.32	111.2	0.36	0.11	62.8	0.07	ND	–	0.00	1.77	7.2	0.13	2.26	16.1	0.36
16	LNLAS-67	1.76	61.7	1.09	0.47	83.3	0.39	ND	–	0.00	ND	–	0.00	1.89	7.0	0.13	2.41	18.9	0.46
17	LNLAS-68	3.03	53.9	1.63	0.27	43.6	0.12	ND	–	0.00	ND	–	0.00	1.92	7.8	0.15	2.39	18.9	0.45

Table 6: LINAC North Land Area Soil Sample Results

#	Sample ID	Radionuclide Concentrations (pCi/g) *Background Not Subtracted*																	
		U-238 (63, 93 Kev)			**U-235** (144,186 Kev)			**Cs-137** (662 Kev)			**Co-60** {(1170+1330) /2} Kev			**Th-228** (238 Kev)			**Th-232** (911 Kev)		
		pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g
18	LNLAS-69	1.57	70.2	1.10	0.28	33.1	0.09	ND	–	0.00	ND	–	0.00	1.42	10.8	0.15	2.14	16.9	0.36
19	LNLAS-70	1.37	90.2	1.24	0.17	52.8	0.09	ND	–	0.00	ND	–	0.00	1.48	8.2	0.12	2.24	14.5	0.32
20	LNLAS-71	1.26	89.3	1.13	0.28	37.0	0.10	ND	–	0.00	ND	–	0.00	1.77	7.7	0.14	2.18	18.8	0.41
21	LNLAS-72	1.56	89.4	1.39	0.62	61.5	0.38	0.11	74.2	0.08	ND	–	0.00	0.99	16.0	0.16	1.67	17.1	0.29
22	LNLAS-72A	1.76	31.4	0.55	0.38	49.1	0.19	0.14	28.4	0.04	ND	–	0.00	1.72	3.5	0.06	2.11	8.6	0.18
23	LNLAS-73	1.77	59.1	1.05	0.19	50.2	0.10	0.18	34.4	0.06	ND	–	0.00	1.43	7.9	0.11	2.11	15.8	0.33
24	LNLAS-74	1.10	97.3	1.07	0.18	53.4	0.10	0.21	46.3	0.10	ND	–	0.00	1.55	7.9	0.12	2.15	18.6	0.40
25	LNLAS-75	2.55	52.0	1.33	0.18	52.8	0.10	0.08	99.2	0.08	ND	–	0.00	1.59	7.7	0.12	2.24	15.5	0.35
26	LNLAS-76	1.83	60.8	1.11	0.23	36.2	0.08	0.12	46.0	0.06	ND	–	0.00	1.34	8.7	0.12	1.85	18.4	0.34
27	LNLAS-77B	1.28	84.8	1.09	0.18	36.2	0.07	ND	–	0.00	ND	–	0.00	1.59	7.3	0.12	1.82	19.4	0.35
28	LNLAS-78	1.89	72.8	1.38	0.22	49.8	0.11	0.19	37.0	0.07	ND	–	0.00	1.64	7.4	0.12	2.17	17.4	0.38
29	LNLAS-79	1.18	92.8	1.10	0.22	42.7	0.09	0.27	35.9	0.10	ND	–	0.00	1.37	8.1	0.11	1.82	17.8	0.32
30	LNLAS-80	1.16	99.5	1.15	0.18	49.9	0.09	0.21	38.5	0.08	ND	–	0.00	1.71	7.9	0.14	2.26	16.3	0.37
31	LNLAS-81	1.72	62.8	1.08	0.25	42.2	0.11	0.17	44.5	0.08	ND	–	0.00	1.65	6.7	0.11	2.38	13.9	0.33
32	LNLAS-82	1.78	71.2	1.27	0.22	32.7	0.07	ND	–	0.00	ND	–	0.00	1.71	6.5	0.11	2.20	15.0	0.33

Table 6: LINAC North Land Area Soil Sample Results

#	Sample ID	Radionuclide Concentrations (pCi/g) *Background Not Subtracted*																
		U-238 (63 Kev)			U-235 (144,186 Kev)			Cs-137 (662 Kev)			Co-60 {(1170+1330) /2} Kev			Th-228 (238 Kev)			Th-232 (911 Kev)		
		pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g
33	LNLAS-82A	2.81	60.7	1.71	0.18	49.5	0.09	ND	–	0.00	ND	–	0.00	1.81	7.6	0.14	2.64	15.5	0.41
34	LNLAS-83	1.17	110.5	1.29	0.23	43.4	0.10	ND	–	0.00	ND	–	0.00	1.98	6.7	0.13	2.57	17.5	0.45
35	LNLAS-84	3.27	43.5	1.42	0.22	52.4	0.12	ND	–	0.00	ND	–	0.00	2.04	6.7	0.14	2.47	14.4	0.36
36	LNLAS-85	1.40	77.9	1.09	0.24	32.2	0.08	0.13	57.5	0.07	ND	–	0.00	1.85	6.5	0.12	2.32	15.1	0.35
37	LNLAS-86	2.24	51.9	1.16	0.46	72.6	0.33	0.35	19.5	0.07	ND	–	0.00	1.67	6.4	0.11	2.00	16.1	0.32
38	LNLAS-87	1.77	63.5	1.12	0.24	33.0	0.08	ND	–	0.00	ND	–	0.00	1.84	6.3	0.12	2.11	15.4	0.32
39	LNLAS-88	1.39	75.6	1.05	0.37	28.8	0.11	ND	–	0.00	ND	–	0.00	1.75	6.3	0.11	2.10	15.2	0.32
40	LNLAS-89	ND	–	0.00	0.28	41.1	0.12	0.21	37.6	0.08	ND	–	0.00	1.77	7.7	0.14	2.83	16.0	0.45
41	LNLAS-90	2.56	61.8	1.58	0.15	63.1	0.09	0.13	62.4	0.08	ND	–	0.00	1.56	8.4	0.13	2.38	14.8	0.35
42	LNLAS-91	ND	–	0.00	0.43	92.6	0.40	0.07	118.4	0.08	ND	–	0.00	1.45	13.2	0.19	2.31	18.7	0.43
43	LNLAS-92	3.30	59.3	1.96	0.22	51.1	0.11	0.16	65.7	0.11	ND	–	0.00	1.73	7.8	0.13	1.93	26.6	0.51
44	LNLAS-93	1.73	91.3	1.58	0.15	66.3	0.10	0.14	50.5	0.07	ND	–	0.00	1.82	7.8	0.14	1.99	20.2	0.40
45	LNLAS-94	1.72	85.4	1.47	0.18	51.6	0.09	ND	–	0.00	ND	–	0.00	1.73	7.5	0.13	2.24	19.1	0.43
46	LNLAS-95	1.60	101.7	1.63	0.21	46.5	0.10	0.23	42.7	0.10	ND	–	0.00	1.76	7.9	0.14	2.36	16.9	0.40
47	LNLAS-96	1.96	71.5	1.40	0.29	35.5	0.10	ND	–	0.00	ND	–	0.00	1.74	7.4	0.13	2.46	16.9	0.42

Table 6: LINAC North Land Area Soil Sample Results

#	Sample ID	Radionuclide Concentrations (pCi/g) *Background Not Subtracted*																
		U-238 (63 Kev)			**U-235** (144,186 Kev)			**Cs-137** (662 Kev)			**Co-60** {(1170+1330) /2} Kev			**Th-228** (238 Kev)			**Th-232** (911 Kev)		
		pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g
48	LNLAS-97	2.22	79.7	1.77	0.21	56.2	0.12	0.12	90.9	0.11	ND	–	0.00	1.68	8.2	0.14	2.18	23.1	0.50
49	LNLAS-98	3.03	68.6	2.08	0.22	53.7	0.12	0.28	35.2	0.10	ND	–	0.00	1.70	9.0	0.15	2.00	22.6	0.45
50	LNLAS-99	2.12	74.6	1.58	0.18	58.9	0.11	0.15	70.6	0.11	ND	–	0.00	1.71	8.2	0.14	2.18	18.6	0.41
51	LNLAS-100	1.88	63.9	1.20	0.20	44.6	0.09	0.14	59.7	0.08	ND	–	0.00	1.53	11.7	0.18	2.11	16.1	0.34
52	LNLAS-101	2.00	81.9	1.64	0.27	40.0	0.11	0.19	36.1	0.07	ND	–	0.00	1.03	12.7	0.13	1.90	19.8	0.38
53	LNLAS-102	3.12	59.6	1.86	0.21	58.2	0.12	0.12	96.1	0.12	ND	–	0.00	1.61	9.8	0.16	2.11	23.0	0.49
54	LNLAS-103	1.74	80.4	1.40	0.19	55.4	0.11	0.18	51.8	0.09	ND	–	0.00	1.57	8.5	0.13	2.33	16.9	0.39
55	LNLAS-104	2.36	76.4	1.80	0.15	64.9	0.10	0.16	53.0	0.08	ND	–	0.00	1.61	8.9	0.14	2.32	18.4	0.43
56	LNLAS-105B	2.11	57.5	1.21	0.12	70.3	0.08	ND	–	0.00	ND	–	0.00	1.79	7.5	0.13	2.15	16.9	0.36
57	LNLAS-106B	2.05	57.9	1.19	0.18	57.1	0.10	ND	–	0.00	ND	–	0.00	1.68	7.7	0.13	2.51	14.9	0.37
58	LNLAS-107	1.58	75.2	1.19	0.33	29.5	0.10	ND	–	0.00	ND	–	0.00	1.70	7.7	0.13	1.92	22.2	0.43
59	LNLAS-108	1.45	91.4	1.33	0.51	20.6	0.11	0.10	71.8	0.07	ND	–	0.00	1.61	8.2	0.13	2.08	17.8	0.37
60	LNLAS-109	1.99	68.3	1.36	0.41	27.6	0.11	ND	–	0.00	ND	–	0.00	1.78	7.3	0.13	2.30	20.2	0.46
61	LNLAS-110	2.06	63.6	1.31	0.33	37.9	0.13	ND	–	0.00	ND	–	0.00	2.02	7.0	0.14	2.57	16.8	0.43
62	LNLAS-111	2.05	54.6	1.12	0.31	30.4	0.09	ND	–	0.00	ND	–	0.00	1.99	6.7	0.13	2.68	14.8	0.40

Table 6: LINAC North Land Area Soil Sample Results

#	Sample ID	Radionuclide Concentrations (pCi/g) *Background Not Subtracted*																	
		U-238 (63 Kev)			**U-235** (144,186 Kev)			**Cs-137** (662 Kev)			**Co-60** {(1170+1330) /2} Kev			**Th-228** (238 Kev)			**Th-232** (911 Kev)		
		pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g
63	LNLAS-112	2.53	67.4	1.71	0.42	27.6	0.12	ND	–	0.00	ND	–	0.00	2.07	6.4	0.13	2.56	11.9	0.30
64	LNLAS-113	1.34	94.1	1.26	0.33	122.5	0.40	0.08	83.6	0.07	ND	–	0.00	2.11	6.2	0.13	2.22	19.5	0.43
65	LNLAS-113A	2.30	67.6	1.55	0.28	37.4	0.10	ND	–	0.00	ND	–	0.00	2.2.4	6.7	0.15	2.59	15.5	0.40
66	LNLAS-114	2.10	78.2	1.64	0.33	34.6	0.11	ND	--	0.00	ND	–	0.00	1.97	7.1	0.14	2.57	14.3	0.37
67	LNLAS-114A	2.39	61.7	1.47	0.15	67.5	0.10	ND	–	0.00	ND	–	0.00	1.67	9.9	0.17	2.31	17.2	0.40
68	LNLAS-115A	1.35	98.1	1.32	0.23	34.0	0.08	ND	–	0.00	ND	–	0.00	1.95	7.0	0.14	2.03	20.1	0.41
69	LNLAS-115B	1.73	70.2	1.21	0.42	23.1	0.10	ND	–	0.00	ND	–	0.00	1.95	7.1	0.14	2.53	17.4	0.44
70	LNLAS-116	3.41	43.7	1.49	0.31	33.8	0.10	ND	–	0.00	ND	–	0.00	2.19	7.1	0.16	3.02	14.2	0.43
71	LNLAS-116A	2.70	52.2	1.41	0.22	47.9	0.11	ND	–	0.00	ND	–	0.00	1.92	7.3	0.14	2.71	16.0	0.43
72	LNLAS-117	1.60	77.2	1.24	0.35	33.4	0.12	ND	–	0.00	ND	–	0.00	2.00	6.3	0.13	2.65	12.6	0.33
73	LNLAS-117A	2.06	72.3	1.49	0.28	39.5	0.11	ND	–	0.00	ND	–	0.00	2.35	6.7	0.16	2.36	22.2	0.52
74	LNLAS-118	1.70	76.2	1.30	0.31	34.3	0.11	ND	–	0.00	ND	–	0.00	2.22	8.3	0.18	3.11	14.1	0.44
75	LNLAS-118A	1.49	85.7	1.28	0.25	41.3	0.10	ND	–	0.00	ND	–	0.00	1.99	7.0	0.14	2.48	16.7	0.41
76	LNLAS-119	2.42	56.9	1.38	0.27	32.5	0.09	ND	–	0.00	ND	–	0.00	2.25	5.7	0.13	2.91	13.7	0.40
77	LNLAS-119A	2.27	65.6	1.49	0.17	63.4	0.11	ND	–	0.00	ND	–	0.00	1.97	6.7	0.13	2.35	16.3	0.38

Table 6: LINAC North Land Area Soil Sample Results

#	Sample ID	Radionuclide Concentrations (pCi/g) *Background Not Subtracted*																	
		U-238 (63 Kev)			**U-235** (144,186 Kev)			**Cs-137** (662 Kev)			**Co-60** {(1170+1330) /2} Kev			**Th-228** (238 Kev)			**Th-232** (911 Kev)		
		pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g
78	LNLAS-120	2.33	52.2	1.22	0.38	26.3	0.10	ND	–	0.00	ND	–	0.00	2.12	6.9	0.15	2.74	13.6	0.37
79	LNLAS-121	1.87	29.5	0.55	0.30	60.3	0.18	ND	–	0.00	ND	–	0.00	1.94	3.3	0.06	2.60	8.4	0.22
80	LNLAS-122	2.32	52.4	1.22	0.33	30.6	0.10	ND	–	0.00	ND	–	0.00	2.09	6.0	0.13	2.80	13.6	0.38
81	LNLAS-123	1.77	34.9	0.62	0.37	13.5	0.05	ND	–	0.00	ND	–	0.00	1.94	3.3	0.06	2.47	7.3	0.18
82	LNLAS-124	1.88	68.8	1.29	0.25	37.5	0.09	ND	–	0.00	ND	–	0.00	1.95	6.2	0.12	2.31	16.1	0.37
83	LNLAS-124A	2.78	51.6	1.43	0.27	34.7	0.09	0.05	84.7	0.04	ND	–	0.00	2.06	5.9	0.12	2.27	15.0	0.34
84	LNLAS-125	1.70	66.2	1.13	0.36	28.2	0.10	0.07	84.7	0.06	ND	–	0.00	2.07	6.2	0.13	2.46	16.2	0.40
85	LNLAS-126	1.60	68.4	1.09	0.29	28.8	0.08	0.06	74.9	0.04	ND	–	0.00	2.25	5.5	0.12	2.33	17.3	0.40
86	LNLAS-127	1.74	75.0	1.31	0.46	20.4	0.09	ND	–	0.00	ND	–	0.00	1.92	6.3	0.12	2.31	13.2	0.30
87	LNLAS-128	2.67	50.0	1.34	0.21	45.9	0.10	ND	–	0.00	ND	–	0.00	2.20	5.6	0.12	2.54	13.5	0.34
88	LNLAS-129	2.34	47.6	1.11	0.23	37.4	0.09	0.08	70.3	0.06	ND	–	0.00	1.78	6.5	0.12	2.23	16.7	0.37
89	LNLAS-130B	2.59	47.8	1.24	0.27	34.7	0.09	ND	–	0.00	ND	–	0.00	1.97	5.8	0.11	2.10	14.4	0.30
90	LNLAS-131	2.82	45.7	1.29	0.28	30.0	0.08	ND	–	0.00	ND	–	0.00	2.16	5.7	0.12	2.20	15.0	0.33
91	LNLAS-132	3.26	43.5	1.42	0.33	30.3	0.10	ND	–	0.00	ND	–	0.00	2.18	5.7	0.12	2.59	12.7	0.33
92	LNLAS-132A	2.26	65.1	1.47	0.24	40.5	0.10	ND	–	0.00	ND	–	0.00	2.16	5.9	0.13	2.50	13.8	0.35

Table 6: LINAC North Land Area Soil Sample Results

#	Sample ID	Radionuclide Concentrations (pCi/g) *Background Not Subtracted*																
		U-238 (63 Kev)			**U-235** (144.186 Kev)			**Cs-137** (662 Kev)			**Co-60** {(1170+1330) /2} Kev			**Th-228** (238 Kev)			**Th-232** (911 Kev)		
		pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g
93	LNLAS-133	2.83	53.5	1.51	0.25	38.2	0.10	ND	–	0.00	ND	–	0.00	1.50	8.5	0.13	2.25	17.2	0.39
94	LNLAS-134	1.55	38.2	0.59	0.49	39.1	0.19	0.06	41.8	0.03	ND	--	0.00	1.95	3.1	0.06	2.41	8.6	0.21
95	LNLAS-135	1.57	90.8	1.43	0.27	32.2	0.09	ND	–	0.00	ND	–	0.00	1.95	6.0	0.12	2.06	17.7	0.36
96	LNLAS-136	3.70	49.9	1.85	0.38	25.0	0.10	ND	–	0.00	ND	–	0.00	1.63	7.0	0.11	2.27	14.5	0.33
97	LNLAS-137	2.45	50.8	1.24	0.30	35.2	0.11	0.18	48.1	0.09	ND	–	0.00	1.70	7.4	0.13	2.26	18.5	0.42
98	LNLAS-138	1.13	82.7	0.93	0.19	43.8	0.08	0.08	68.3	0.05	ND	--	0.00	0.99	10.3	0.10	1.58	19.9	0.31
99	LNLAS-139	1.19	79.9	0.95	0.13	65.6	0.09	0.07	81.1	0.06	ND	–	0.00	1.07	9.6	0.10	1.62	18.7	0.30
100	LNLAS-140	1.10	81.3	0.89	0.18	51.3	0.09	ND	–	0.00	ND	–	0.00	1.00	13.7	0.14	1.64	18.1	0.30
101	LNLAS-141	2.44	53.9	1.32	0.12	82.9	0.10	ND	–	0.00	ND	–	0.00	1.38	9.1	0.13	1.99	19.1	0.38
102	LNLAS-142	1.52	73.9	1.12	0.15	70.3	0.11	ND	–	0.00	ND	–	0.00	1.17	10.2	0.12	1.55	21.1	0.33
103	LNLAS-143	1.83	72.4	1.32	0.11	76.1	0.08	ND	–	0.00	ND	–	0.00	1.40	8.3	0.12	1.71	20.8	0.36
104	LNLAS-144	1.85	35.2	0.65	0.15	122.3	0.18	ND	–	0.00	ND	–	0.00	2.65	3.0	0.08	3.20	7.3	0.23
105	LNLAS-144B	1.79	65.3	1.17	0.24	38.7	0.09	ND	–	0.00	ND	–	0.00	2.34	6.1	0.14	3.04	13.1	0.40
106	LNLAS-145	1.85	73.8	1.37	0.22	52.2	0.11	ND	–	0.00	ND	–	0.00	1.97	7.3	0.14	2.44	20.7	0.51
107	LNLAS-145A	1.64	89.8	1.47	0.26	46.5	0.12	ND	–	0.00	ND	–	0.00	1.92	11.2	0.22	2.81	15.1	0.42

Table 6: LINAC North Land Area Soil Sample Results

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		U-238 (63 Kev)			**U-235** (144,186 Kev)			**Cs-137** (662 Kev)			**Co-60** {(1170+1330) /2} Kev			**Th-228** (238 Kev)			**Th-232** (911 Kev)		
		pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g
108	LNLAS-146	ND	–	0.00	0.16	61.0	0.10	ND	–	0.00	ND	–	0.00	1.03	10.3	0.11	1.37	22.0	0.30
109	LNLAS-147	4.24	36.2	1.53	0.25	46.0	0.12	ND	–	0.00	ND	–	0.00	1.33	11.0	0.15	2.08	17.7	0.37
110	LNLAS-148	2.89	37.4	1.08	0.30	36.1	0.11	ND	–	0.00	ND	–	0.00	1.55	8.3	0.13	1.88	24.4	0.46
111	LNLAS-149	2.39	57.6	1.38	0.28	36.0	0.10	ND	–	0.00	ND	–	0.00	1.83	7.5	0.14	2.01	18.1	0.36
112	LNLAS-150	3.45	34.2	1.18	0.32	33.6	0.11	ND	–	0.00	ND	–	0.00	1.36	10.4	0.14	1.96	16.5	0.32
113	LNLAS-151	3.15	37.8	1.19	0.38	31.0	0.12	ND	–	0.00	ND	–	0.00	1.40	8.5	0.12	2.53	17.7	0.45
114	LNLAS-152	2.57	53.2	1.37	0.39	25.8	0.10	ND	–	0.00	ND	–	0.00	1.48	8.1	0.12	1.98	20.3	0.40
115	LNLAS-153	5.01	42.1	2.11	0.40	29.9	0.12	ND	–	0.00	ND	–	0.00	1.40	8.9	0.12	2.05	20.8	0.43
116	LNLAS-154	1.64	66.7	1.09	0.29	30.8	0.09	ND	–	0.00	ND	–	0.00	1.62	8.2	0.13	1.91	18.7	0.36
117	LNLAS-155	1.27	92.7	1.18	0.21	47.9	0.10	ND	–	0.00	ND	–	0.00	1.12	11.2	0.13	1.52	22.1	0.34
118	LNLAS-156	2.28	54.1	1.23	0.38	30.6	0.12	ND	–	0.00	ND	–	0.00	1.63	8.1	0.13	2.27	18.0	0.41
119	LNLAS-157	2.24	61.9	1.39	0.42	35.1	0.15	ND	–	0.00	ND	–	0.00	1.52	8.6	0.13	2.42	19.2	0.46
120	LNLAS-158	3.63	44.7	1.62	0.35	33.1	0.12	ND	–	0.00	ND	–	0.00	1.45	8.0	0.12	1.92	18.3	0.35
121	LNLAS-159	1.63	84.5	1.38	0.38	33.5	0.13	ND	–	0.00	ND	–	0.00	1.64	8.3	0.14	1.79	27.2	0.49
122	LNLAS-160B	1.34	95.5	1.28	0.23	36.5	0.08	0.11	69.4	0.08	ND	–	0.00	1.74	7.0	0.12	2.04	19.5	0.40

Table 6: LINAC North Land Area Soil Sample Results

#	Sample ID	Radionuclide Concentrations (pCi/g) *Background Not Subtracted*																
		U-238 (63 Kev)			**U-235** (144,186 Kev)			**Cs-137** (662 Kev)			**Co-60** {(1170+1330) /2} Kev			**Th-228** (238 Kev)			**Th-232** (911 Kev)		
		pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g
123	LNLAS-161	3.99	48.8	1.95	0.34	40.6	0.14	ND	–	0.00	ND	–	0.00	1.62	9.1	0.15	2.27	21.6	0.49
124	LNLAS-162	2.24	66.7	1.49	0.30	41.4	0.12	ND	–	0.00	ND	–	0.00	1.67	8.7	0.15	2.24	16.8	0.38
125	LNLAS-163	2.02	81.0	1.64	0.23	52.8	0.12	ND	–	0.00	ND	–	0.00	1.87	7.4	0.14	2.26	18.7	0.42
126	LNLAS-164	2.76	54.6	1.51	0.39	29.3	0.11	ND	–	0.00	ND	–	0.00	1.57	8.5	0.13	2.32	18.1	0.42
127	LNLAS-165	ND	–	0.00	0.25	38.7	0.10	ND	–	0.00	ND	–	0.00	1.76	7.3	0.13	2.44	16.1	0.39
128	LNLAS-165A	2.20	67.9	1.49	0.21	49.5	0.10	ND	–	0.00	ND	–	0.00	2.00	7.3	0.15	2.61	14.9	0.39
129	LNLAS-166	2.15	63.1	1.36	0.30	36.4	0.11	ND	–	0.00	ND	–	0.00	2.16	6.7	0.14	2.58	17.0	0.44
130	LNLAS-166A	ND	–	0.00	0.27	46.0	0.12	ND	–	0.00	ND	–	0.00	2.19	7.7	0.17	3.14	16.1	0.51
131	LNLAS-167	2.62	65.4	1.71	0.27	49.6	0.13	ND	–	0.00	ND	–	0.00	2.23	8.0	0.18	2.58	23.4	0.60
132	LNLAS-167A	1.71	89.1	1.52	0.17	59.8	0.10	ND	–	0.00	ND	–	0.00	1.91	8.0	0.15	3.48	13.5	0.47
133	LNLAS-168	2.26	31.3	0.71	0.27	74.1	0.20	ND	–	0.00	ND	–	0.00	2.29	3.2	0.07	2.69	8.5	0.23
134	LNLAS-168A	1.60	83.3	1.33	0.18	48.4	0.09	ND	–	0.00	ND	–	0.00	1.69	9.9	0.17	1.97	22.7	0.45
135	LNLAS-169	2.79	23.7	0.66	0.25	95.9	0.24	ND	–	0.00	ND	–	0.00	2.32	3.4	0.08	2.65	8.8	0.23
136	LNLAS-169A	2.67	48.8	1.30	0.20	49.9	0.10	ND	–	0.00	ND	–	0.00	1.82	7.8	0.14	2.49	16.5	0.41
137	LNLAS-170	ND	–	0.00	0.23	58.6	0.13	ND	–	0.00	ND	–	0.00	2.18	7.5	0.16	2.97	14.8	0.44

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		pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g
138	LNLAS-170A	2.16	71.7	1.55	0.24	53.7	0.13	ND	–	0.00	ND	–	0.00	1.78	7.5	0.13	2.34	19.7	0.46
139	LNLAS-171	1.18	107.7	1.27	0.30	37.1	0.11	ND	–	0.00	ND	–	0.00	1.30	10.6	0.14	1.92	23.1	0.44
140	LNLAS-172	1.76	34.5	0.61	0.23	19.6	0.05	0.06	74.2	0.04	ND	–	0.00	1.89	3.3	0.06	2.23	7.7	0.17
141	LNLAS-173	1.28	48.8	0.62	0.15	32.4	0.05	ND	–	0.00	ND	–	0.00	1.82	3.5	0.06	2.24	9.3	0.21
142	LNLAS-174	1.46	44.1	0.64	0.17	29.1	0.05	ND	–	0.00	ND	–	0.00	2.12	3.4	0.07	2.59	8.2	0.21
143	LNLAS-175	1.24	71.4	0.89	0.18	40.2	0.07	0.17	43.4	0.07	ND	–	0.00	1.13	9.5	0.11	1.76	18.1	0.32
144	LNLAS-176	1.16	103.3	1.20	0.15	60.2	0.09	ND	–	0.00	ND	–	0.00	1.00	10.2	0.10	1.55	20.7	0.32
145	LNLAS-177	1.93	65.1	1.26	0.17	47.9	0.08	ND	–	0.00	ND	–	0.00	1.69	7.9	0.13	2.52	15.9	0.40
146	LNLAS-178	1.97	61.5	1.21	0.23	51.5	0.12	ND	–	0.00	ND	–	0.00	1.96	6.9	0.14	2.41	17.3	0.42
147	LNLAS-179	1.76	82.1	1.45	0.24	41.7	0.10	ND	–	0.00	0.06	98.8	0.06	1.75	8.1	0.14	2.42	18.5	0.45
148	LNLAS-180	2.36	55.2	1.30	0.32	26.9	0.09	0.19	54.2	0.10	ND	–	0.00	1.95	7.2	0.14	2.48	16.8	0.42
149	LNLAS-181	1.85	72.4	1.34	0.45	92.7	0.42	ND	–	0.00	ND	–	0.00	1.65	8.7	0.14	2.28	19.1	0.44
150	LNLAS-182	1.98	64.2	1.27	0.46	85.1	0.39	ND	–	0.00	ND	–	0.00	1.91	7.1	0.14	2.65	14.7	0.39
151	LNLAS-183	1.27	86.6	1.10	0.31	31.6	0.10	ND	–	0.00	ND	–	0.00	2.00	6.3	0.13	2.45	15.7	0.38
152	LNLAS-184	2.01	62.7	1.26	0.36	27.0	0.10	ND	–	0.00	ND	--	0.00	2.08	5.9	0.12	2.48	15.2	0.38

Table 6: LINAC North Land Area Soil Sample Results

#	Sample ID	Radionuclide Concentrations (pCi/g) *Background Not Subtracted*																
		U-238 (63 Kev)			**U-235** (144,186 Kev)			**Cs-137** (662 Kev)			**Co-60** {(1170+1330) /2} Kev			**Th-228** (238 Kev)			**Th-232** (911 Kev)		
		pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g
153	LNLAS-185	2.14	59.0	1.26	0.38	32.2	0.12	ND	–	0.00	ND	–	0.00	2.12	6.6	0.14	2.57	14.9	0.38
154	LNLAS-186	1.31	48.4	0.63	0.19	95.9	0.18	0.09	53.1	0.05	ND	–	0.00	1.96	3.3	0.06	2.31	8.7	0.20
155	LNLAS-187	2.33	57.5	1.34	0.20	41.0	0.08	0.13	53.0	0.07	ND	–	0.00	1.16	9.5	0.11	1.46	23.9	0.35
156	LNLAS-188	1.90	57.3	1.09	0.31	37.2	0.12	0.07	92.4	0.06	ND	–	0.00	1.60	8.2	0.13	1.99	19.0	0.38
157	LNLAS-189	2.43	68.4	1.66	0.48	89.0	0.43	ND	–	0.00	ND	–	0.00	1.75	7.2	0.13	2.18	18.7	0.41
158	LNLAS-190	2.20	60.6	1.33	0.36	100.3	0.36	ND	–	0.00	ND	–	0.00	1.80	7.1	0.13	2.44	16.7	0.41
159	B31-3-43	1.65	79.1	1.31	0.40	39.0	0.16	ND	–	0.00	ND	–	0.00	2.13	7.2	0.15	2.51	17.6	0.44
160	B31-3-44	2.14	51.4	1.10	0.29	22.1	0.06	ND	–	0.00	ND	–	0.00	1.94	5.9	0.11	2.03	16.3	0.33
161	B31-3-45	1.17	102.2	1.20	0.26	39.4	0.10	ND	–	0.00	ND	–	0.00	1.86	7.2	0.13	2.45	16.9	0.41
162	B31-3-46	1.77	57.7	1.02	0.25	34.0	0.09	ND	–	0.00	ND	–	0.00	1.85	6.2	0.11	2.00	17.2	0.34
163	B31-3-47	1.69	71.0	1.20	0.24	45.5	0.11	0.08	115.7	0.09	ND	–	0.00	1.88	7.6	0.14	2.42	17.2	0.42
164	B31-3-48	1.47	62.1	0.91	0.23	37.7	0.09	ND	–	0.00	ND	–	0.00	1.76	6.4	0.11	2.01	14.7	0.30
165	B31-3-49	1.78	67.7	1.21	0.18	50.3	0.09	ND	–	0.00	ND	–	0.00	1.93	7.4	0.14	2.72	15.9	0.43
166	B31-3-50	1.18	80.1	0.95	0.20	34.2	0.07	ND	–	0.00	ND	–	0.00	1.79	6.3	0.11	1.69	16.9	0.29
167	B31-3-51	1.67	64.6	1.08	0.28	45.1	0.13	ND	–	0.00	ND	–	0.00	1.95	7.3	0.14	2.33	19.2	0.45

Table 6: LINAC North Land Area Soil Sample Results

#	Sample ID	Radionuclide Concentrations (pCi/g) *Background Not Subtracted*																
		U-238 (63 Kev)			**U-235** (144,186 Kev)			**Cs-137** (662 Kev)			**Co-60** {(1170+1330) /2} Kev			**Th-228** (238 Kev)			**Th-232** (911 Kev)		
		pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g
168	B31-3-52	4.19	23.2	0.97	0.36	28.9	0.10	0.13	66.3	0.09	ND	–	0.00	1.96	7.1	0.14	2.06	21.5	0.44
169	B31-3-53	2.51	47.7	1.20	0.21	113.5	0.24	ND	–	0.00	ND	–	0.00	1.85	6.1	0.11	1.99	17.7	0.35
170	B31-3-54	1.87	64.6	1.21	0.24	36.2	0.09	ND	–	0.00	ND	–	0.00	2.05	6.0	0.12	2.26	14.5	0.33
171	B31-3-55	3.52	26.5	0.93	0.29	36.8	0.11	0.08	105.5	0.08	ND	–	0.00	1.92	7.2	0.14	2.52	17.2	0.43
172	B31-3-56	2.00	61.7	1.23	0.25	44.8	0.11	0.08	114.5	0.09	ND	–	0.00	2.00	7.1	0.14	2.46	17.2	0.42
173	B31-3-57	1.93	64.5	1.24	0.33	29.7	0.10	ND	–	0.00	ND	–	0.00	1.82	6.2	0.11	2.13	15.6	0.33
174	B31-3-58	2.53	47.8	1.21	0.32	84.4	0.27	0.05	103.5	0.05	ND	–	0.00	1.93	6.0	0.12	2.34	12.8	0.30
175	B31-3-59	2.51	62.5	1.57	0.32	37.3	0.12	0	–	0.00	ND	–	0.00	2.04	6.7	0.14	2.51	16.1	0.40
176	B31-3-60	2.41	53.1	1.28	0.27	27.3	0.07	0	–	0.00	ND	–	0.00	2.15	5.5	0.12	2.23	15.9	0.35
177	B31-3-61	2.91	51.1	1.49	0.20	56.6	0.11	0	–	0.00	ND	–	0.00	1.98	7.1	0.14	2.67	16.4	0.44
178	B31-3-62	2.15	61.6	1.32	0.30	36.8	0.11	0.06	98.1	0.06	ND	–	0.00	2.04	6.2	0.13	2.04	17.6	0.36
179	B31-3-63	2.68	52.2	1.40	0.28	34.8	0.10	0.19	41.5	0.08	ND	–	0.00	1.98	6.7	0.13	2.32	15.8	0.37
180	B31-3-64	2.27	69.8	1.58	0.21	48.8	0.10	0.12	74.6	0.09	ND	–	0.00	2.01	7.5	0.15	2.34	17.3	0.40
181	B31-3-65	1.51	100.1	1.51	0.25	45.4	0.11	0.13	77.8	0.10	ND	–	0.00	2.03	8.1	0.16	2.64	20.0	0.53
182	B31-3-66	1.45	64.4	0.93	0.23	32.6	0.08	0.16	50.0	0.08	ND	–	0.00	1.71	6.2	0.11	1.94	14.7	0.29

Table 6: LINAC North Land Area Soil Sample Results

#	Sample ID	Radionuclide Concentrations (pCi/g) *Background Not Subtracted*																
		U-238 (63 Kev)			U-235 (144,186 Kev)			Cs-137 (662 Kev)			Co-60 {(1170+1330) /2} Kev			Th-228 (238 Kev)			Th-232 (911 Kev)		
		pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g
183	B31-3-67	2.00	65.0	1.30	0.30	34.8	0.10	0.11	69.6	0.08	ND	–	0.00	1.95	7.8	0.15	2.29	16.7	0.38
184	B31-3-68B	2.63	55.9	1.47	0.45	33.2	0.15	ND	–	0.00	ND	–	0.00	1.76	7.6	0.13	2.12	21.5	0.46
185	B31-3-69	2.41	61.3	1.48	0.21	51.8	0.11	ND	–	0.00	ND	–	0.00	1.78	10.3	0.18	2.34	23.2	0.54
186	B31-3-70	2.43	61.7	1.50	0.20	53.3	0.11	ND	–	0.00	ND	–	0.00	1.86	8.0	0.15	2.73	15.1	0.41
187	B31-3-71	1.11	99.3	1.10	0.23	38.9	0.09	ND	–	0.00	ND	–	0.00	1.70	9.3	0.16	2.58	17.0	0.44
188	B31-3-72	1.69	68.7	1.16	0.33	33.4	0.11	0.26	28.1	0.07	ND	–	0.00	2.03	6.9	0.14	2.43	15.8	0.38
189	B31-3-73	1.71	72.3	1.24	0.40	28.6	0.11	0.10	70.4	0.07	ND	–	0.00	1.99	7.2	0.14	2.13	20.2	0.43
190	B31-3-74	1.58	68.8	1.09	0.34	23.6	0.08	0.22	37.5	0.08	ND	–	0.00	1.84	5.9	0.11	1.99	17.5	0.35
191	B31-3-75	1.80	74.0	1.33	0.33	39.1	0.13	0.10	81.8	0.08	ND	–	0.00	2.02	7.5	0.15	2.53	16.4	0.41
192	B31-3-76	1.93	57.6	1.11	0.33	27.4	0.09	0.08	85.4	0.07	ND	–	0.00	1.67	6.7	0.11	1.98	13.5	0.27
193	B31-3-77	2.46	64.5	1.59	0.23	48.6	0.11	ND	–	0.00	ND	–	0.00	2.12	7.2	0.15	2.78	17.0	0.47
194	B31-3-78	2.80	47.6	1.33	0.28	31.5	0.09	0.09	78.3	0.07	ND	–	0.00	2.01	6.3	0.13	2.08	14.6	0.30
195	B31-3-79	1.97	63.2	1.25	0.50	82.2	0.41	ND	–	0.00	ND	–	0.00	1.67	8.3	0.14	2.15	20.6	0.44
196	B31-3-80	1.65	59.5	0.98	0.16	61.8	0.10	0.17	45.5	0.08	ND	--	0.00	1.52	7.7	0.12	2.57	14.3	0.37
197	B31-3-81	1.96	58.8	1.15	0.34	35.0	0.12	ND	–	0.00	ND	–	0.00	1.67	10.6	0.18	1.98	22.3	0.44

Table 6: LINAC North Land Area Soil Sample Results

#	Sample ID	Radionuclide Concentrations (pCi/g) *Background Not Subtracted*																
		U-238 (63 Kev)			**U-235** (144,186 Kev)			**Cs-137** (662 Kev)			**Co-60** {(1170+1330) /2} Kev			**Th-228** (238 Kev)			**Th-232** (911 Kev)		
		pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g
198	B31-3-82	3.11	40.6	1.26	0.24	32.0	0.08	ND	–	0.00	ND	–	0.00	1.82	5.9	0.11	2.19	14.9	0.33
199	B31-3-83	2.06	57.3	1.18	0.37	28.8	0.11	ND	–	0.00	ND	–	0.00	1.67	7.4	0.12	2.36	17.9	0.42
200	B31-3-84	2.07	72.0	1.49	0.29	34.3	0.10	ND	–	0.00	ND	–	0.00	1.77	7.3	0.13	2.29	16.1	0.37
201	LNLAS-39	2.37	60.1	1.42	0.23	47.3	0.11	ND	–	0.00	ND	–	0.00	1.67	10.4	0.17	2.42	19.1	0.46
202	LNLAS-40	2.45	50.7	1.24	0.19	47.3	0.09	ND	–	0.00	ND	–	0.00	1.65	7.1	0.12	1.82	23.3	0.42
203	LNLAS-41	2.47	36.3	0.90	0.14	69.2	0.10	ND	–	0.00	ND	–	0.00	1.07	9.5	0.10	1.58	19.6	0.31
204	LNLAS-42	1.87	73.1	1.37	0.13	50.1	0.07	ND	–	0.00	ND	–	0.00	1.33	8.4	0.11	1.64	17.4	0.29
205	LNLAS-43	1.56	75.8	1.18	0.24	37.4	0.09	ND	–	0.00	ND	–	0.00	1.22	9.3	0.11	1.68	22.6	0.38
206	LNLAS-44	1.88	80.1	1.51	0.21	46.2	0.10	ND	–	0.00	ND	–	0.00	1.55	8.6	0.13	1.97	18.9	0.37
207	LNLAS-45	1.04	104.3	1.08	0.22	47.5	0.10	ND	–	0.00	ND	–	0.00	1.38	8.3	0.11	1.90	18.1	0.34
208	LNLAS-46	2.85	48.4	1.38	0.19	53.0	0.10	0.07	70.2	0.05	ND	–	0.00	1.34	8.8	0.12	1.78	19.4	0.35
209	LNLAS-47	2.36	53.0	1.25	0.21	52.8	0.11	ND	–	0.00	ND	–	0.00	1.49	8.1	0.12	1.93	17.8	0.34
210	LNLAS-48	2.78	74.5	2.07	0.14	65.5	0.09	0.09	77.5	0.07	ND	–	0.00	1.65	7.7	0.13	1.82	18.3	0.33
211	LNLAS-49	1.42	80.1	1.14	0.19	61.1	0.12	ND	–	0.00	ND	–	0.00	1.28	9.3	0.12	1.95	20.1	0.39
212	LNLAS-50	2.08	56.5	1.18	0.24	35.2	0.08	0.06	89.8	0.05	ND	–	0.00	1.49	7.5	0.11	1.49	19.4	0.29
213	LNLAS-51	1.07	95.7	1.02	0.19	45.1	0.09	ND	–	0.00	ND	–	0.00	1.40	8.5	0.12	1.84	18.3	0.34
214	LNLAS-52	1.68	48.3	0.81	0.19	47.0	0.09	0.10	70.4	0.07	ND	–	0.00	1.41	7.6	0.11	1.76	17.3	0.30
215	LNLAS-53	1.33	94.0	1.25	0.20	42.0	0.08	ND	–	0.00	ND	–	0.00	1.24	8.4	0.10	1.78	18.4	0.33

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Table 6: LINAC North Land Area Soil Sample Results

#	Sample ID	Radionuclide Concentrations (pCi/g) *Background Not Subtracted*																
		U-238 (63 Kev)			U-235 (144.186 Kev)			Cs-137 (662 Kev)			Co-60 {(1170+1330) /2} Kev			Th-228 (238 Kev)			Th-232 (911 Kev)		
		pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g
216	LNLAS-54	2.97	38.7	1.15	0.25	41.0	0.10	ND	--	0.00	ND	--	0.00	1.57	9.7	0.15	2.29	19.8	0.45
217	LNLAS-55	1.89	41.3	0.78	0.21	49.5	0.10	ND	--	0.00	ND	--	0.00	1.48	7.6	0.11	1.76	19.9	0.35
218	LNLA-S-191	1.43	82.3	1.18	0.21	49.3	0.10	0.20	57.3	0.11	ND	--	0.00	1.57	9.6	0.15	2.26	19.3	0.44
219	LNLA-S-192	1.33	98.9	1.32	0.32	41.7	0.13	0.19	60.0	0.11	ND	--	0.00	1.72	8.5	0.15	2.67	15.9	0.42
220	LNLA-S-193	2.41	59.4	1.43	0.21	57.8	0.12	0.14	46.1	0.06	ND	--	0.00	2.09	6.3	0.13	2.62	14.8	0.39

Note:s:

1. ND = Not detected, <0.1 pCi/g Cs-137, <0.1 pCi/g Co-60, <3.0 pCi/g U-238, <0.3 pCi/g U-235
2. Sample ID numbers ending in A (i.e., LNLAS-32A) were taken at 6-12".
3. Sample ID numbers ending in B were retakes following remediation.
4. Shaded data were taken in the Hillside drainage and trench area outside of the LINAC North Land Area footprint.

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Figure 1A: Torrey Pines (Main) Site Land Areas

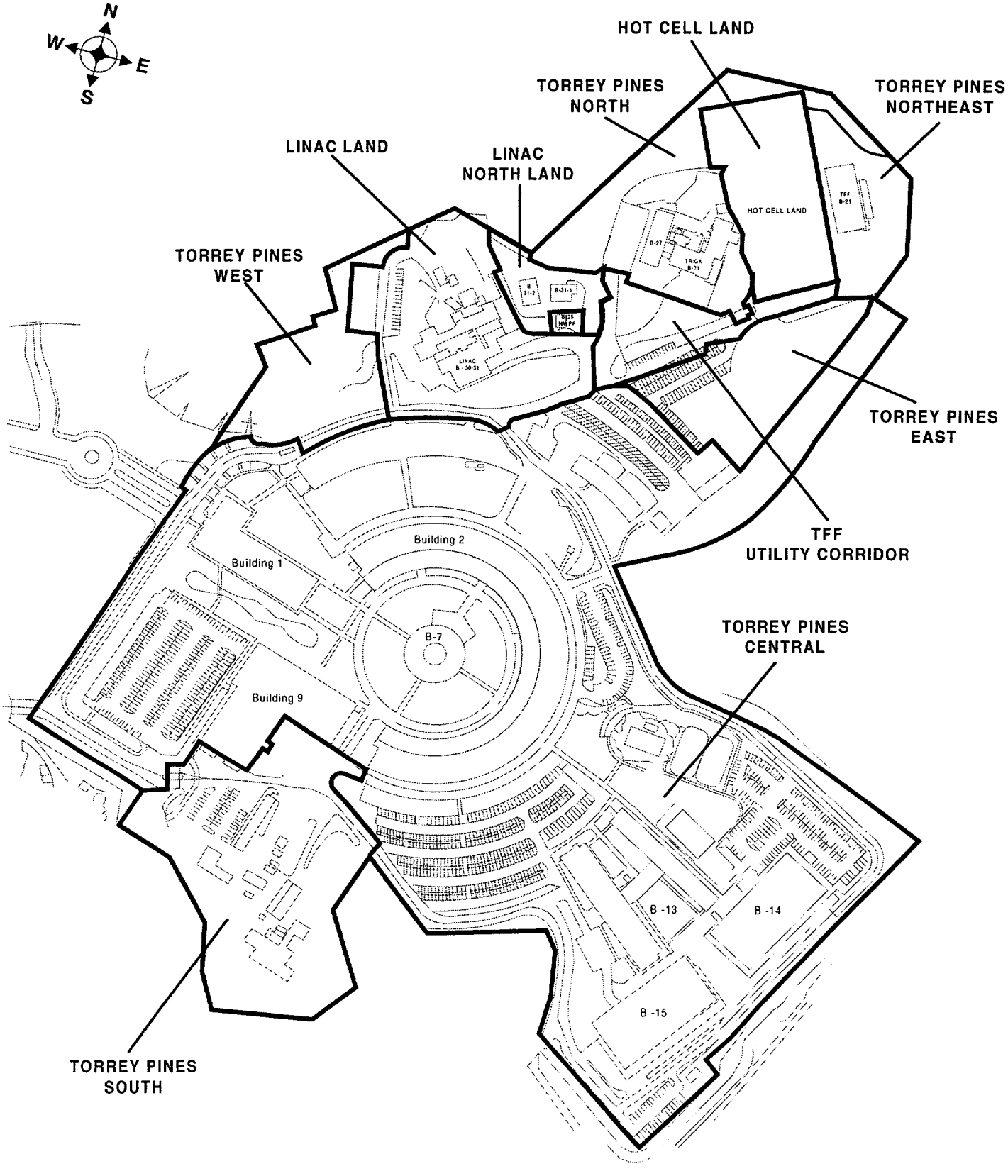


Figure 1B: LINAC North Land Area in Relationship to Surrounding Area

= LINAC North Land

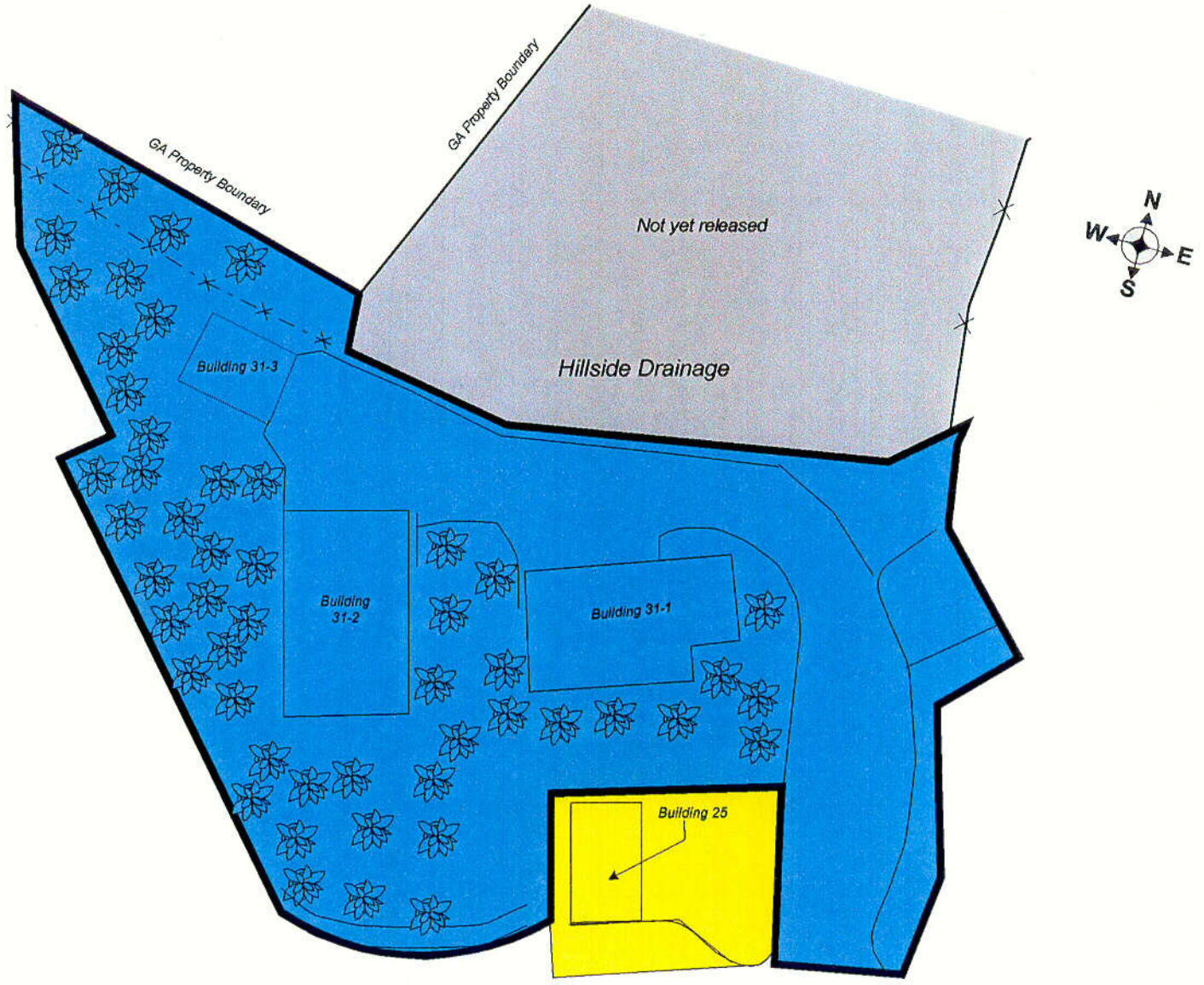
= Building 25 (NWPF Liquid Filtration Bldg.) & Surrounding Land Area

=LINAC LAND

= Building 30/31 Complex (LINAC)

C01

Figure 2: LINAC North Land Area Boundary



= LINAC North Land Area

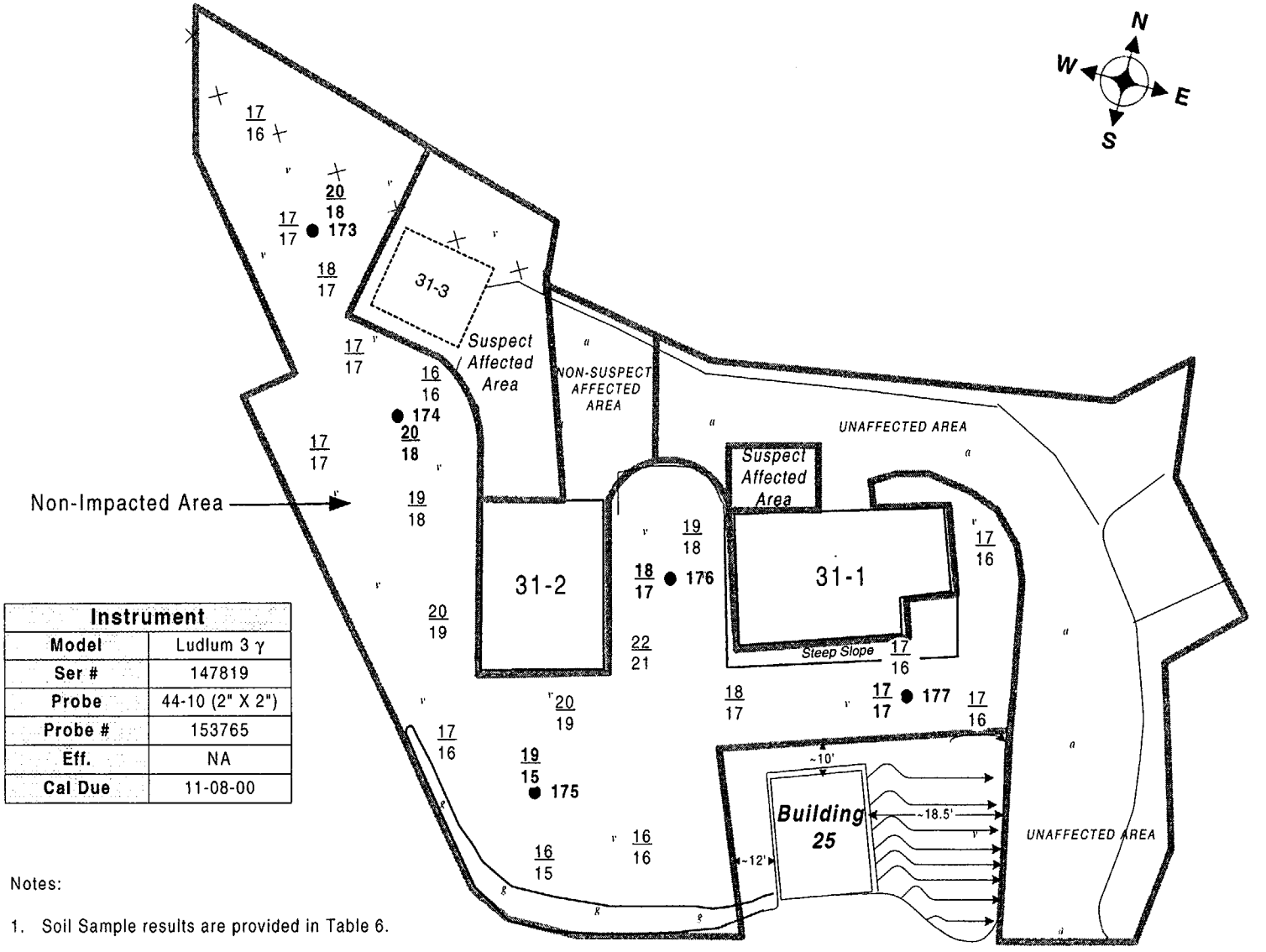
= Building 25 (NWPF Liquid Filtration Bldg.) & Surrounding Land Area

= LINAC North Land Boundary

C02

Figure 3: LINAC North Land Area Survey Classification

Figure 4: Non-Impacted Area Soil Sample Locations and Exposure Rate Fixed Measurement Locations and Results



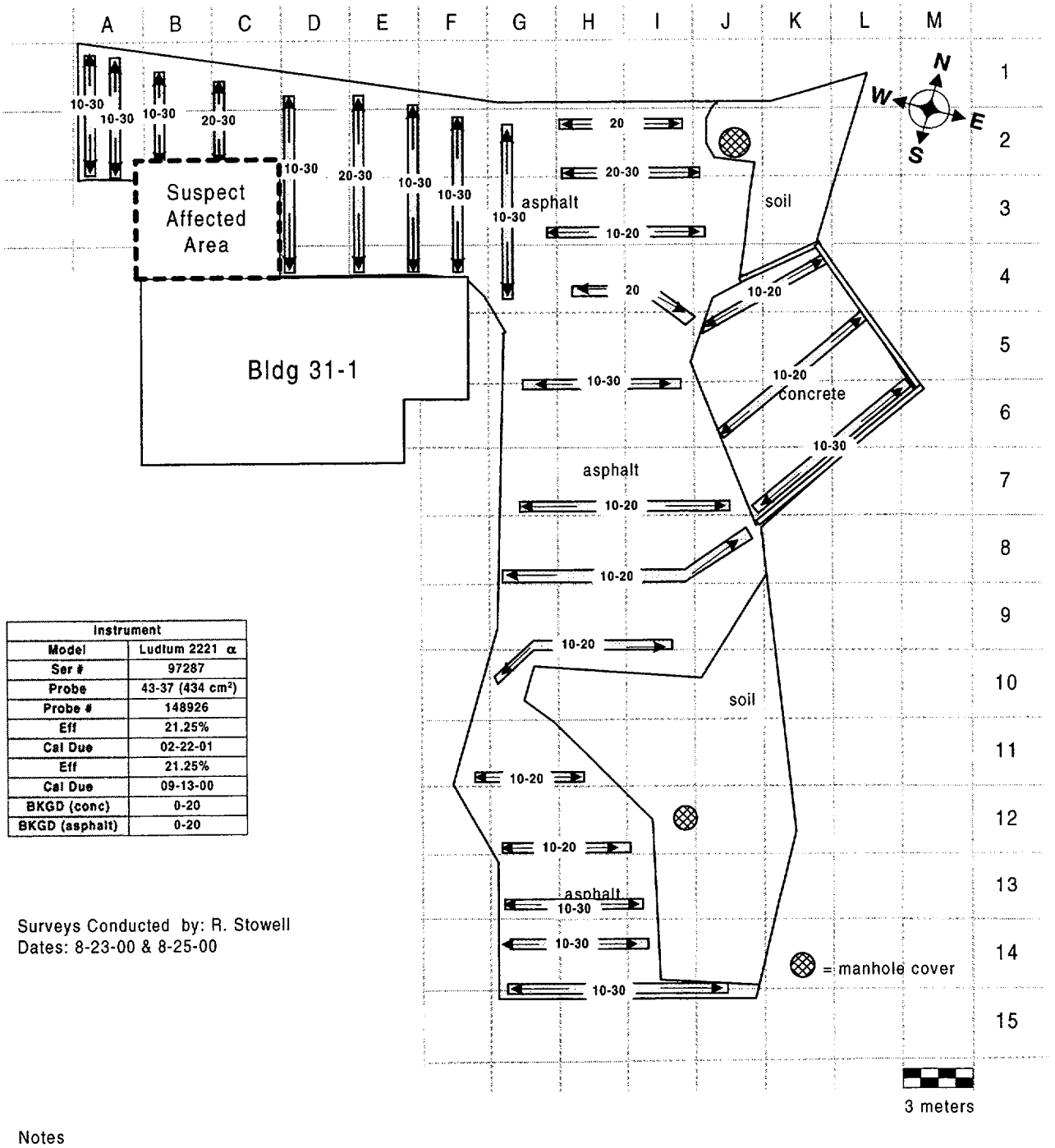
Instrument	
Model	Ludlum 3 γ
Ser #	147819
Probe	44-10 (2" X 2")
Probe #	153765
Eff.	NA
Cal Due	11-08-00

Notes:

1. Soil Sample results are provided in Table 6.
2. ●XXX Denotes soil sample location.
3. All readings are in µR/hr, $\frac{XX}{XX} = \frac{\text{contact}}{\text{at 1 meter}}$.
4. Exposure rate results range from 16-22 µR/hr at the surface and from 15-21 µR/hr at 1 meter.

Surveys Conducted by: P. Poole & J. Vassett
Dates: 10-09-00 & 10-13-00

Figure 5: Unaffected Area Alpha Scan Survey Locations and Results



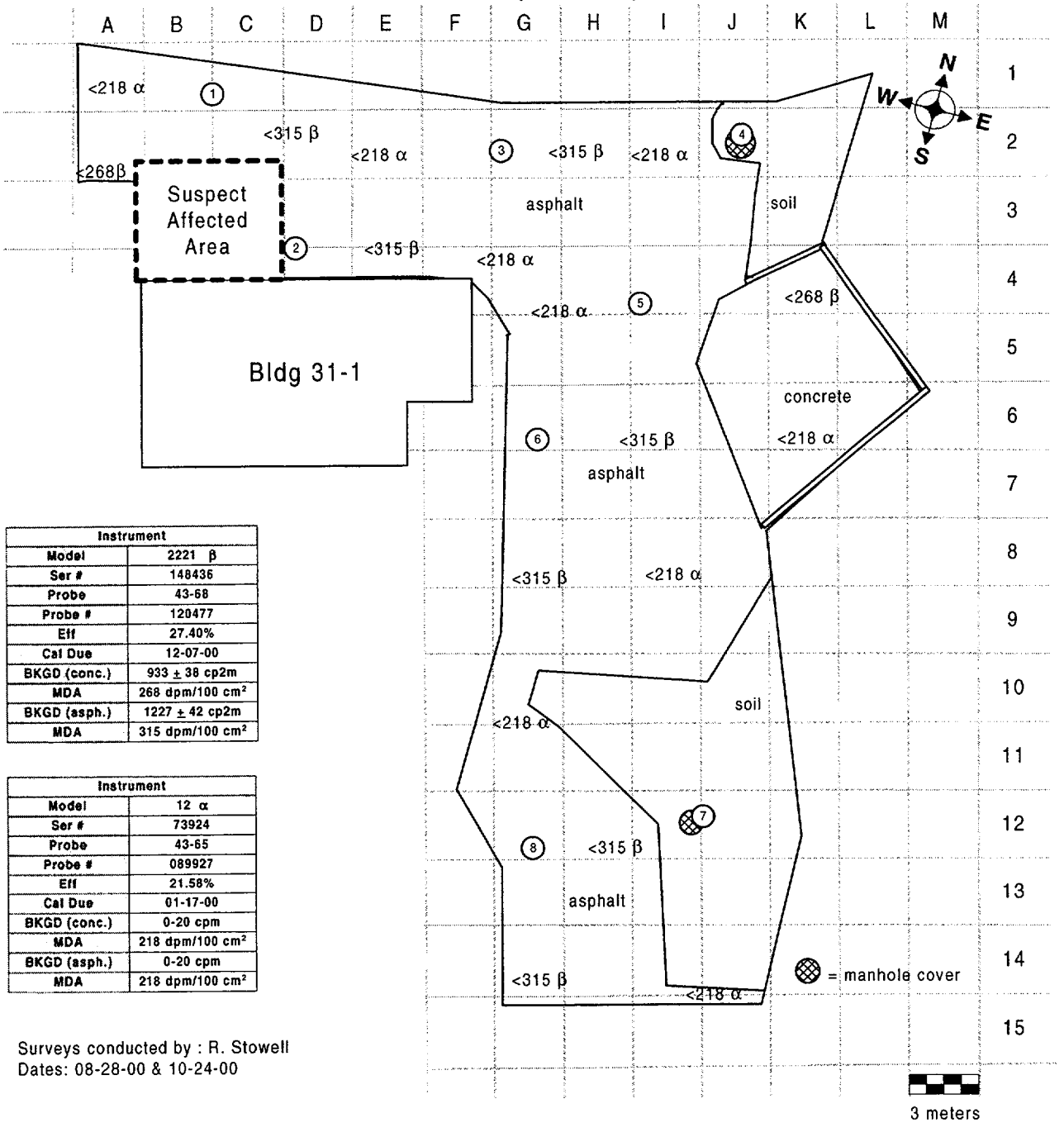
Instrument	
Model	Ludlum 2221 α
Ser #	97287
Probe	43-37 (434 cm²)
Probe #	148926
Eff	21.25%
Cal Due	02-22-01
Eff	21.25%
Cal Due	09-13-00
BKGD (conc)	0-20
BKGD (asphalt)	0-20

Surveys Conducted by: R. Stowell
Dates: 8-23-00 & 8-25-00

Notes

1. 10 % of accessible flat surface area scanned with results ranging from 10 - 30 cpm.
2. ▭ Denotes scan area.
3. ←xx-xx→ Denotes scan range in cpm.

Figure 6: Unaffected Area Fixed Alpha and Fixed Beta Measurement Locations and Results and Wipe Survey Locations



Instrument	
Model	2221 β
Ser #	148436
Probe	43-68
Probe #	120477
Eff	27.40%
Cal Due	12-07-00
BKGD (conc.)	933 ± 38 cp2m
MDA	268 dpm/100 cm²
BKGD (asph.)	1227 ± 42 cp2m
MDA	315 dpm/100 cm²

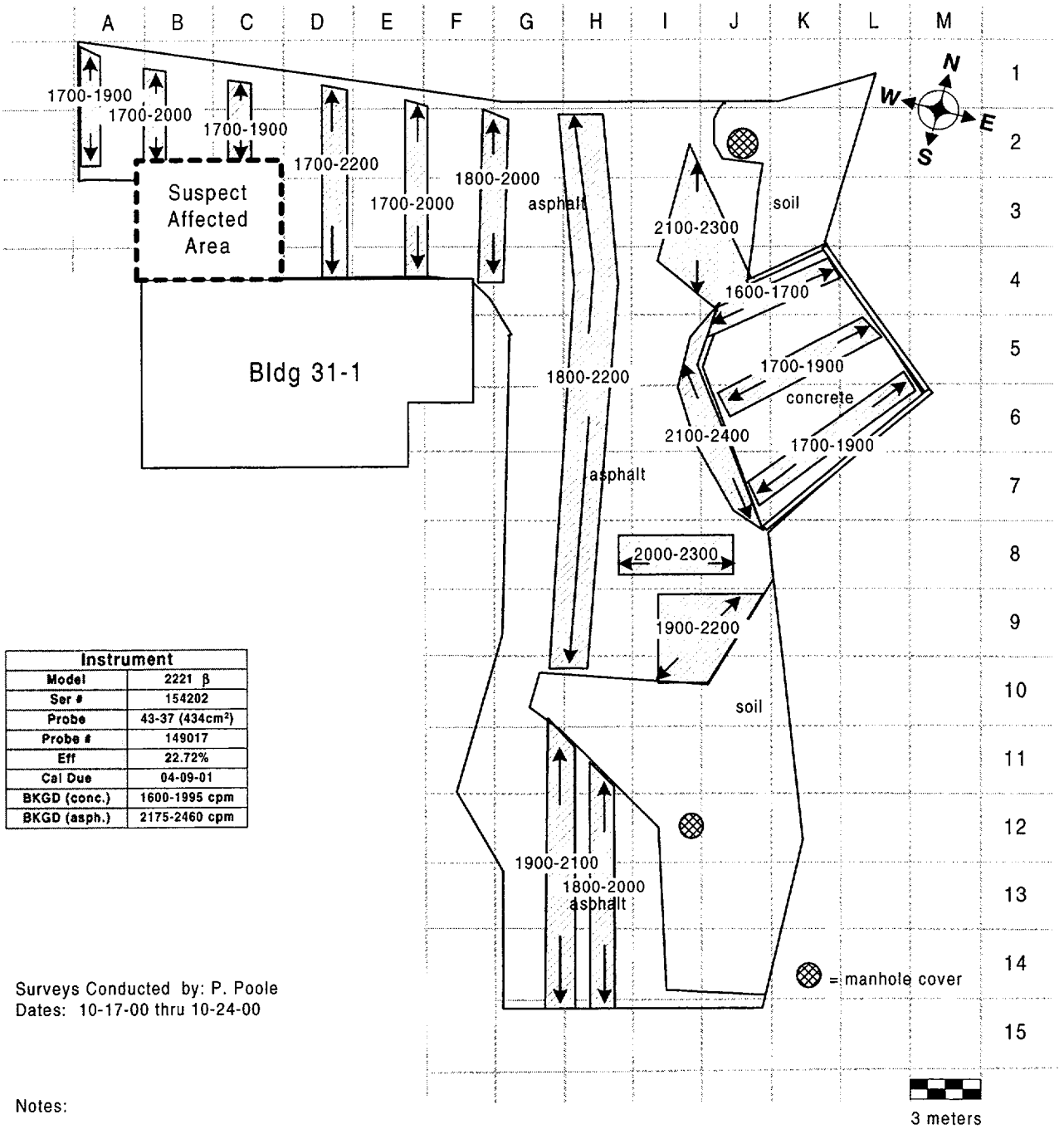
Instrument	
Model	12 α
Ser #	73924
Probe	43-65
Probe #	089927
Eff	21.58%
Cal Due	01-17-00
BKGD (conc.)	0-20 cpm
MDA	218 dpm/100 cm²
BKGD (asph.)	0-20 cpm
MDA	218 dpm/100 cm²

Surveys conducted by : R. Stowell
Dates: 08-28-00 & 10-24-00

Notes:.

1. (X) Denotes approximate wipe location. Wipe results are provided in Table 5.
2. Fixed alpha readings (XXX α) are in dpm/100 cm² with a maximum result of <218 dpm/100cm². (MDA for asphalt and concrete)
3. Fixed Beta readings (XXX β) are in dpm/100 cm² with a maximum result of < 315 dpm/100cm² (MDA for asphalt).

Figure 7: Unaffected Area Beta Scan Survey Locations and Results



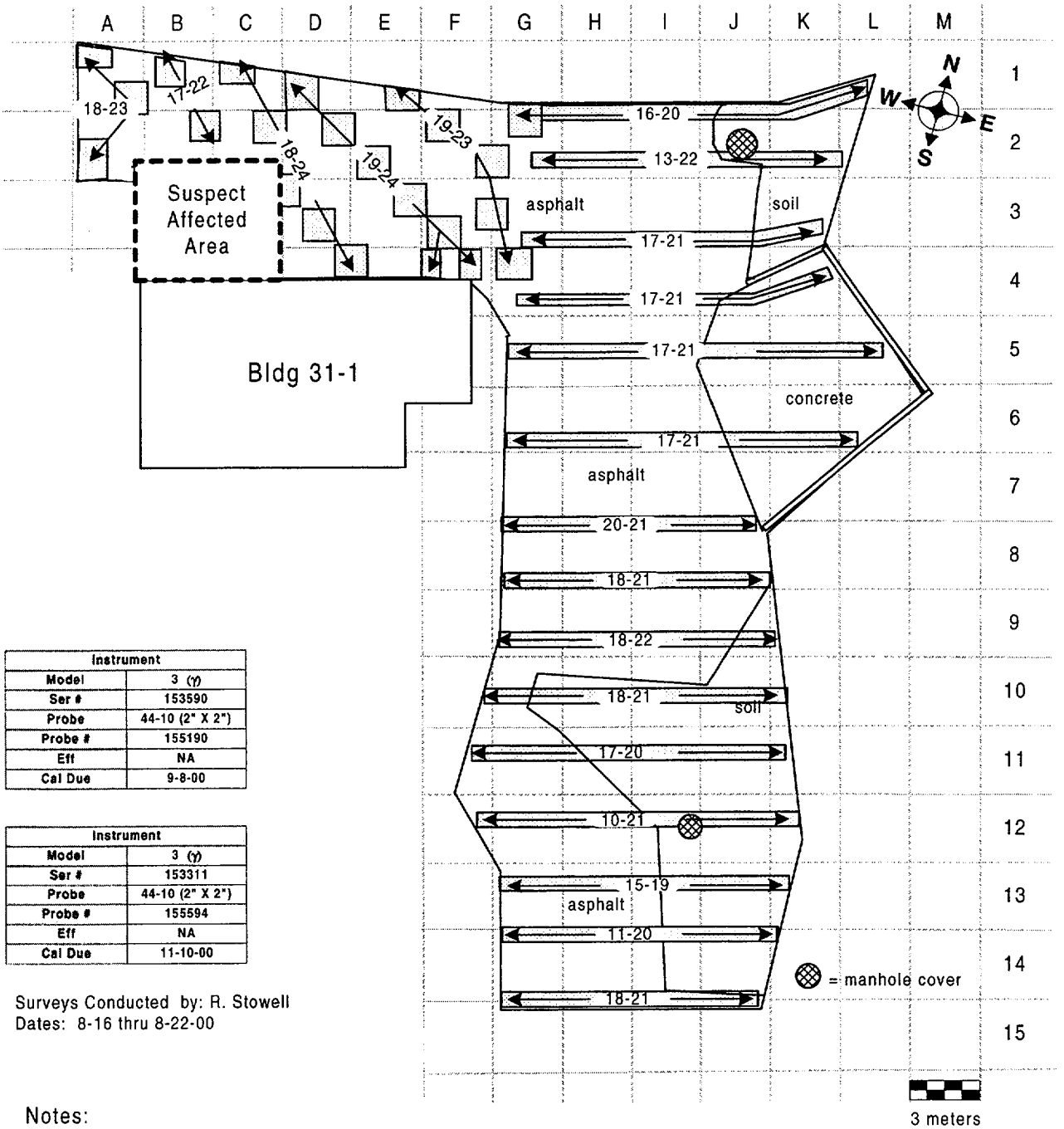
Instrument	
Model	2221 β
Ser #	154202
Probe	43-37 (434cm²)
Probe #	149017
Eff	22.72%
Cal Due	04-09-01
BKGD (conc.)	1600-1995 cpm
BKGD (asph.)	2175-2460 cpm

Surveys Conducted by: P. Poole
Dates: 10-17-00 thru 10-24-00

Notes:

1. 10% of flat surfaces scanned with a result of 1600 to 2400 cpm .
2. ▭ Denotes area scanned.
3. ← xxxx-xxxx → Denotes scan range in cpm.

Figure 8: Unaffected Area Exposure Rate Scan Measurement Locations and Results



Instrument	
Model	3 (γ)
Ser #	153590
Probe	44-10 (2" X 2")
Probe #	155190
Eff	NA
Cal Due	9-8-00

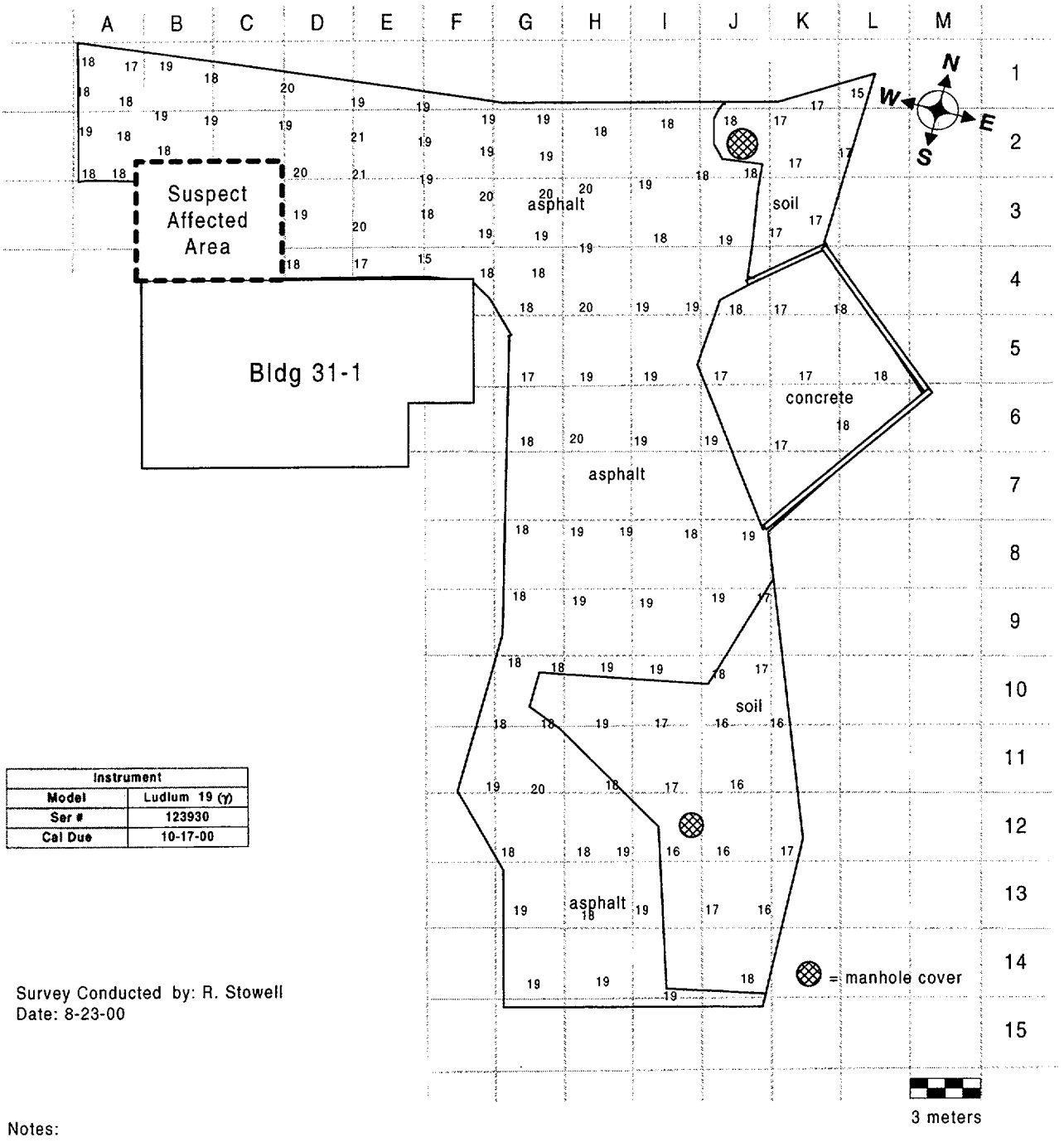
Instrument	
Model	3 (γ)
Ser #	153311
Probe	44-10 (2" X 2")
Probe #	155594
Eff	NA
Cal Due	11-10-00

Surveys Conducted by: R. Stowell
Dates: 8-16 thru 8-22-00

Notes:

1. 25% of surface scanned with results ranging 10-24 µR/hr.
2. ▭ Denotes area scanned.
3. ← xx-xx → Denotes scan range in µR/hr

Figure 9: Unaffected Area Exposure Rate Fixed Measurement Locations and Results



Instrument	
Model	Ludlum 19 (γ)
Ser #	123930
Cal Due	10-17-00

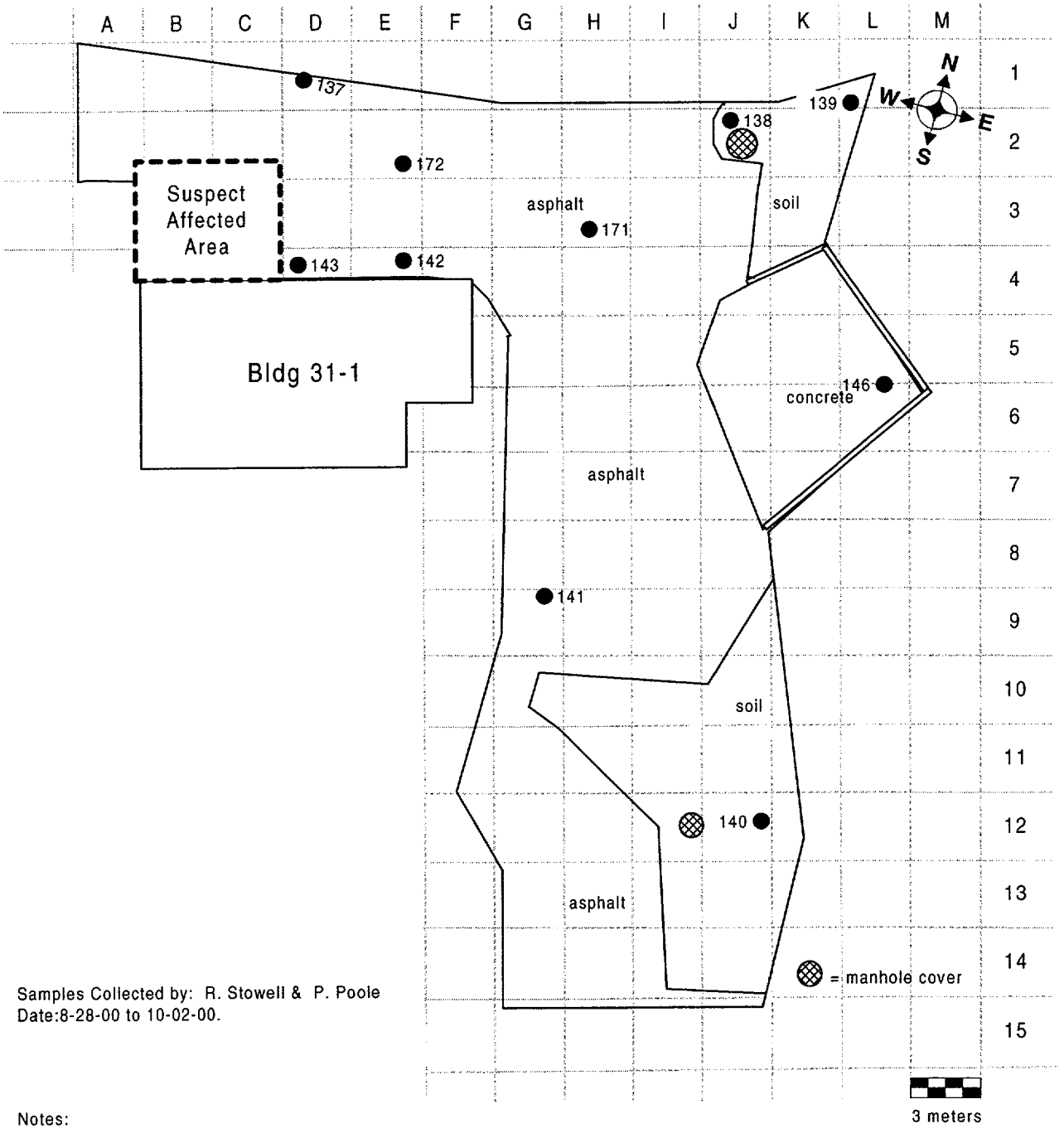
Survey Conducted by: R. Stowell
Date: 8-23-00

Notes:

1. XX Denotes reading in µR/hr taken one meter above the surface.

2.. Results range from 15 to 21 µR/hr.

Figure 10: Unaffected Area Soil Sample Locations

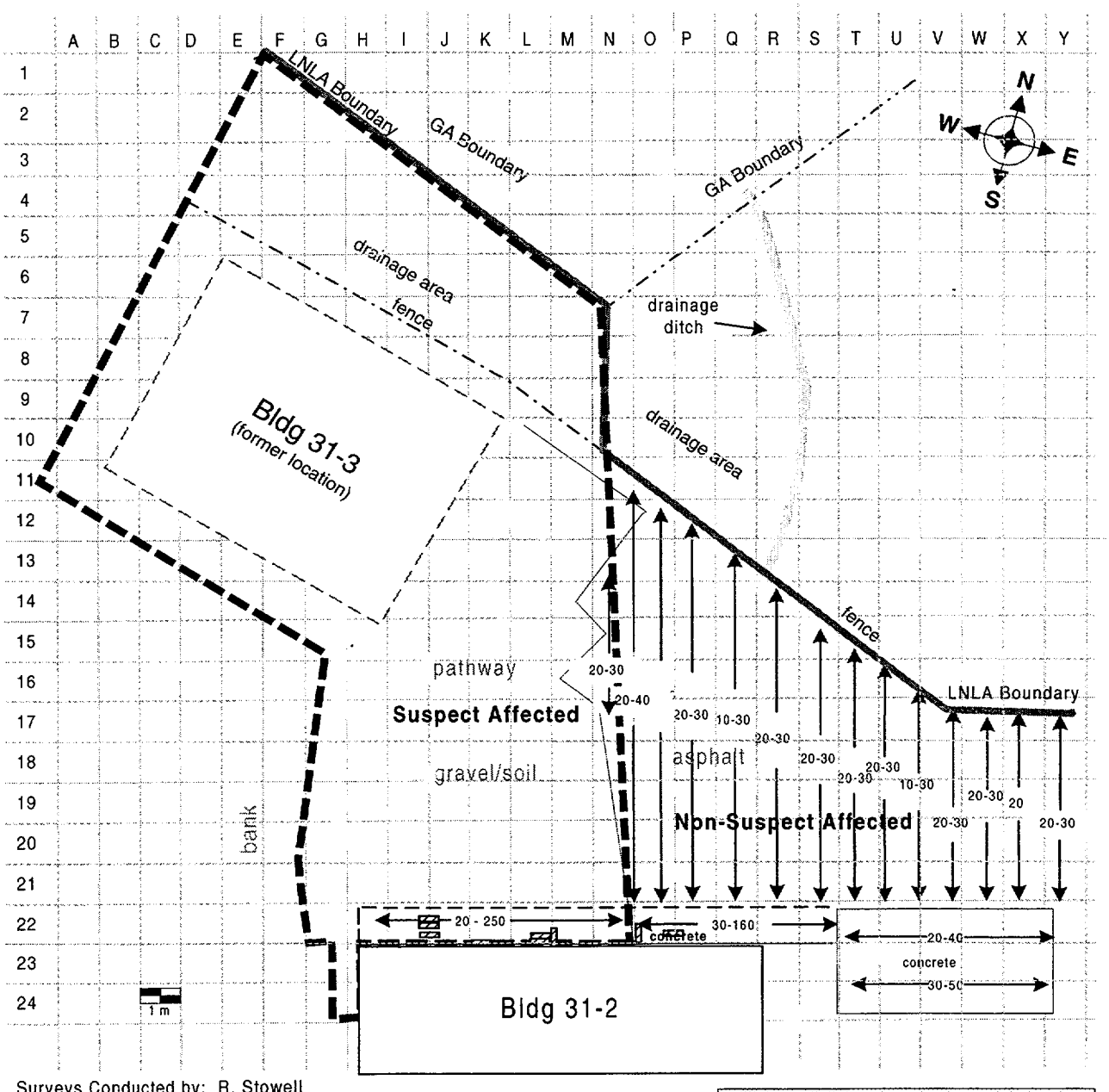


Samples Collected by: R. Stowell & P. Poole
Date:8-28-00 to 10-02-00.

Notes:

1. Soil Sample results are provided in Table 6.
2. Soil Sample ID LNLA-S-XXX
3. ● XXX Denotes approximate sample location.

Figure 11: Affected Areas Alpha Scan Locations and Results



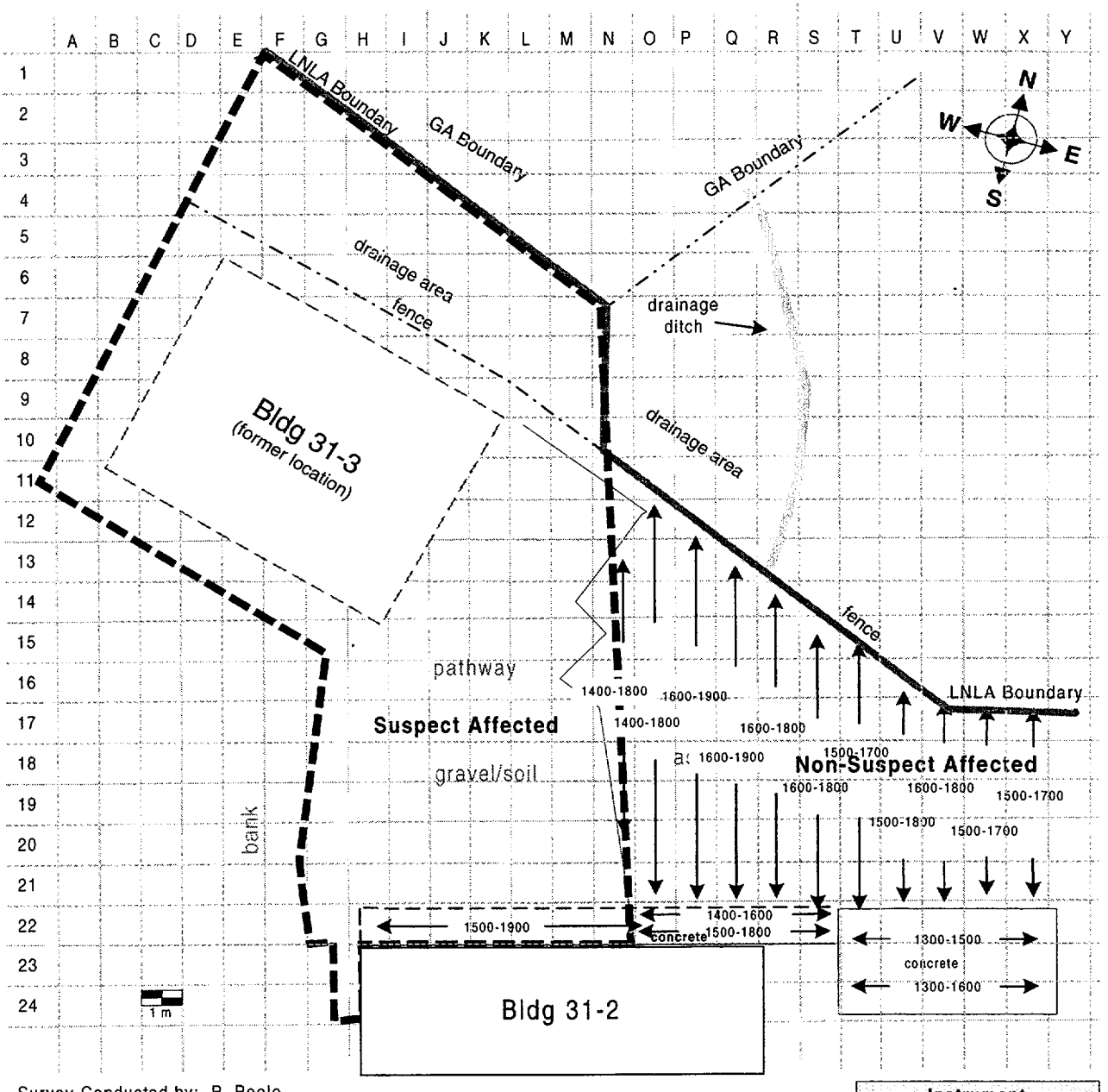
Surveys Conducted by: R. Stowell
Dates: 08-14-00 thru 09-21-00

Notes:

1. ←XX-XX→ Denotes scan range in cpm .
2. Approximately 100% of available flat surface area scanned. Results range from 10 to 250 cpm.
3. ▭ Denotes an elevated area (>100 cpm).
4. Nine elevated areas were resurveyed using a 50 cm^2 alpha detector with a maximum result of 417 dpm/100cm^2.

Instrument		
Model	Ludlum 2221 α	Ludlum 12 α
Serial #	97287	73924
Probe	43-37 (434 cm^2)	43-65 (50 cm^2)
Probe #	148926	089927
Efficiency	21.25%	21.58%
Cal Due Date	02-22-01	01-17-01
BKGD (conc)	0-20 cpm	0-20 cpm
BKGD (asph)	0-20 cpm	NA

Figure 12: Affected Areas Beta Scan Locations and Results



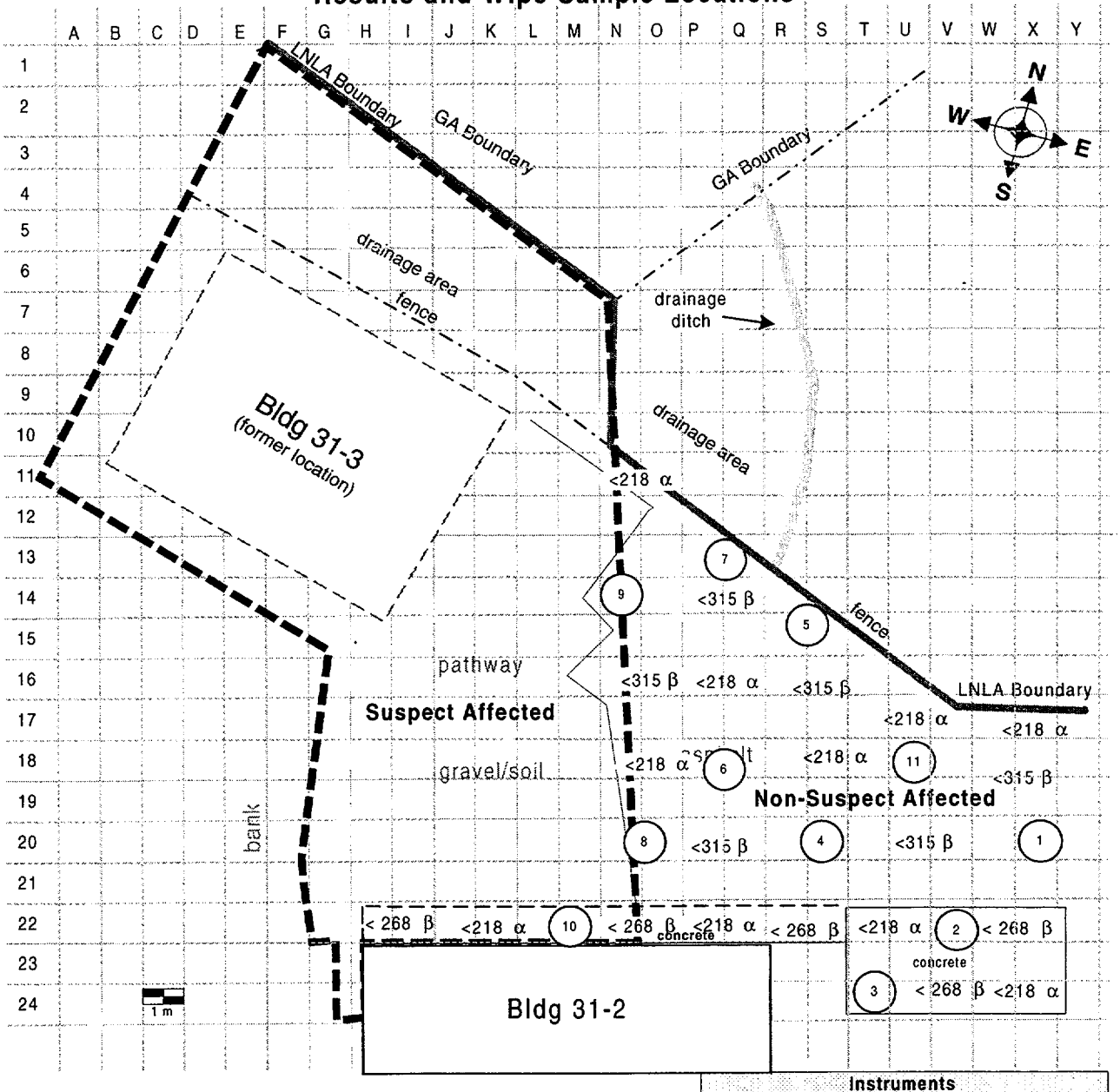
Survey Conducted by: P. Poole
Date: 10-24-00

Instrument	
Model	Ludlum 2221 β
Serial #	154202
Probe	43-37 (434 cm²)
Probe #	149017
Efficiency	22.72%
Cal Due Date	04-09-01
BKGD (conc)	1600-1995 cpm
BKGD (asph)	2175-2460 cpm

Notes:

1. 100% of available flat surfaces scanned . Results range from 1300 to 1900 cpm.
2. ← XXXX-XXXX → Denotes scan range in cpm.

Figure 13: Affected Areas Alpha and Beta Fixed Measurement Locations and Results and Wipe Sample Locations



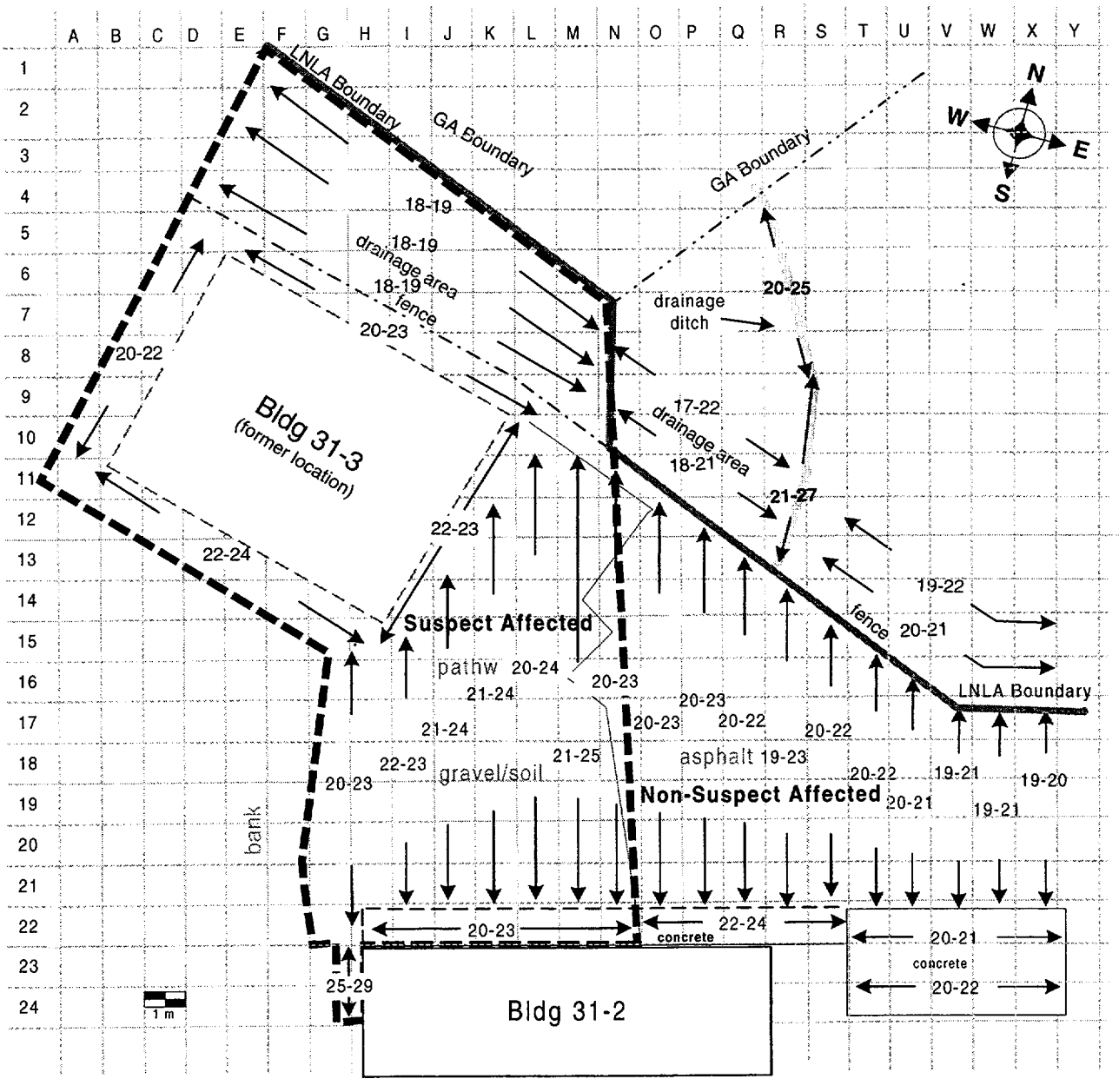
Instruments		
Model	Ludlum 2221 (β)	Ludlum 12 (α)
Serial #	148436	91051
Probe	43-68	43-65
Probe #	120477	094053
Efficiency	27.40%	21.58%
Cal Due Date	12-07-00	04-05-01
BKGD (concrete)	933 cp2m	0.-20 cpm
MDA (concrete)	268 dpm/100 cm2	218 dpm/100 cm2
BKGD (asphalt)	1227 cp2m	0-20 cpm
MDA (asphalt)	315 dpm/100 cm2	218 dpm/100 cm2

Surveys Conducted by: R. Stowell & P.Poole
Date: 10-24-00

Notes:

1. XXX β Denotes a fixed beta reading in dpm/100 cm^2. Maximum result for beta was <315 dpm/100 cm^2 (MDA for asphalt).
2. XXX α Denotes a fixed alpha reading in dpm/100 cm^2. Maximum result for alpha was <218 dpm/100 cm^2 (MDA for asphalt and concrete).
3. (XX) Denotes a wipe location. Wipe results are provided in Table 5.

Figure 14: Affected Areas Exposure Rate Scan Locations and Results



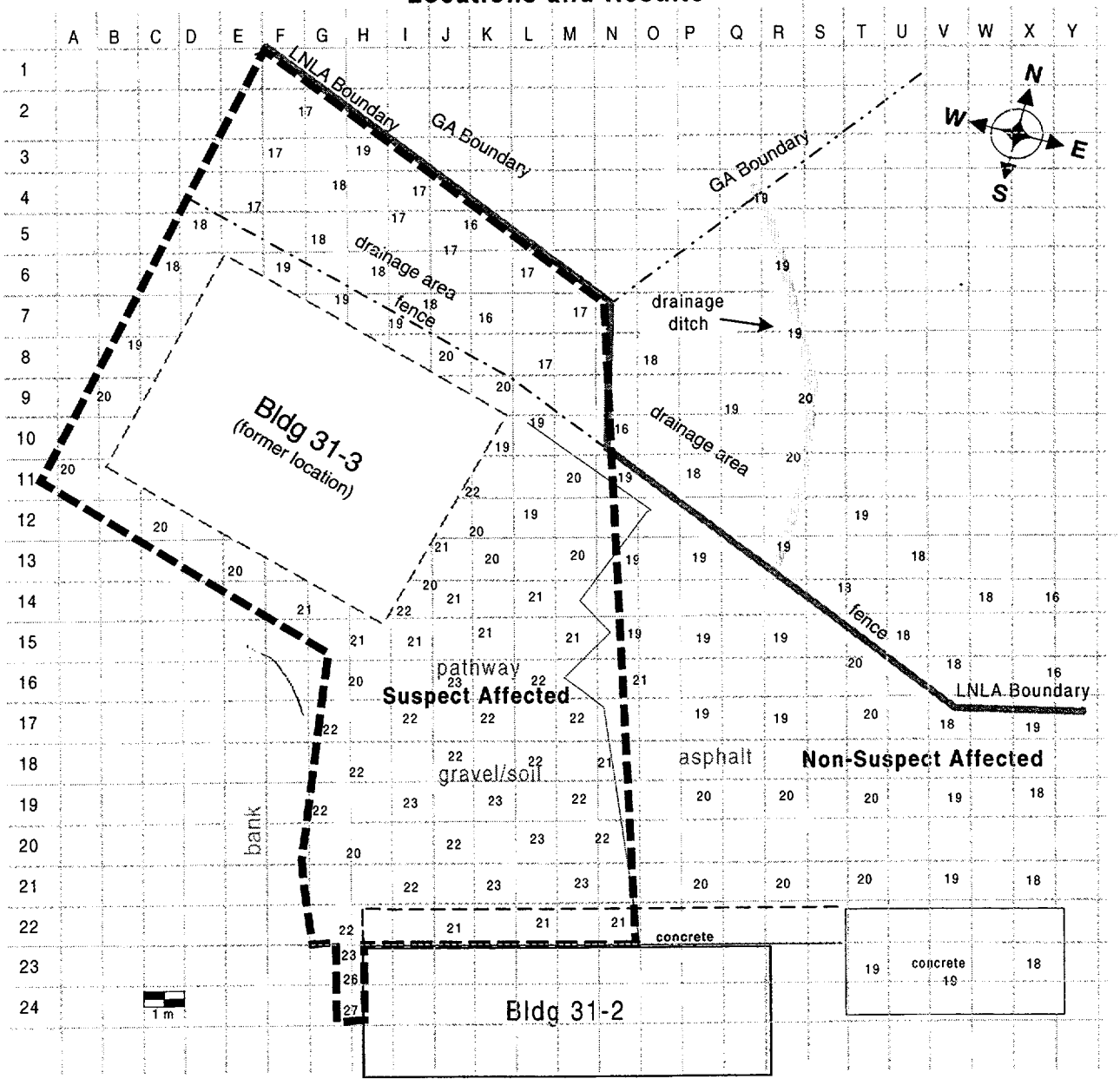
Surveys Conducted by: R Stowell & J. Vassett
Dates: 8/10/00 thru 11/08/00.

Instruments		
Model	Ludlum 3 (γ)	Ludlum 3 (γ)
Serial #	153590	147819
Probe	44-10 (2" X 2")	44-10 (2" X 2")
Probe #	155190	153765
Efficiency	NA	NA
Cal Due Date	09-08-00	11-08-00

Notes:

1. Approximately 100 % of the accessible surface area scanned.
2. ← xx-xx → Denotes surface scan range in µR/hr.
3.. Scan results range from 18 to 29 µR/hr inside LNLA and 17-27 µR/hr outside LNLA.

Figure 15: Affected Areas Fixed Exposure Rate Measurement Locations and Results



Surveys Conducted by: R. Stowell & J. Vassett
Dates:09-11-00 thru 09-26-00

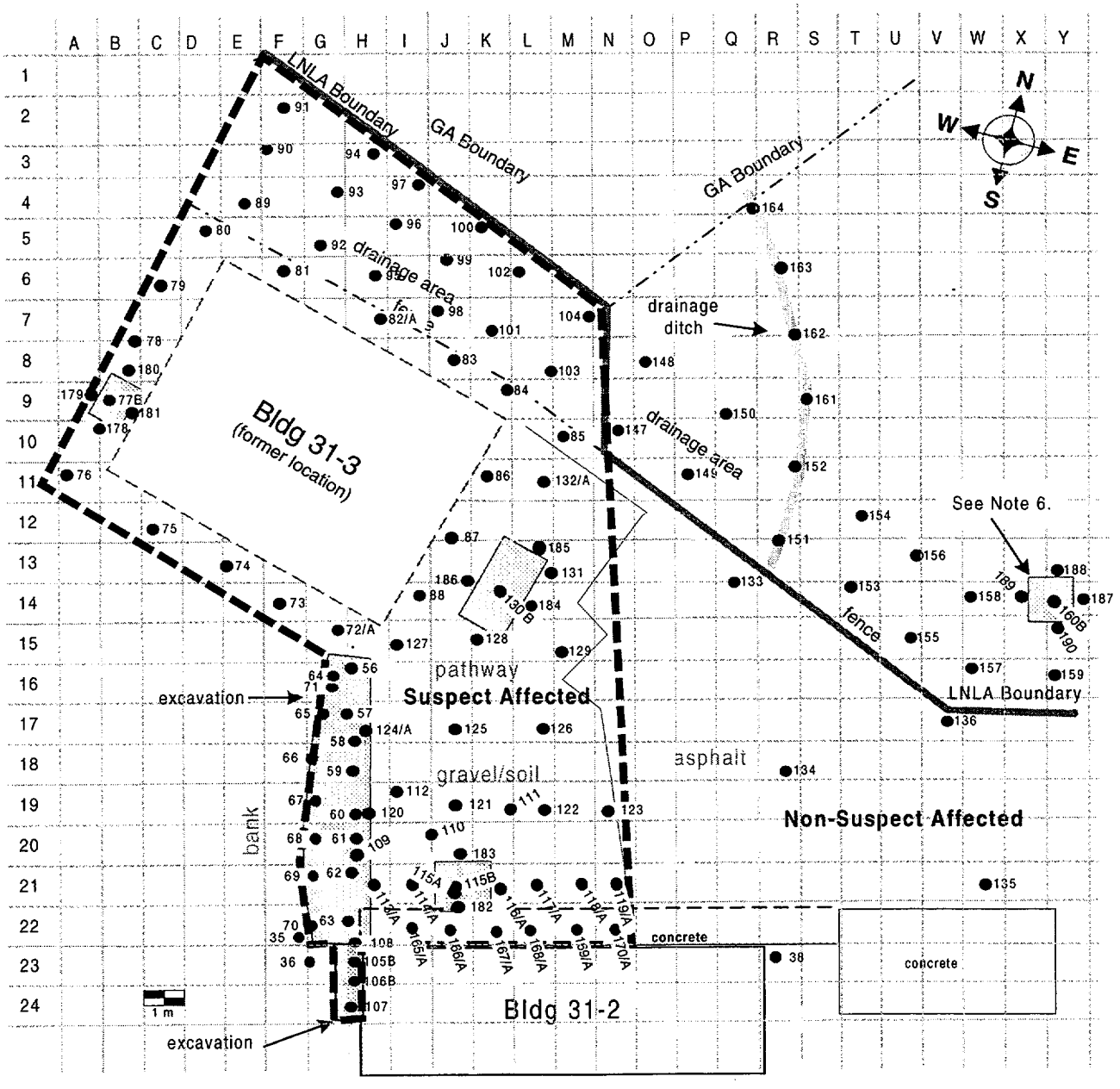
Instruments		
Model	Ludlum 3 (γ)	Ludlum 3 (γ)
Serial #	153590	147819
Probe	44-10	44-10
Probe #	155190	153765
Cal Due Date	12-07-00	11-08-00

Notes:

1. Exposure rates were taken at approximately 1 meter above the surface and are recorded in μR/hr.

2. Results range from 16-27μR/hr inside LNLA Boundary and 16-20 μR/hr outside LNLA Boundary.

Figure 16: Affected Areas Soil Sample Locations and Remediated Areas

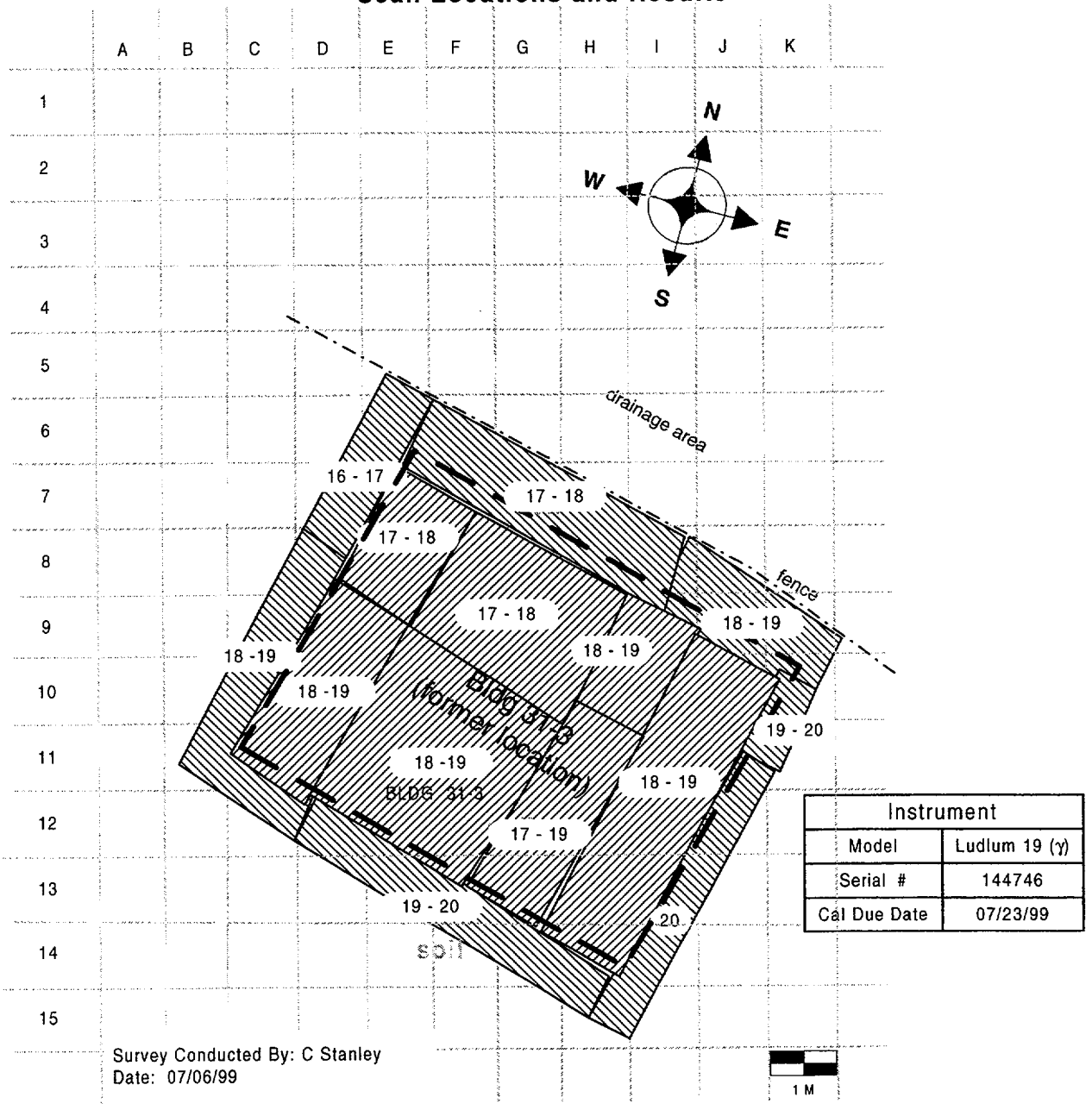


Surveys Conducted by: J Vasset, P.Poole & R Stowell
Dates:8/28/00 thru 10/23/00

Notes:

1. Soil sample results are provided in Table 6.
2. ●XXX Denotes approximate soil sample location, LNLA-S-XXX.
3. ●XXXB Denotes resample at original location following remediation.
4. ●XXX/A Denotes dual sample, surface 0-6" and subsurface 6-12".
5. ▭ Denotes excavated / remediated area.
6. The original sample at this location had 98% of the limit for U-235. This area was excavated and resampled as shown.

Figure 17: Building 31-3 Suspect Affected Area Exposure Rate Scan Locations and Results

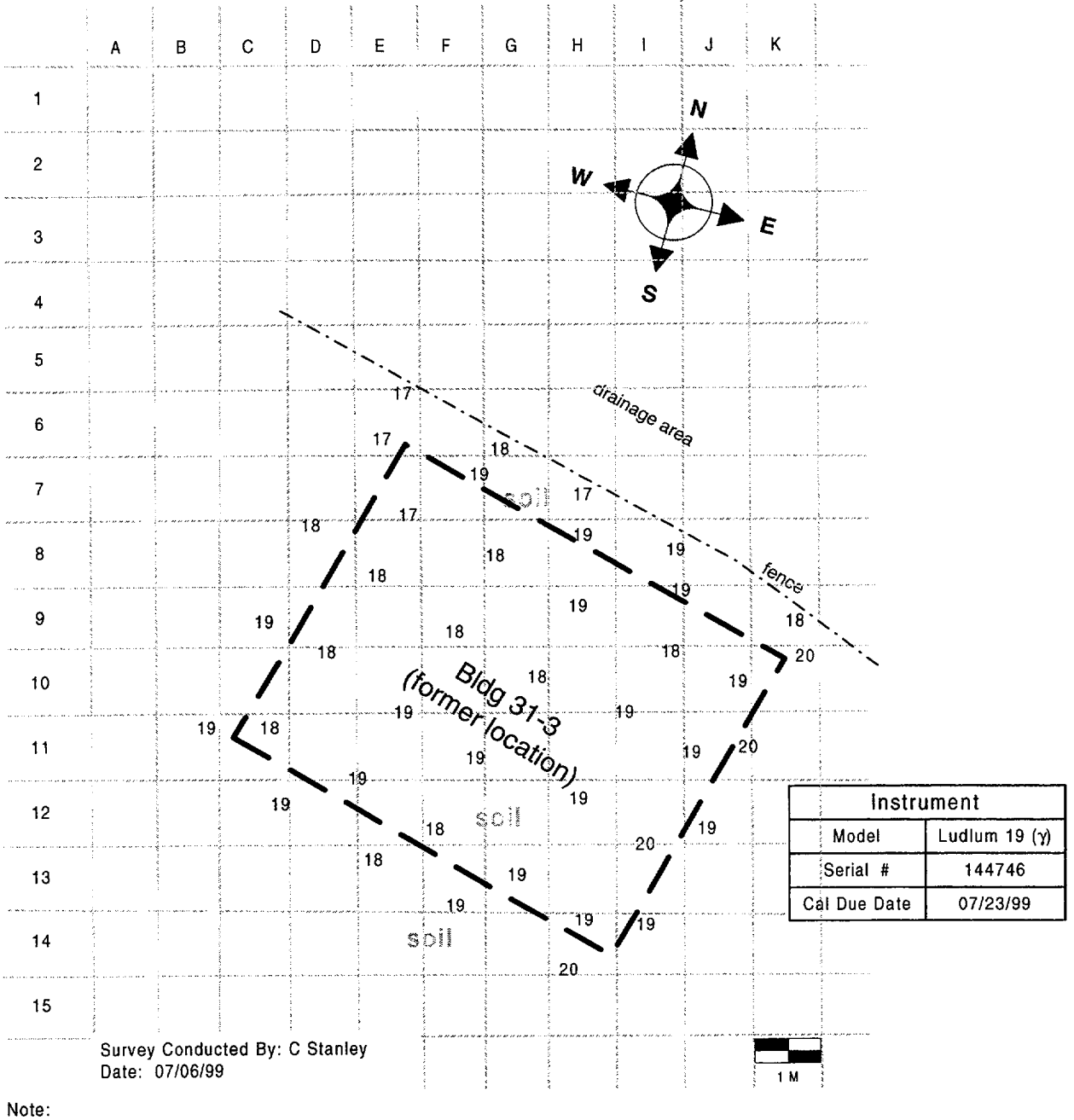


Instrument	
Model	Ludlum 19 (γ)
Serial #	144746
Cal Due Date	07/23/99

Notes:

1. Approximately 100% of of the accessible surface area scanned.
2. Denotes surface scan area, ranges shown in µR/hr.
3. Scan results range from 17 to 20 µR/hr.

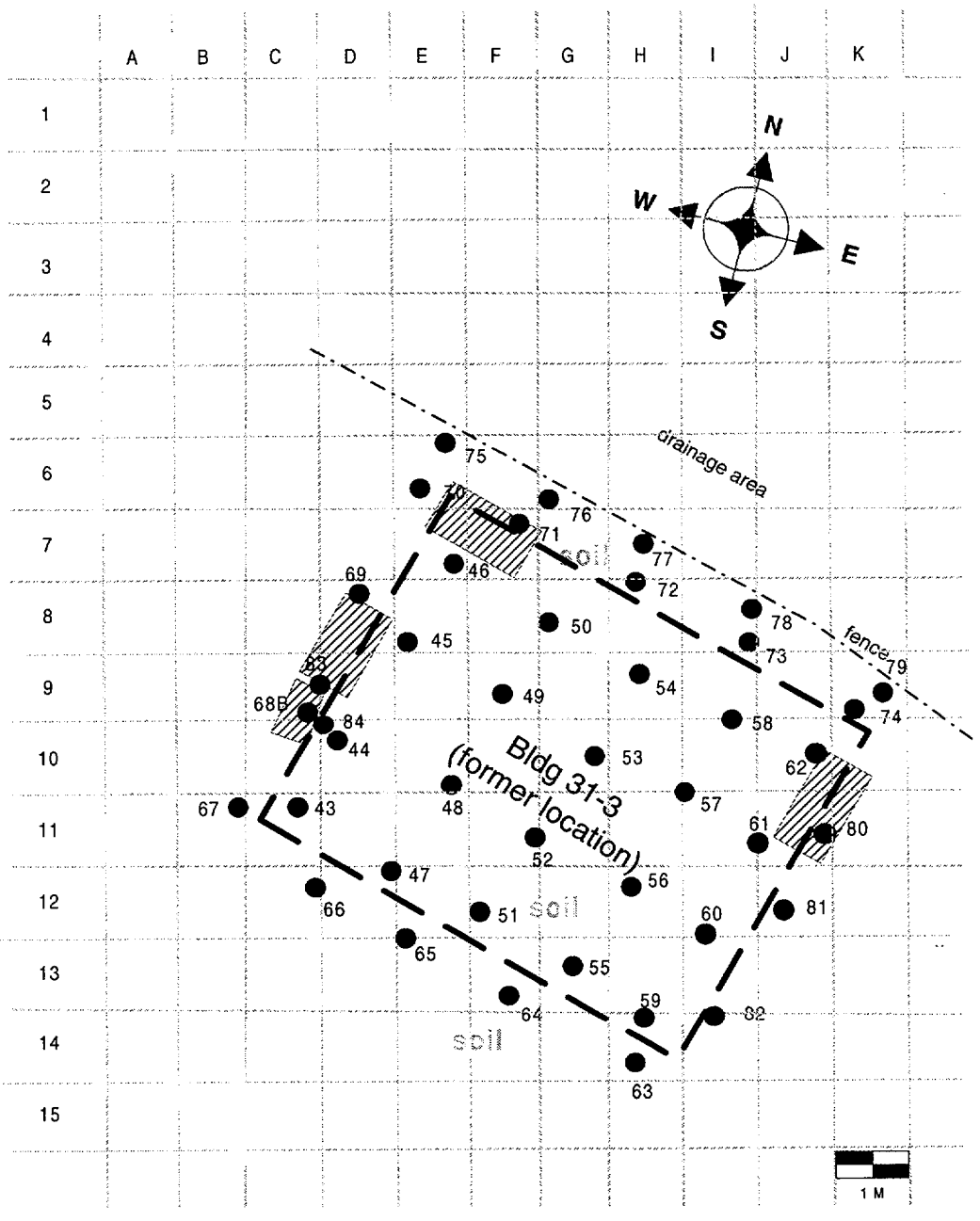
Figure 18: Building 31-3 Suspect Affected Area Exposure Rate Fixed Measurement Locations and Results



Note:

1. All readings are in µR/hr and taken at ~ 1m above the surface.
2. Results range from 17 to 20 µR/hr.

Figure 19: Building 31-3 Suspect Affected Area Soil Sample Locations and Remediated Areas

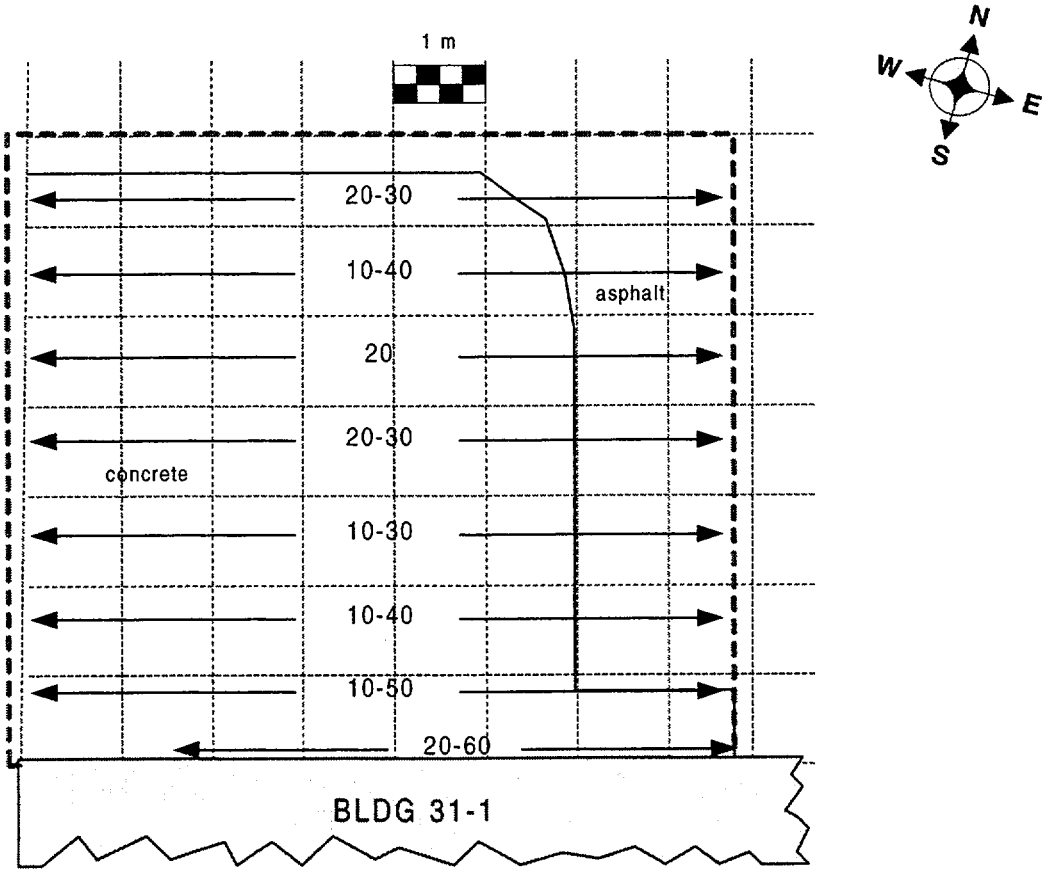


Samples Collected By: C. Stanley & R .Stowell
Dates: 07/06/99 & 12/04/00

Notes:

1. Soil sample results are provided in Table 6.
2. ● xx Denotes soil sample location, 31-3-XX.
3. ▨ Denotes remediated area.

Figure 20: Suspect Affected Area Outside Building 31-1 Alpha Scan Locations and Results



Surveys Conducted by: R. Stowell
Dates: 8-23-00 & 8-25-00

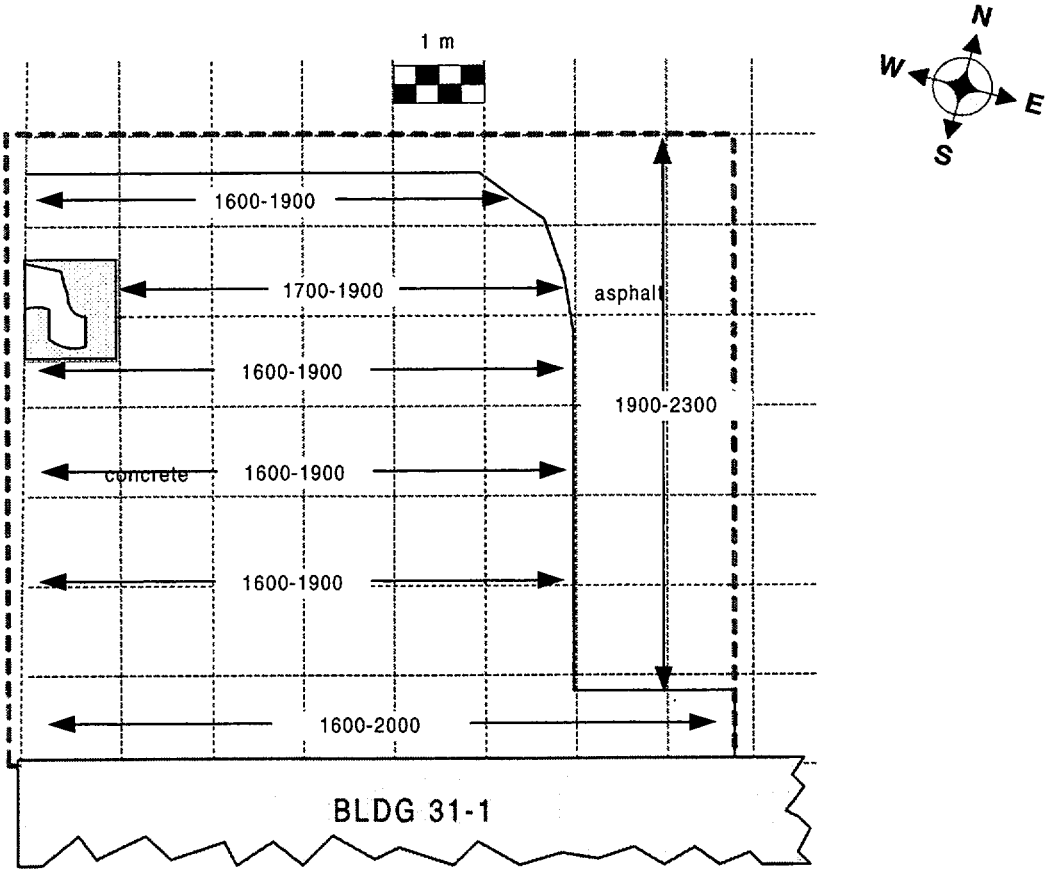
Instrument	
Model	Ludlum 2221 α
Ser #	97287
Probe	43-37 (434 cm²)
Probe #	148926
Eff	21.25%
Cal Due	02-22-01
Eff	21.25%
Cal Due	09-13-00
BKGD (conc)	0-20
BKGD (asphalt)	0-20

Notes

1. 100% of accessible flat surface area scanned with results ranging from 10 - 60 cpm.

3. ◄—— xx-xx ——► Denotes scan range in cpm.

Figure 21: Suspect Affected Area Outside Building 31-1
Beta Scan Locations and Results



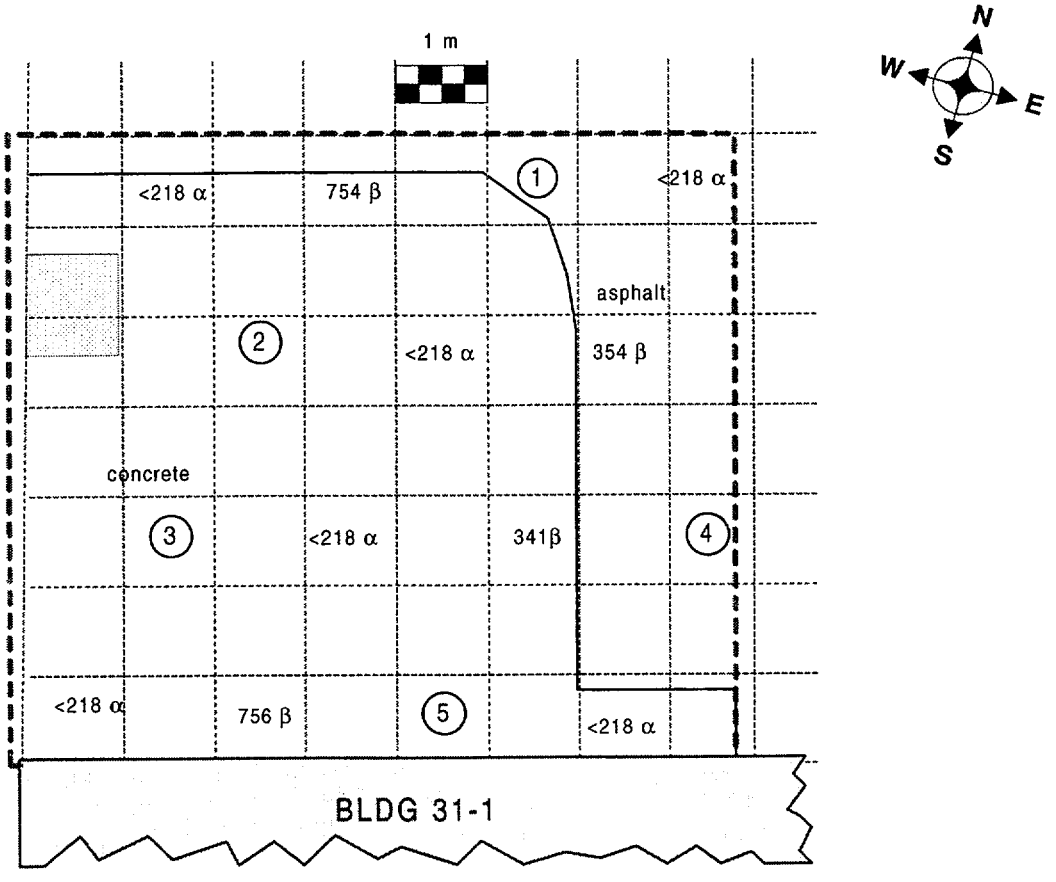
Instruments		
Model	2221 β	2221 β
Ser #	154202	148436
Probe	43-37 (434cm²)	43-68 (100cm²)
Probe #	149017	120477
Eff	22.72%	27.40%
Cal Due	04-09-01	12-07-00
BKGD (conc.)	1600-1995 cpm	933 cp2m
BKGD (asph.)	2175-2460 cpm	1227 cp2m

Survey Conducted By: P. Poole
Dates: 10-17-00 to 10-18-00

Notes:

1. ~100% of accessible surface area scanned with a result of 1600-2300 cpm except as noted below.
2. One small area, denoted as , had scan results of up to 6000 cpm. Contamination was identified as Co-60.
3. Subsequent investigation using a 100 cm^2 beta detector resulted in (12) two-minute fixed readings with a maximum of 3220 dpm/ 100 cm^2 with an average of 1182 dpm/100 cm^2 (below the Co-60 release criteria).
4. ← XX → Denotes scan range in cpm.
5. Denotes area where concrete was removed to access soil for sample LNLA-S-193

Figure 22: Suspect Affected Area Outside Building 31-1
Fixed Alpha and Beta Measurement Locations and Results and Wipe Locations



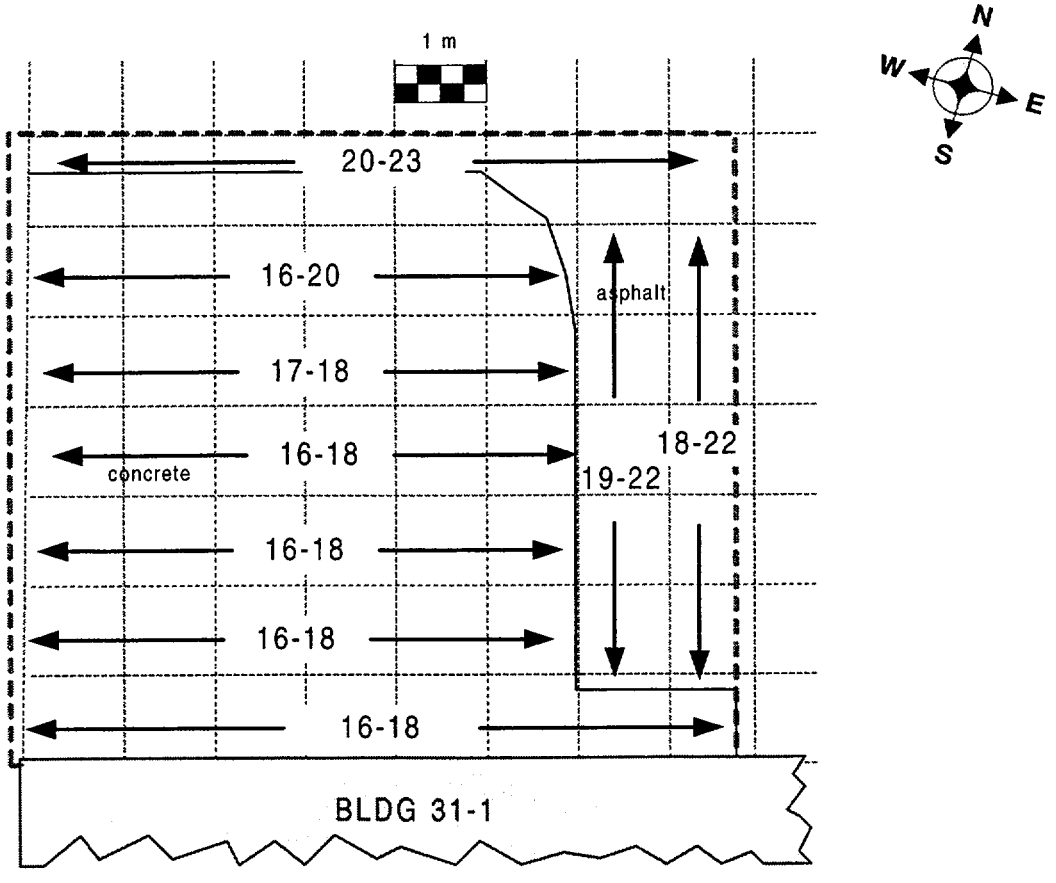
Surveys Conducted By: R. Stowell
Dates: 04-12-01 & 04-13-01

Instruments		
Model	Ludlum 2221 (β)	Ludlum 12 (α)
Serial #	148436	138739
Probe	43-68	43-65
Probe #	120477	145699
Efficiency	24.13	21.58%
Cal Due Date	09-26-01	08-31-01
BKGD (concrete)	933 cp2m	0-20 cpm
MDA (concrete)	268 dpm/100 cm2	218 dpm/100 cm2
BKGD (asphalt)	1227 cp2m	0-20 cpm
MDA (asphalt)	315 dpm/100 cm2	218 dpm/100 cm2

Notes:

1. (X) Denotes approximate wipe location. Wipe results are provided in Table 5.
2. XX α Denotes Fixed Alpha Measurement in dpm/100 cm^2. Results were all <218 dpm/100 cm^2, (MDA for asphalt and concrete.)
3. XXX β Denotes Two Minute Fixed Beta Measurement in dpm/100 cm^2. Results ranged from 341 to 756 dpm/100 cm^2.
4. ▭ Denotes area where concrete was removed to access soil for sample LNLA-S-193.

Figure 23: Suspect Affected Area Outside Building 31-1
Exposure Rate Scan Locations and Results



Survey Conducted By: R.Stowell
Date: 04-12-01

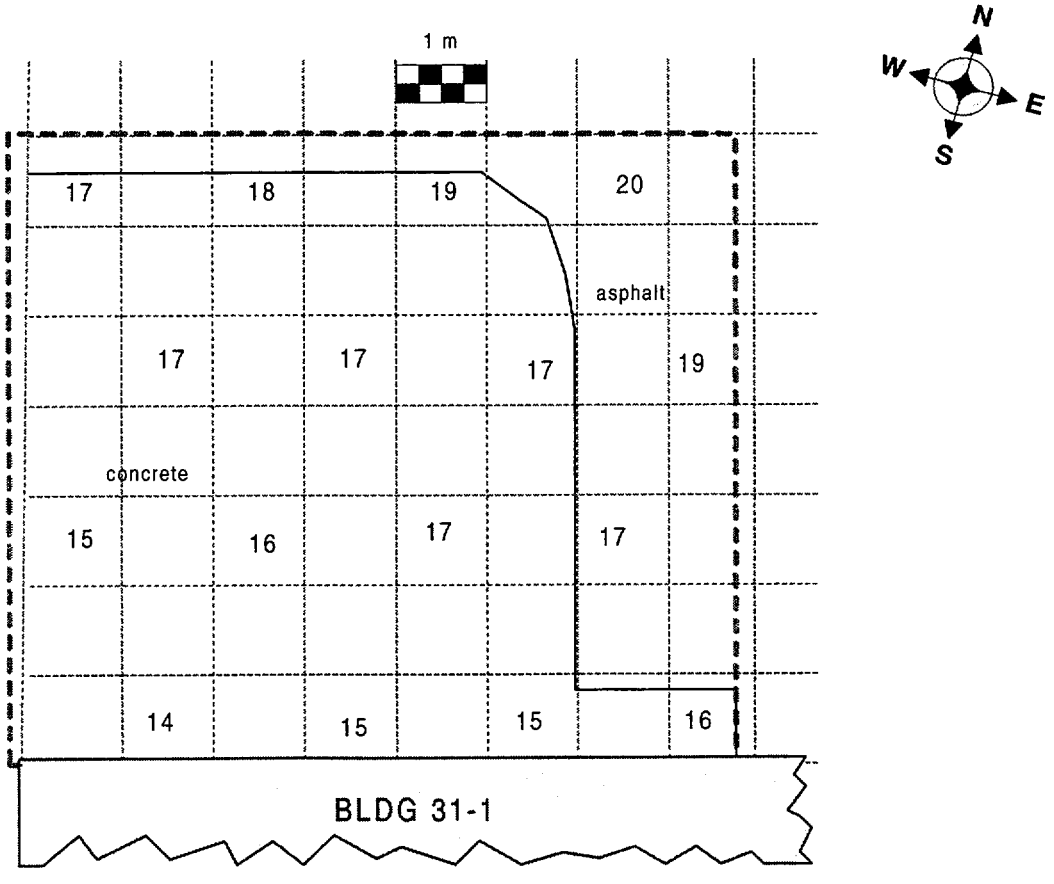
Instrument	
Model	Ludlum 3 (γ)
Serial #	147819
Probe	44-10
Probe #	153765
Cal Due Date	07-04-01

Notes:

1. 100 % of accessible surface scanned with results of 16 to 23 µR/hr.

2. ←xx-xx→ Denotes scan ranges in µR/hr.

Figure 24: Suspect Affected Area Outside Building 31-1
Fixed Exposure Rate Measurement Locations and Results



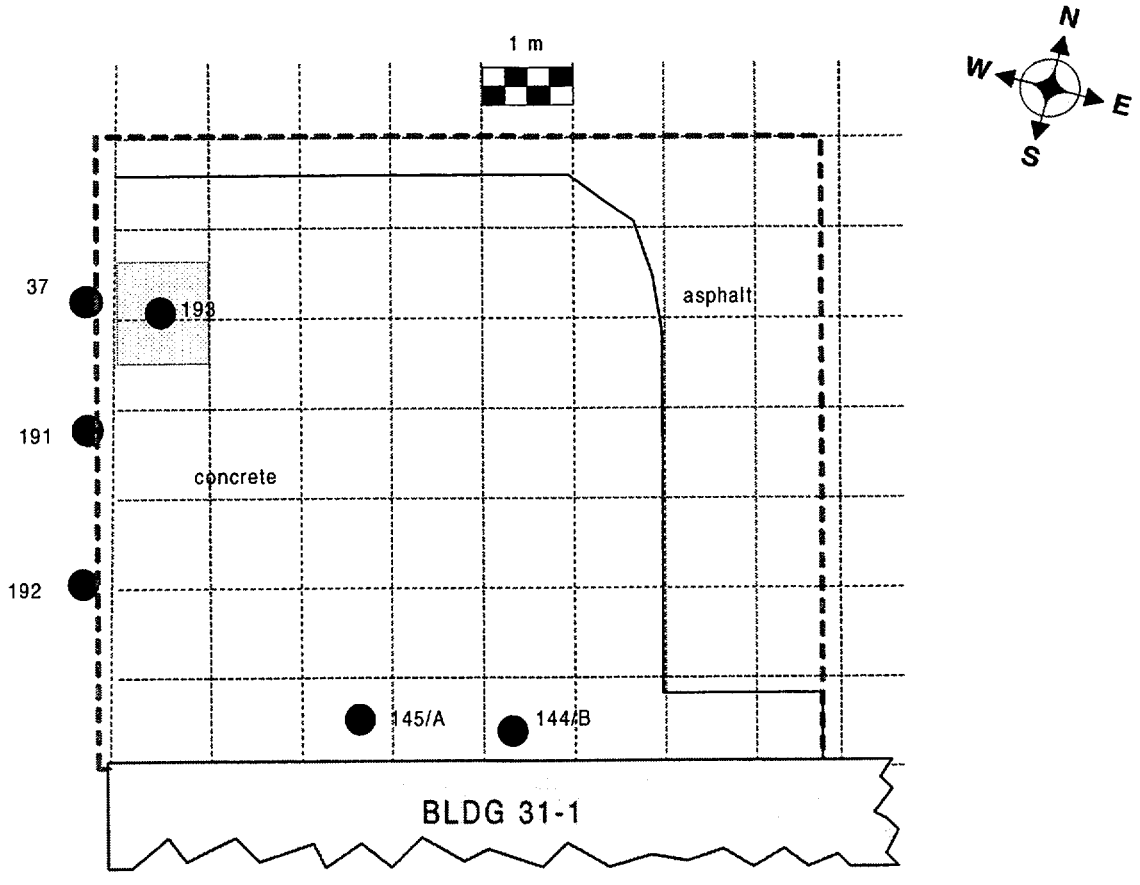
Survey Conducted By: R. Stowell
Date: 04-13-01

Instrument	
Model	Ludlum 3 (γ)
Serial #	147819
Probe	44-10
Probe #	153765
Cal Due Date	07-04-01

Notes:

1. XX Denotes reading in μR/hr taken 1 meter above the surface.
2. Results range from 14 to 20 μR/hr.

Figure 25: Suspect Affected Area Outside Building 31-1
Soil Sample Locations

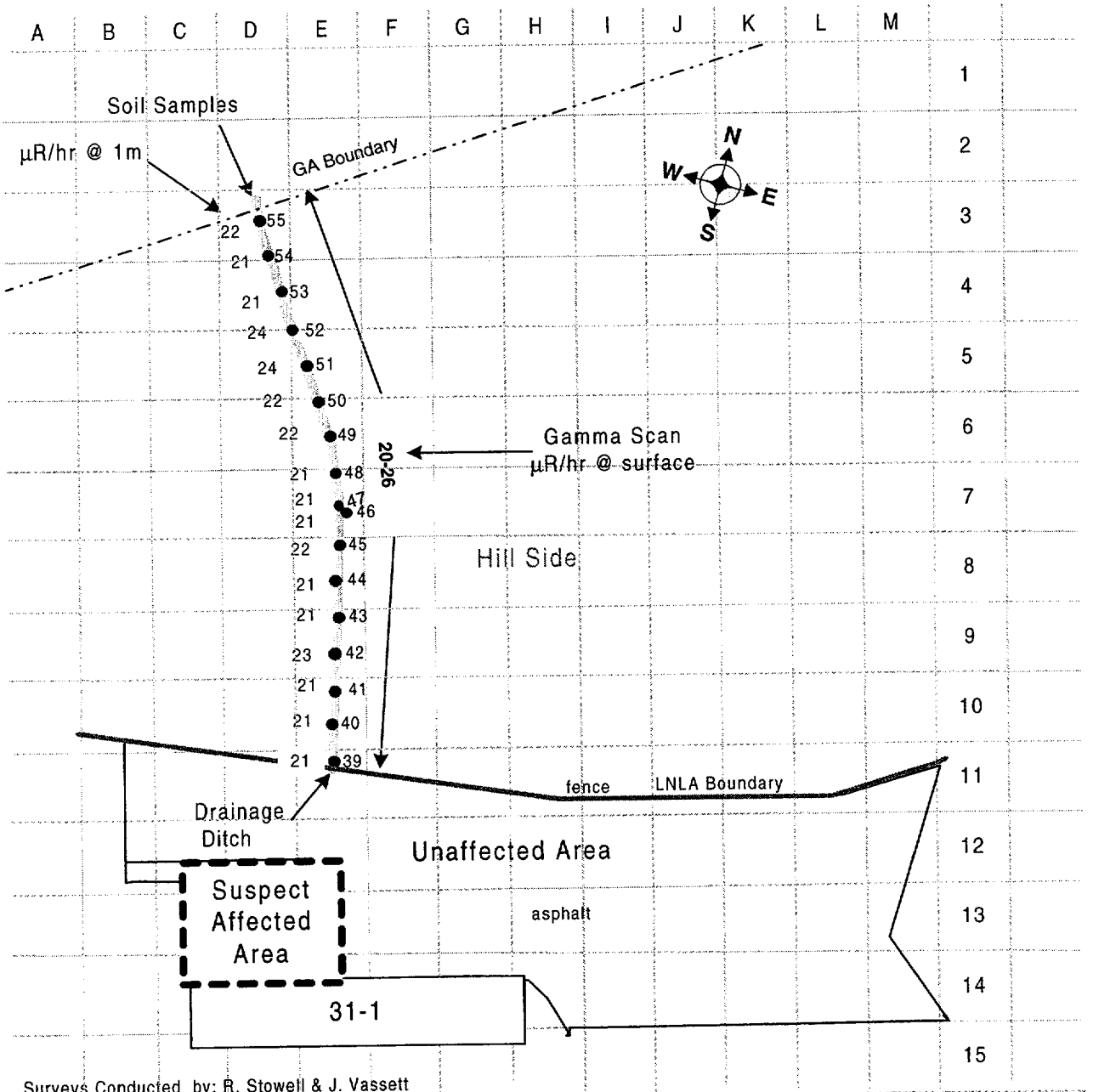


Samples Collected BY: R. Stowell & P. Poole
Dates: 08-28-00 to 04-27-01

Notes:

1. Soil Sample results are provided in Table 6.
2. ● XXX Denotes approximate soil sample location, LNLA-S-XX.
3. XXX/A or XXX/B Denote dual samples, surface (0-6") and subsurface (6-12").
4. ▭ Denotes area where concrete was removed.

Figure 26: Unaffected Area Drainage Surveys



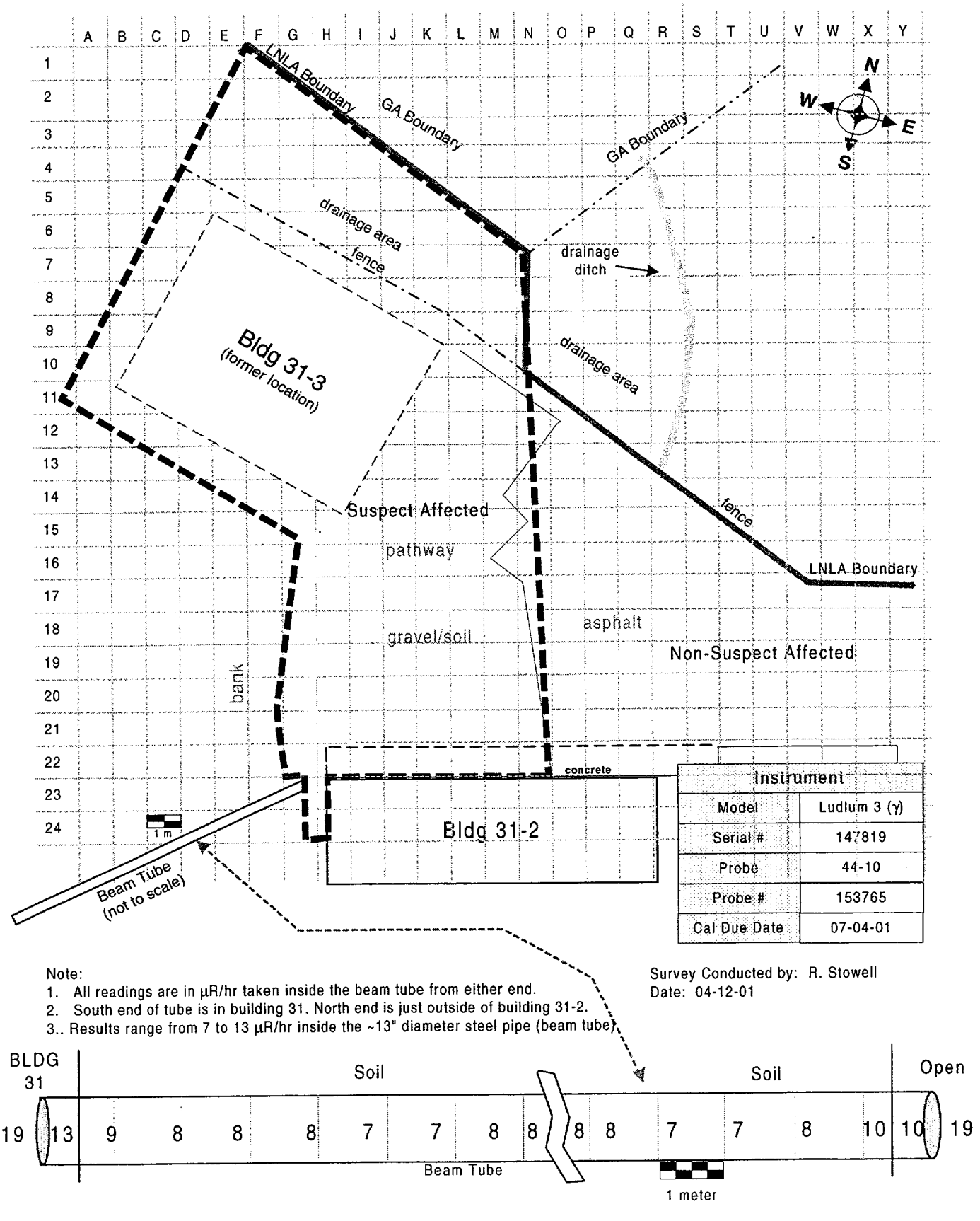
Surveys Conducted by: R. Stowell & J. Vassett
Dates: 08-31-00 thru 09-29-00

	Instrument	
Model	Ludlum 3 (γ)	Ludlum 3 (γ)
Ser #	153590	147819
Probe	44-10	44-10
Probe #	155190	153765
Eff	NA	NA
Cal Due	09-08-00	11-08-00

Notes:

1. Soil Sample results are provided in Table 6.
2. ● XX Denotes approximate soil sample location.
3. XX Denotes exposure rate measurement in µR/hr taken at ~1 meter above the surface. Results range from 21-24 µR/hr.
4. ←xx-xx→ Denotes gamma scan range in µR/hr taken in the drainage ditch at the surface. Results range from 20 -26 µR/hr.

Figure 27: Beam Tube Exposure Rate Measurements



Instrument	
Model	Ludlum 3 (γ)
Serial #	147819
Probe	44-10
Probe #	153765
Cal Due Date	07-04-01

Survey Conducted by: R. Stowell
Date: 04-12-01

Note:
1. All readings are in µR/hr taken inside the beam tube from either end.
2. South end of tube is in building 31. North end is just outside of building 31-2.
3.. Results range from 7 to 13 µR/hr inside the ~13" diameter steel pipe (beam tube).

APPENDIX A

"Final Survey Plans for the LINAC North Land Area"

GENERAL ATOMICS'

FINAL RADIOLOGICAL SURVEY REPORT FOR THE

LINAC NORTH LAND AREA

August 3, 2000
Laura Gonzales Laura A Gonzales

Final Radiological Survey Plan for Linac North Land Area

Background

Figure 1 shows the Linac Footprint showing the location of Linac North Land in Relation to the Surrounding Area. This Final Radiological Survey Plan covers ***only*** the Linac North Land Area (blue area shown in Figure 1).

Figure 2 provides a view of the land area identifying surfaces (i.e., asphalt, vegetation, and gunite) and gives a general idea of the topography. The Linac North Land Area includes non-impacted, unaffected and non-suspect affected areas (see Figure 2).

The Linac North Land Area includes the land formally occupied by Building 31-3. Building 31-3 was dismantled and disposed of as radioactive waste. The soil underneath the building and immediately surrounding the building has been sampled. Low levels of uranium contamination was found and remediated. A Soil Sampling Plan was issued (Attachment 1) and implemented. The results will be included in the Linac North Land Area Final Radiological Survey Plan. The NRC also collected soil samples from this location, the results of which will also be included in GA's Final Report.

The buildings (Building 31-1 and Building 31-2) within the Linac North Land Area have been addressed separately. Radiological contamination was found in both buildings; decontamination continued until radiation levels were below the release criteria. Building 31-1 was released to unrestricted use by the NRC on 12/6/99 (license amendment #63) and the State of CA on 1/21/00 (license amendment #141). Building 31-2 was released to unrestricted use by the NRC on 8/18/92 (license amendment #22) and the State of CA on 8/24/92 (license amendment #106). Note: Uranium contamination was found in the soil under and near Building 31-2 and outside of the former Building 31-3.

The **sewage drain lines** present within the Linac North Land Area are not being addressed in this Survey Plan. Another survey plan(s) will address all sewage drain lines present in this land area.

Survey Objectives and Responsibility

The purpose of performing a final survey is to demonstrate that the radiological conditions within the Linac North Land area satisfy the NRC and State of CA guidelines for release to unrestricted use. The objectives include (1) to show that the average surface contamination levels for each survey unit are within the authorized value, (2) to show that the maximum residual activity ("hot spot" area) do not exceed three times the average value in an area up to 100 cm^2 and (3) that a reasonable effort has been made to clean removable contamination and fixed contamination and (4) that the exposure rates in occupiable locations are less than 10 μR/hr above background measured at 1 meter above the surface. Samples will be counted in the Health Physics laboratory (onsite). Surveys will be taken only by qualified Health Physics Technicians having a minimum of 3 years Health Physics Technician experience in accordance with this Plan. The survey and final report documenting the survey will be performed by GA's Health Physics group.

Classification of Area(s)

The area between Building 31-2 and the site of the former Building 31-3 has potential for soil contaminated

with uranium because soil contamination was found in Building 31-2 and the Building 31-3 area. Soil contamination above the release criteria is not expected, but may be present. Therefore, this area was classified as a **"non-suspect affected area"** (see Figures 2 and 3). Additional soil samples will be taken in the area between Building 31-2 and the site of the former Building 31-3.

The area includes rugged slopes and extensive brush and vegetation which have no history of radioactive contamination or use involving the use of radioactive materials. Therefore, these slopes/brush areas are **"non-impacted areas"** (see Figure 2).

All other areas within the Linac North Land Area have a very low, if any, potential for contamination. For this reason, they were classified as "**unaffected areas**" (see Figure 2).

Release Criteria (per GA Site Decommissioning Plan)

Concrete/Asphalt Surface Release Criteria
The applicable guidelines for residual contamination on asphalt/concrete surfaces enriched uranium are:

5,000 dpm α/100 cm^2, averaged over a 1 m^2 area
15,000 dpm α/100 cm^2, total, maximum in a 100 cm^2 area
1,000 α dpm/100 cm^2, removable activity

Exposure Rate Measurements
The guideline value for exposure rates measured at 1 m above the surface, is 10 μR/hr above background.

Alert Levels

Alpha Alert Values
If the following "alert levels" are exceeded, notify HP Management so an evaluation can be performed and to evaluate if decontamination is required.

> 100 cpm alpha using the large area (~434 cm^2) probe (check area with a hand-held alpha meter).
> 60 cpm using an ~ 50 cm^2 and-held alpha probe (~ 600 dpm/100 cm^2)

Beta Monitoring
>300 cpm above the appropriate background using the 434 cm^2 probe.
>200 cpm above the appropriate background using the 100 cm^2 probe.
>150 cpm above background using a portable GM detector.

Exposure Rate Measurements
> 25 μR/hr at surface
> 20 μR/hr at 1 m

Documentation
Every survey conducted must be documented *on a daily basis* on a drawing showing the approximate locations surveyed. Include the results (including units), the technicians signature, date, instrument(s) used (including model and serial number of both the ratemeter and the detector), calibration due date, % efficiency, background readings (if applicable) and any other applicable information.

Final Radiological Surveys for the Linac North Land Area (as of August 2, 2000)			
Type of Survey/Activity	**Non-Suspect Affected Areas**	**Unaffected Areas**	**Non-Impacted Area**
Gridding Required?	No (Flat areas should be gridded)	No	No
µR/hr Readings @ surface	100% scan on all surfaces **(Scan surface before taking other measurements)**	25% scan on all flat surfaces **(Scan surface before taking other measurements**	None Required
Asphalt or Concrete Surfaces (1) (Scan w/ 434 cm^2 alpha probe)	100 % α	10 % α	None Required
Asphalt or Concrete Surfaces (1) (Scan w/ 434 cm^2 beta probe)	100 % β	10 % β	None Required
Minimum number of Measurements (3) (4)	Measurement every ~2 m Alternate between (1) a wipe, (2) an alpha fixed measurement **and** (3) a beta fixed measurement on **all asphalt or concrete surfaces.**	Measurement every ~ 7 m Alternate between (1) a wipe, (2) an alpha fixed measurement **and** (3) a beta fixed measurement **on all asphalt or concrete surfaces.**	None Required
Soil Samples	Collect surface and subsurface soil samples approximately every 1 m in the **front** of Building 31-2 (at least 2 rows) - see Figure 4. Collect surface soil samples approximately every 2 m around the former Building 31-3 site and in the pathway between Building 31-2 and the former Building 31-3 site (see Figure 4). In about 10% of these locations, also collect subsurface soil samples. Collect surface soil samples approximately every 5 m in all other locations within the non-suspect affected area (except hillside); see Figure 4.	Collect ~10 soil samples (under asphalt/concrete if needed) within the unaffected area as shown in Figure 5. • 3 outside Building 31-1 • 3 below Building 27 • 4 other random locations within the unaffected area	Collect soil samples in 5 biased locations to be determined by HP Technician.

Final Radiological Surveys for the Linac North Land Area (as of August 2, 2000)			
Type of Survey/Activity	**Non-Suspect Affected Areas**	**Unaffected Areas**	**Non-Impacted Area**
Drainage Areas	Scan using a microR meter all drainage areas within the Linac North Land Area Collect soil samples in every drainage area ~every 2 m (even beyond the Linac North Land Area. Collect a soil sample in the drainage area at or near GA's property boundary).		
µR/hr Readings @ 1m from surface	1 every 2 m	1 every 3 m	Take surface reading and reading at 1 m in 20 accessible locations

(1) Clean surfaces to remove debris or dirt. Grid (1 m or 2 m grid pattern), as needed.

(2) For removable measurements, take a 100 cm^2 wipe at each location. Count on a low level alpha/beta counter.

(3) For the fixed measurements:

- For α measurements; use the hand held alpha counter (*minimum* of ~6 second count). Document all readings in cpm.
- For β measurements; take a 2 minute count using the 100 cm^2 gas flow proportional detector (beta) with the Model 2221 ratemeter. Document all readings and mark on a drawing the locations the readings were taken.

(4) A "measurement" is either (1) a "fixed" radiation measurement representing total activity or (2) a wipe (removable activity).

Figure 1: LINAC Footprint Showing the Location of LINAC North Land in Relation to Surrounding Area

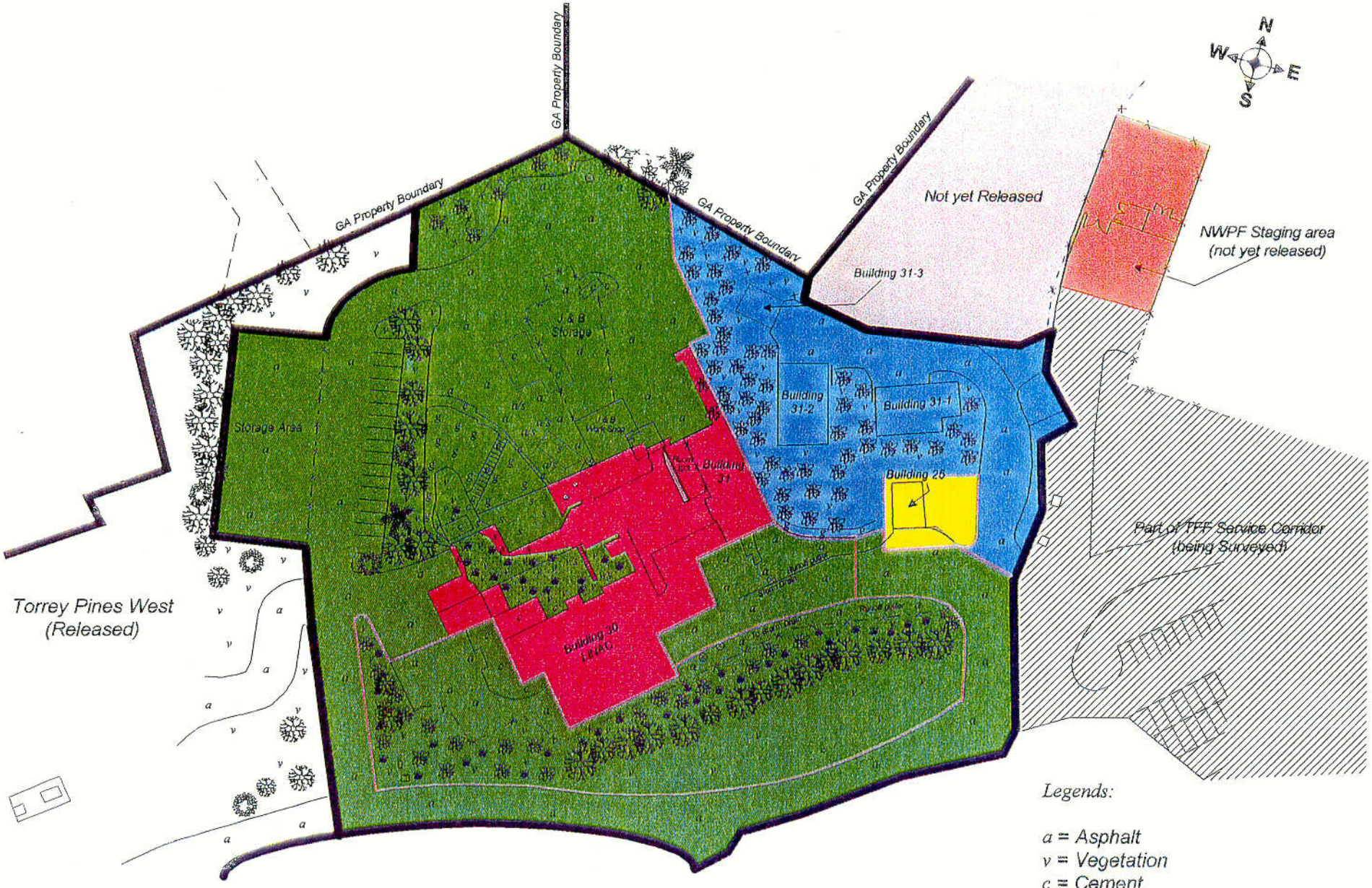


Figure 2: LINAC LAND NORTH

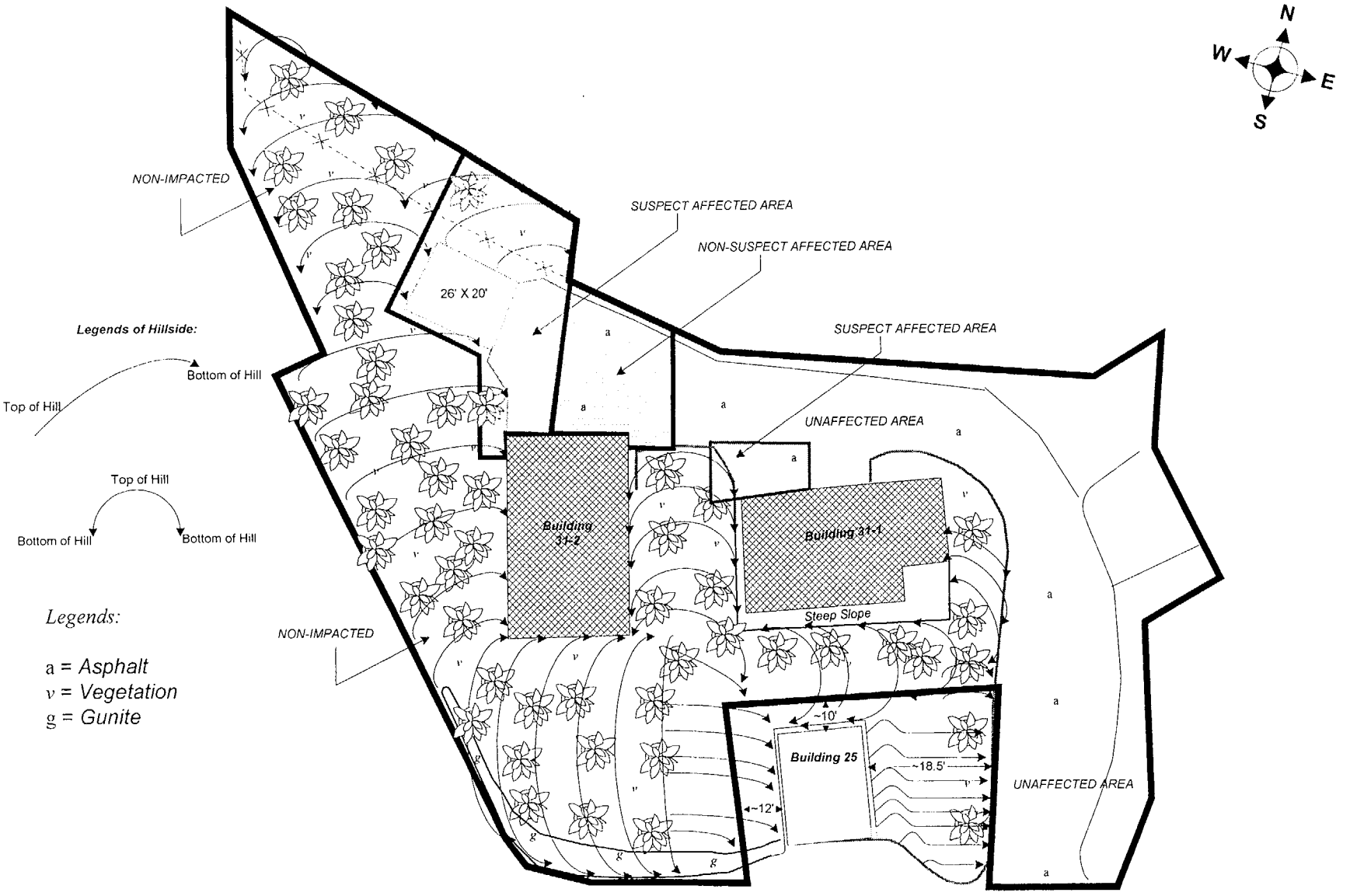


Figure 3: Non-Suspect Affected Area within LINAC North Land

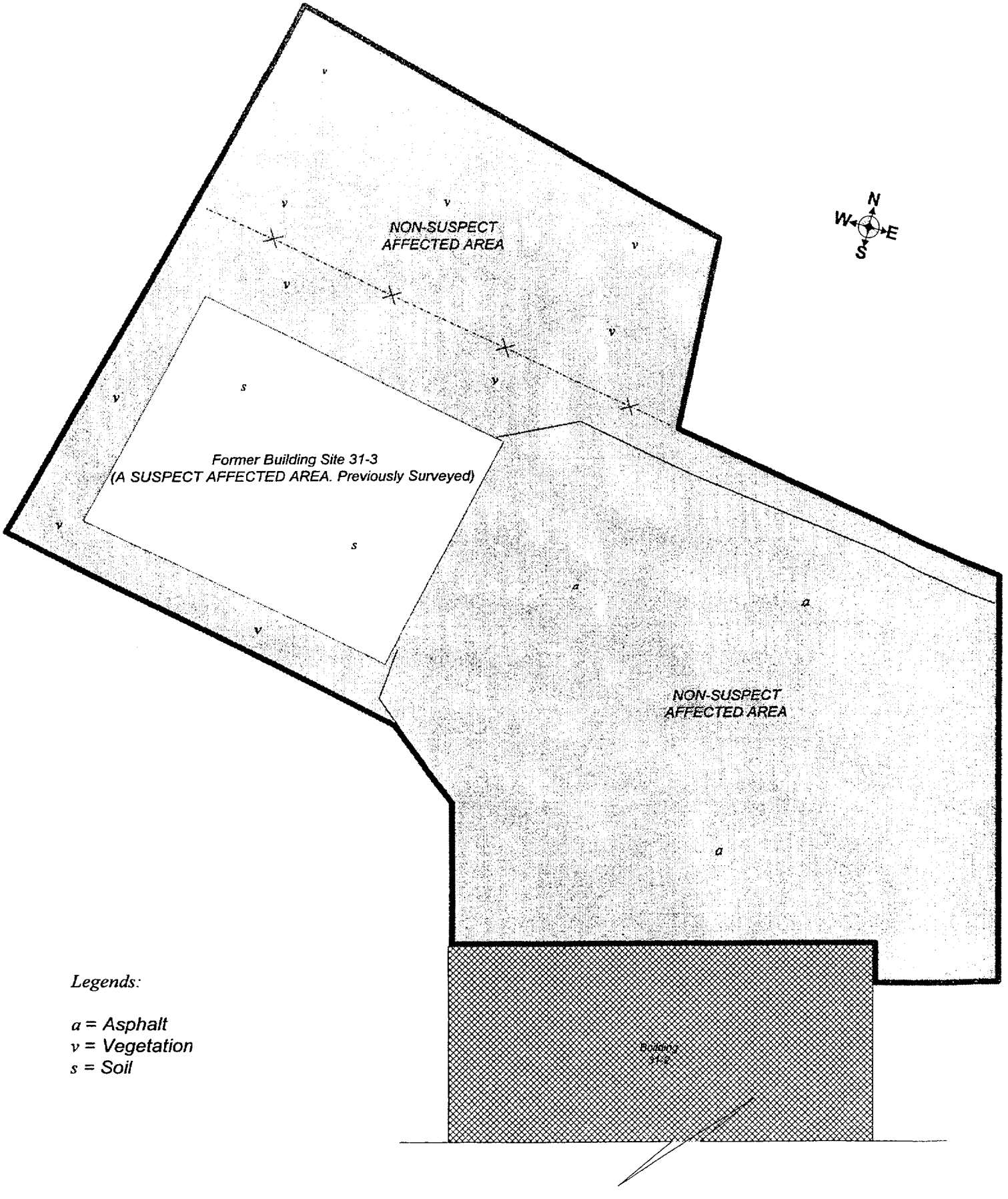


Figure 4: Soil Samples to be Collected within the Non-Suspect Affected Area of LINAC Land North Area

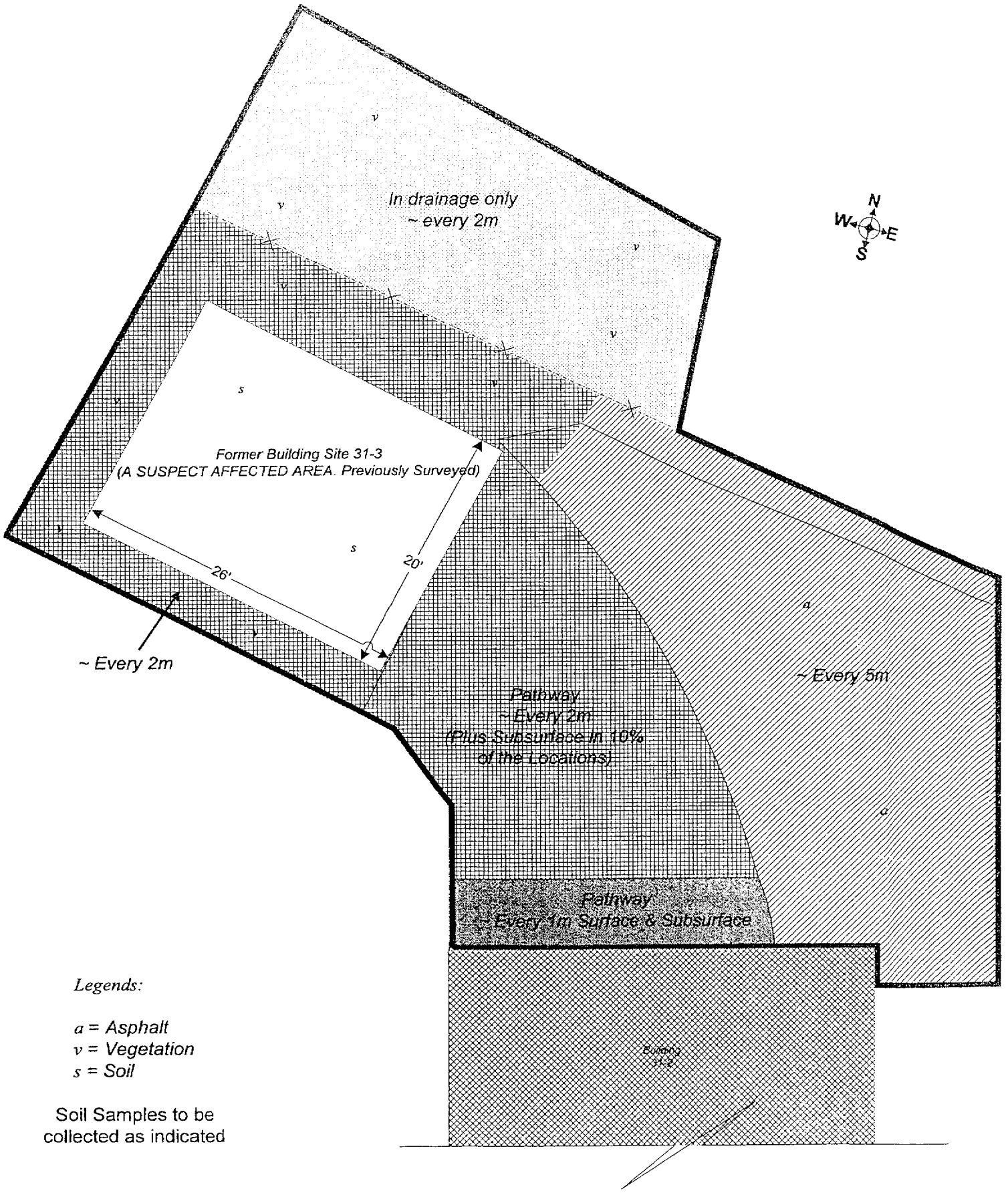
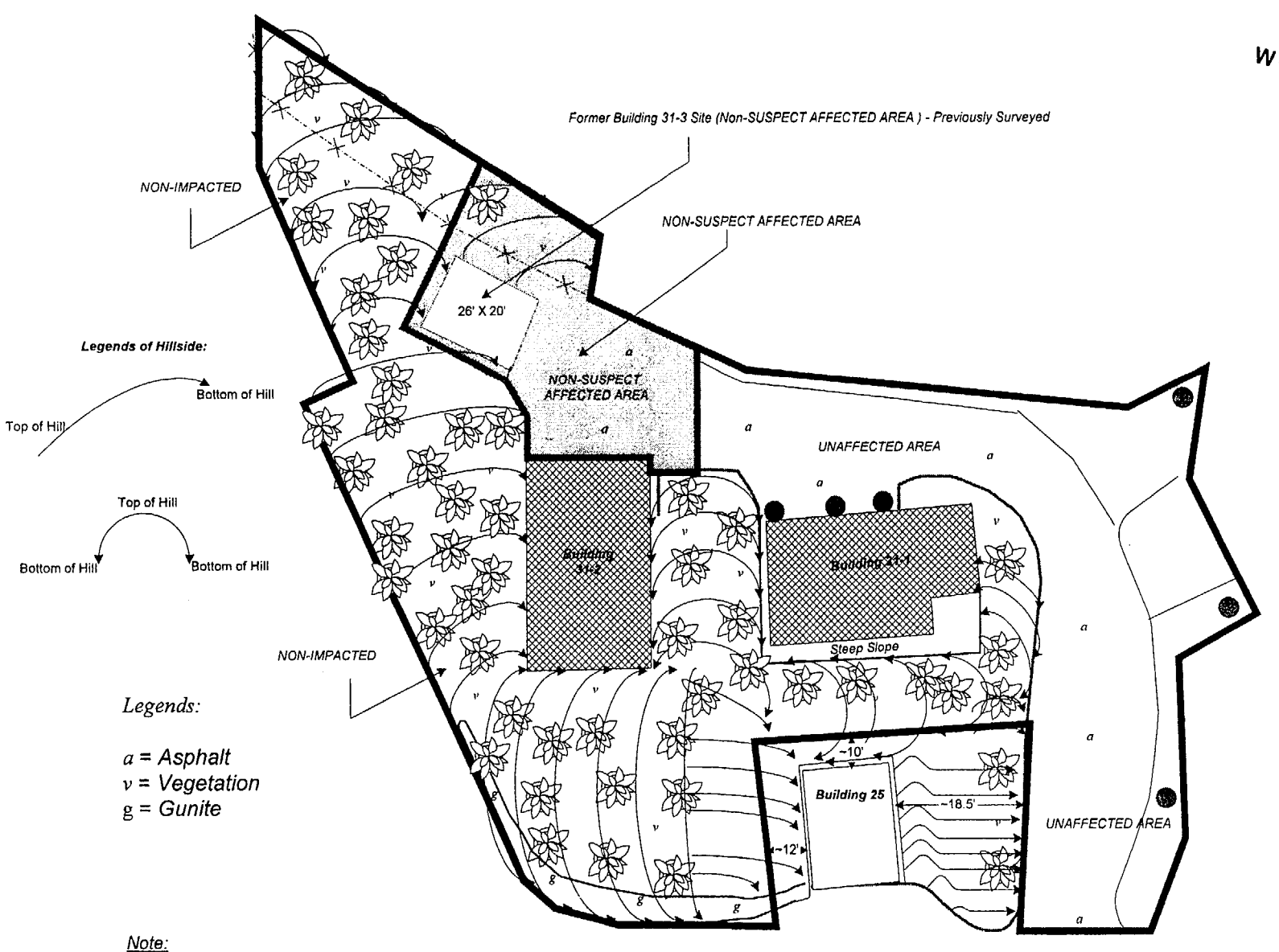


Figure 5: Soil Samples In Unaffected Area of LINAC North Area



Note:

= Buildings 31-1 and 31-2 have been released to Unrestricted use

= Boundary of LINAC Land North

● = Approximate Soil Locations (6) in Unaffected Area
(Plus 4 Biased Locations)
5 Biased in the Non-Impacted Area

FULL FILENAME

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April 2001
Prepared by: W. LaBonte W LaBonte

Approved by: Laura Gonzales **Date:** 4/6/01
L. Q. Gonzales

Revised Final Survey Plan for LINAC North Land Area

This revised final survey plan documents the additional survey requirements imposed following the discovery of elevated activity levels during the implementation of the Final Survey Plan issued on August 3, 2000.

Additional Background Information and Re-Classification

The history of use for the buildings located in the LINAC Land North footprint and the surrounding land is described in the Final Survey Plan issued on August 3, 2000. This background information describes the actions taken following the initiation of the Final survey Plan.

The Final survey for the Building 31-3 footprint was initiated after the building was dismantled and disposed of as radioactive waste in October 1998. This survey detected elevated activity levels of U-235 in the soil on the West side of the Building footprint. Samples of this soil was sent to an independent laboratory for Uranium isotopic analysis. The result indicated an enrichment of approximately 60%. This area was remediated and post remediation Final survey analysis did not identify any elevated activity levels. The NRC performed a confirmatory survey in August 2000 and did not detect any elevated activity levels.

In August 2000, the Final Survey for LINAC Land North was initiated. This Final survey included the Building 31-3 footprint because a release request for this footprint had not been submitted. See Figure-1 for details on the LINAC Land North boundary.

During this final survey, elevated activity was discovered in localized areas adjacent to Building 31-1, 31-2 and the Building 31-3 footprint. As a result, these area were remediated and re-classified from Non-Suspect affected areas to Suspect affected areas. See Figure-2 for the re-classification of this footprint.

This revised Final Survey Plan also addresses the buried LINAC Beam Tube that traverses the Non-Impacted Area between Building 30 (the former LINAC Facility) and Building 31-2.

Survey Objectives and Responsibility

The purpose of performing a confirmatory survey is to demonstrate that the Final Survey performed by GA Health Physics technicians was effective in identifying the radiological conditions of the area.

Release Criteria (per GA Site Decommissioning Plan)

Direct Surface Scans

Characterization and pre/post remediation surveys performed on this land area and in the adjacent building included gamma spectroscopy analysis. The predominate isotope detected was ^{235}U.

Prior to remediation, alpha contamination was detected in a few small areas while performing surveys on this land area. The alpha release criteria for alpha surveys are:

5,000 dpm/100 cm^2, averaged over 1 m^2 area
15,000 dpm/100 cm^2, maximum in a 100 cm^2 area
1,000 dpm/100 cm^2, removable contamination.

Exposure Rate Measurements

The guideline value for exposure rates measured at 1 m above the surface is 10 μR/hr above background.

Soil Criteria (soil limits apply to roof gravel, concrete rubble and asphalt rubble)

The release criteria for soil are specified in the Site Decommissioning Plan and summarized below. The values presented below are above background levels.

Cs-137	15 pCi/g
Co-60	8 pCi/g
Enriched Uranium (U-234 plus U-235)	30 pCi/g
Thorium (Th-232 plus Th-228)	10 pCi/g
Sr-90	1800 pCi/g

If multiple nuclides are present, the sum of the ratios of the concentration of each Radionuclide to its respective guideline must not exceed 1. **If other nuclides are encountered, notify HP Management for release criteria.**

Alert Levels

If the following "alert levels" are exceeded, notify HP Management so an evaluation can be performed to determine if increased survey coverage or decontamination is required.

On Concrete or Asphalt Surfaces

Note: The Alert levels provided below are based on the background cpm plus the meter cpm value taking into account the instrument efficiency and probe surface area. The alert level for each instrument used must be determined prior to performing surveys. The

background determination must be performed in building 13 or other HP management approved area.

Alpha Monitoring

>100 cpm alpha using the large area (434 cm^2) probe. If >100 cpm, check with a hand held alpha meter.
>60 cpm using a hand held alpha probe, notify Health Physics Management.

Beta Scanning using 434 cm^2 probe

> ~300 cpm above background using any other 434 cm^2 probe.

Beta Scanning using a 15 cm^2 pancake GM detector

> ~ 80 cpm above background.

Exposure Rate Measurement

Exposure rate measurements at contact (1-2" above the surface) and at 1m above the surface: 20 μR/hr.

Soil Samples

Any Radionuclide above natural background levels (see HP-40 for background levels). All soil sample results must be reviewed by Laura Gonzales, Paul Maschka, or Bill LaBonte.

Additional Final Survey Requirements

The minimum final survey requirements for the re-classified areas and the LINAC Beam tube are as follows:

Final Survey Requirements for Suspect Affected Areas and LINAC Beam Tube					
Area	Gridding	Exposure Rate Measurements	α, β Scans	Fixed Measurements	Soil Samples
Suspect Affected	1m x 1m grids	100% scan at surface, Take 1 fixed reading at 1m from surface every 2m.	ON asphalt/ concrete 100% Scan for activity, See Figure 2 for location.	On asphalt/concrete ,Alternate taking fixed α, β, and wipes at the rate of 1 every 2m.	Based on a 5 m triangular grid methodology a minimum of 32
LINAC Beam Tube	No	Take measurements at least 10 feet (~3m) into the tube at each end	No	No	NA

Documentation

Every survey conducted must be documented on a **daily basis** on a drawing showing the approximate locations surveyed. Include the results (including units), the technicians' signature, date, instrument(s) used, efficiency, background readings (if applicable) and any other applicable information.

Figure 1: LINAC Footprint Showing the Location of LINAC North Land in Relation to Surrounding Area

C04

Figure 2: LINAC LAND NORTH Classification

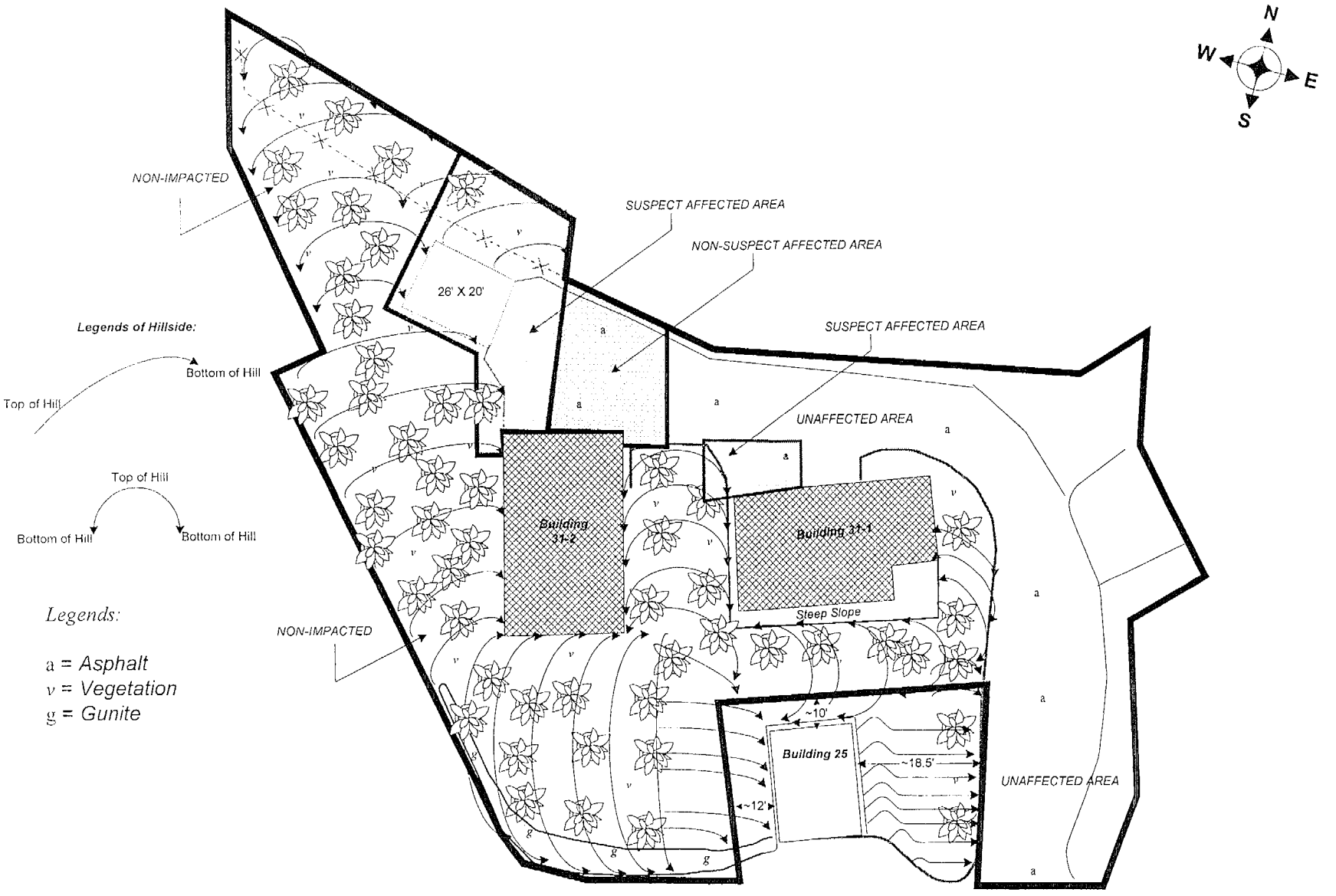


Figure 3: Non-Suspect Affected Area within LINAC North Land

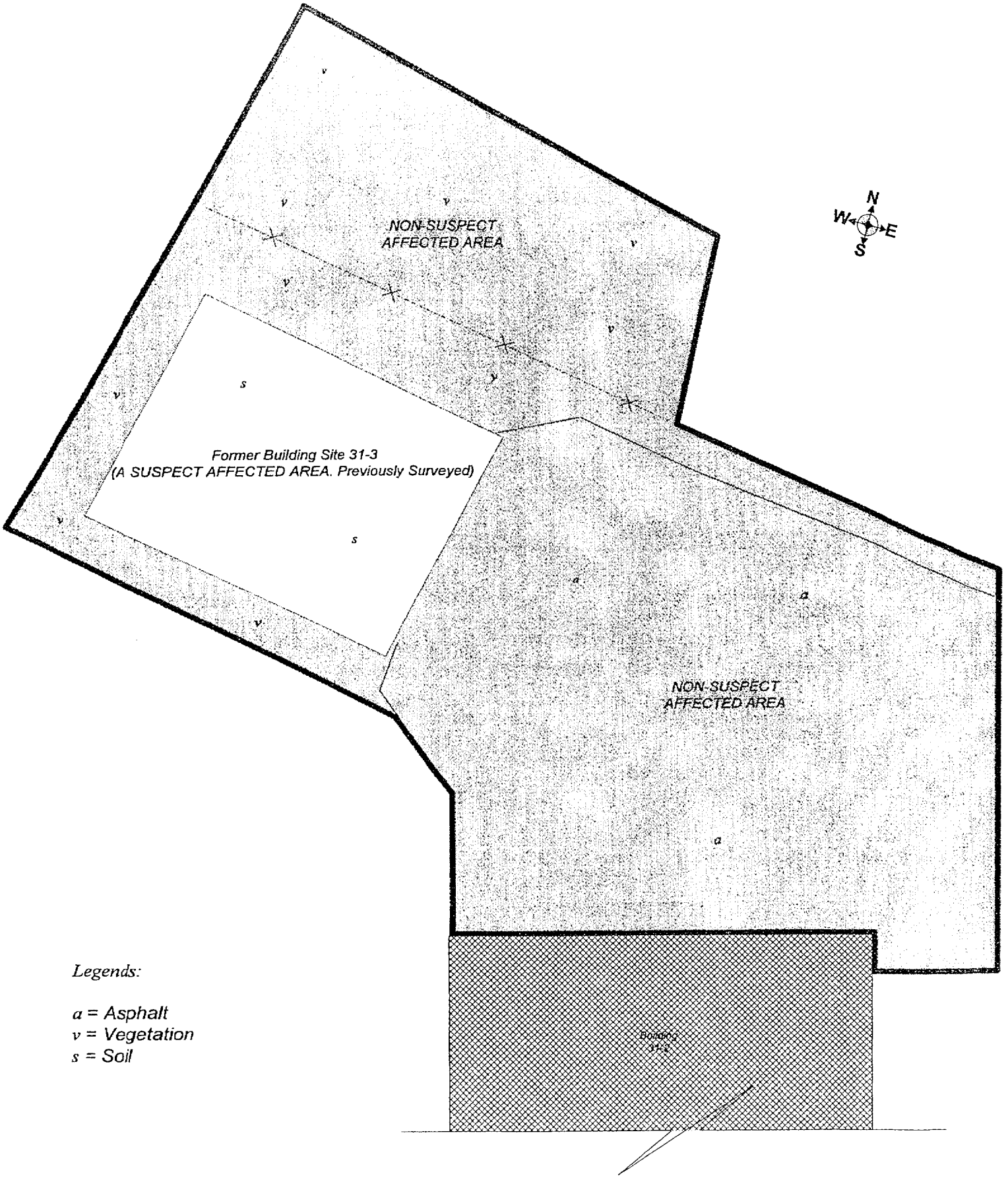


Figure 4: Soil Samples to be Collected within the Non-Suspect Affected Area of LINAC Land North Area

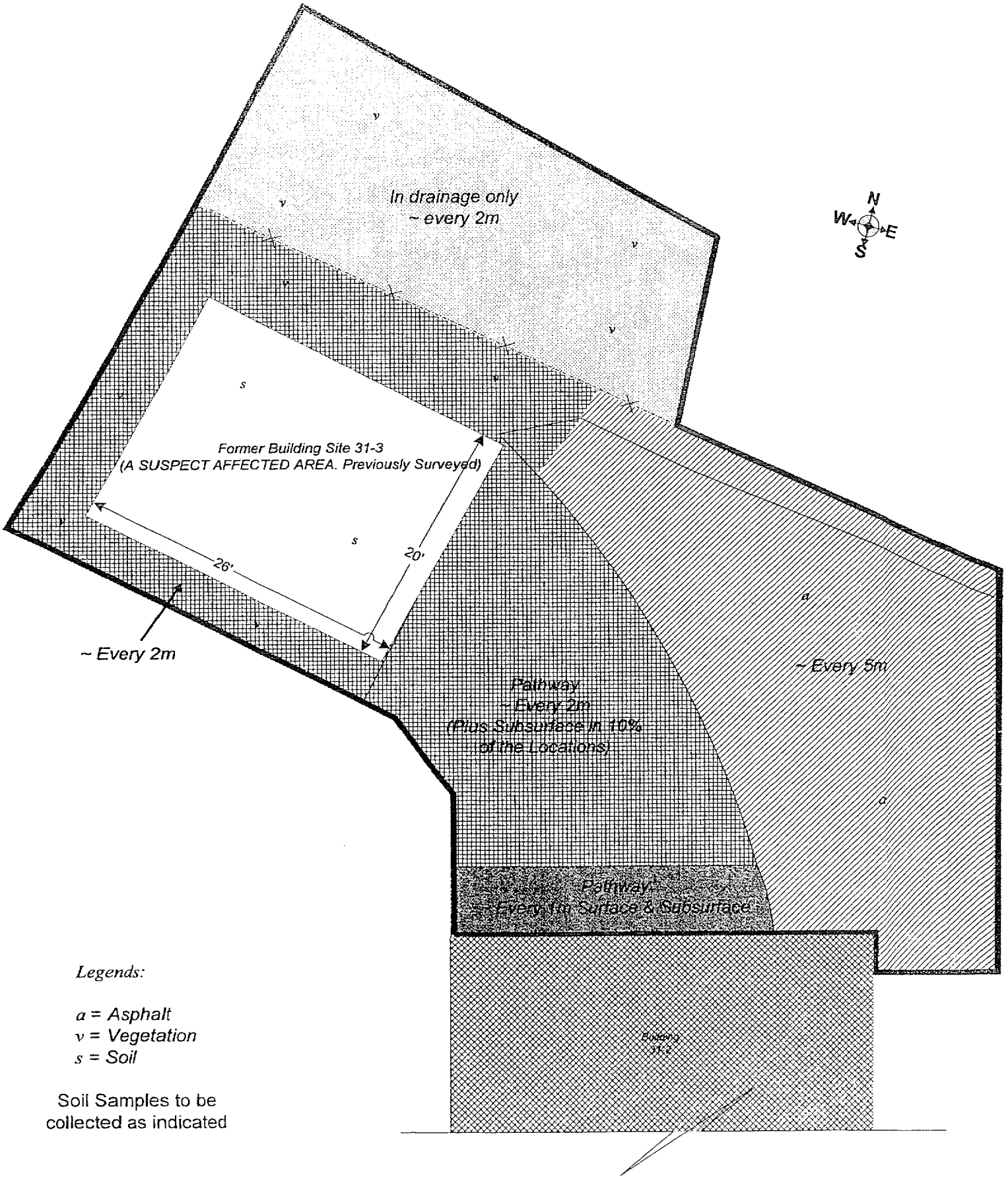
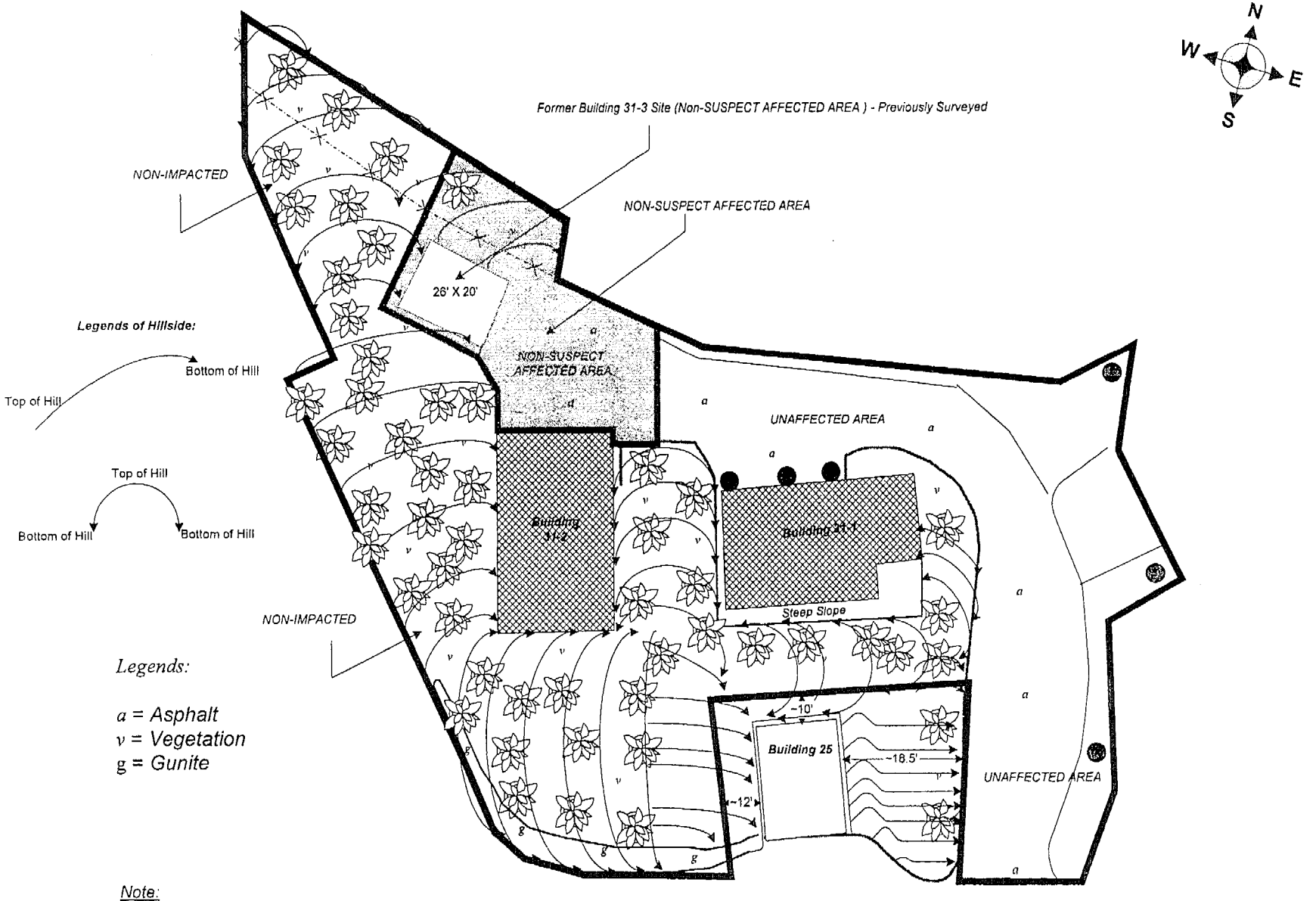


Figure 5: Soil Samples In Unaffected Area of LINAC North Area



Note:

= Buildings 31-1 and 31-2 have been released to Unrestricted use

= Boundary of LINAC Land North

= Approximate Soil Locations (6) in Unaffected Area
(Plus 4 Biased Locations)
5 Biased in the Non-Impacted Area

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GENERAL ATOMICS PRM-98-41

FINAL SURVEY PLAN FOR BUILDING 31-3

September 1, 1998
Prepared and Approved by: Laura Gonzales Laura Gonzales Date: 9/1/98
Paul R. Maschka ZD for PM Date: 9/1/98

Purpose

The purpose of this radiation survey is to provide evidence that the radiation levels on the walls, ceilings, and fixtures are below the approved release criteria specified in GA's Site Decommissioning Plan by performing this final Survey.

Background

Work Authorization Records indicate that this building was used to assemble thermionics fuel elements and fast reactor fuel elements. In addition packaged uranium and thorium were stored in this building. A previous survey after removal of radioactive material from this building was performed and a small area was decontaminated at that time.

Classification

This building is classified as a "Suspect Affected Area". The area of the building is 20'x25.8' (513 ft^2) or 7.8mx6m (46.8m^2).

Release Limits (per GA Site Decommissioning Plan

The primary contaminants of concern for this building are natural thorium and enriched uranium.

The applicable NRC guidelines for residual natural thorium surface activity levels are:

1,000 dpm/100cm^2, total averaged over a 1 m^2 area
3,000 dpm/100cm^2, total, maximum in a 100 cm^2 area
200 dpm/100cm^2, removable activity

As interpreted by the NRC, the average 1000 dpm/100cm^2 and the maximum 3000 dpm/100cm^2 should apply to both alpha and beta measurements, independently, for surface contamination involving natural thorium. ("Interpretation of Thorium Surface Decontamination Limits," U.S. Nuclear Regulatory Commission, February 9, 1992). Thorium emits alpha radiation to beta radiation in a 1:0.67 ratio; therefore, the corresponding average and maximum beta activity guidelines were adjusted to be 670 dpm/100cm^2 and 2000 dpm/100cm^2, respectively, for beta monitoring.

The applicable NRC guidelines for residual enriched uranium surface activity levels are:

5,000 dpm α/100cm^2, total, averaged over a 1 m^2 area
15,000 dpm α/100cm^2, total, maximum in a 100 cm^2 area
1,000 dpm α/100cm^2, removable activity

Since the instruments cannot distinguish between uranium and thorium contamination, the most restrictive activity guideline for natural thorium (670 dpm/100cm²) is used to compare all direct measurement for beta activity.

Exposure rate level - 10 μR/hr above background at 1 m from surface.

Alert Levels
Notify Health Physics Management if any of the following alert levels are exceeded:

Alpha Monitoring
>100 cpm using the 434 cm^2 probe (check area with a hand-held alpha meter).
> 60 cpm using a 50 cm^2 hand-held probe.

Beta Monitoring
>300 cpm above the appropriate background using the 434 cm^2 probe.
>200 cpm above the appropriate background using the 100 cm^2 probe.
>150 cpm above background using a portable GM detector.

Exposure Rate Measurements
20 µR/hr

Soil Sampling
Soil sampling is not required unless the floor has fixed radiation contamination that is above the guideline release criteria. If soil sampling is required, samples will be taken from specified locations where it is most likely that liquid could have passed through the concrete into the soil.

Documentation
Every radiological survey conducted must be documented on a daily basis to a worksheet/log book and on a drawing showing the appropriate locations surveyed. The documentation must include the results of the measurements (including units), the technician's printed name and signature, date, instrument(s) used (including the model and serial number of both the ratemeter and the detector), calibration due date, % efficiency, background readings (if applicable) and any other pertinent information.

FINAL SURVEY PLAN BUILDING 31-3 September 1, 1998	
Gridding	Gridding required
Floor masslinn smears	Take two large area masslinn smears on the floor, count the masslinn with hand held instruments for alpha and beta/gamma radiations.
Floor Scans	Scan 100% of the floor for **beta** using the 434 cm^2 probe Scan 100% of the floor for **alpha** using the 434 cm^2 probe
Floor Measurements	Alternate between a ***2 minute*** fixed measurement and a 100 cm^2 wipe every 2 meters
Walls masslinn smears	Take 1 large area masslinn smear on each wall Count the masslinn with hand held instruments for alpha and beta
Wall Scans Bottom 2 m	Scan 100% of each wall up 2 m **for alpha** using the 434 cm^2 probe Scan 100% of each wall up 2 m **for beta** using the 434 cm^2 probe
Wall Scans Above 2 m	Scan 10% of the walls above 2m for **alpha** using the 434 cm^2 probe. Scan 10% of the walls above 2m for **beta** using the 434 cm^2 probe.
Walls Measurements	Alternate between a ***2 minute*** fixed measurement (at 1 m above surface) and a 100 cm^2 wipe
Fixtures or overhead structures	**Scan** with pancake GM and alpha counter **Take about 10 smears**
Exposure Rate measurements	Take every ~~3~~ 2 m at one meter above the surface Per LG 9/10/98

APPENDIX B

"GA Internal Confirmatory Survey Plan and Results"

GENERAL ATOMICS'

FINAL RADIOLOGICAL SURVEY REPORT FOR THE

LINAC NORTH LAND AREA

CONFIRMATORY SURVEY PLAN

February 2001
Prepared by: W. LaBonte W LaBonte 2/13/01

Approved by: Laura Q Gonzales **Date:** 2/23/01
L. Q. Gonzales

GA Confirmatory Survey Plan for LINAC North Land Area

This survey plan is for a confirmatory survey of the LINAC North Land Areas. Only the areas classified as Non-Suspect Affected Areas and Unaffected Areas will be surveyed. Final Surveys are not required for Non-Impacted Areas, however surveys and soil sampling was performed during the Final Survey of this land area and no activity above natural background was detected.

Background and Classification

The location of the LINAC North Land Area in relation to other facilities at GA's Main Site is shown in Figure 1, LINAC Footprint Showing the Location of LINAC North Land Area in Relation to Surrounding Area.. The classification of this land, which includes Non-Impacted, Unaffected, and Non-Suspect Affected Areas, is shown in Figure 2, LINAC Land North.

The LINAC North Land Area is adjacent to Buildings 31-1, which was released to unrestricted use by the USNRC on 12/6/99 (license amendment #63) and the State of California on 1/21/00 (license amendment #141), Building 31-2, which was released to unrestricted use by the USNRC on 8/18/92 (license amendment #22) and the State of California on 8/24/92 (license amendment #106), and Building 31-3, which was dismantled and disposed of as radioactive waste.

During the Final Survey of this land area, enriched uranium was found in a few soil samples. These were remediated and subsequent surveys taken did not find any activity distinguishable from natural background activity.

Sewer lines that traversed and/or serviced this area are not included in the Final Survey or this Confirmatory Survey of this land area.

Survey Objectives and Responsibility

The purpose of performing a confirmatory survey is to demonstrate that the Final Survey performed by GA Health Physics technicians was effective in identifying the radiological conditions of the area.

Release Criteria (per GA Site Decommissioning Plan)

Direct Surface Scans

Characterization and pre/post remediation surveys performed on this land area and in the adjacent building included gamma spectroscopy analysis. The predominate isotope detected was ^{235}U.

Prior to remediation, alpha contamination was detected in a few small areas while performing surveys on this land area. The alpha release criteria for alpha surveys are:

5,000 dpm/100 cm^2, averaged over 1 m^2 area
15,000 dpm/100 cm^2, maximum in a 100 cm^2 area
1,000 dpm/100 cm^2, removable contamination.

Exposure Rate Measurements

The guideline value for exposure rates measured at 1 m above the surface is 10 μR/hr above background.

Soil Criteria (soil limits apply to roof gravel, concrete rubble and asphalt rubble)

The release criteria for soil are specified in the Site Decommissioning Plan and summarized below. The values presented below are above background levels.

Cs-137	15 pCi/g
Co-60	8 pCi/g
Enriched Uranium (U-234 plus U-235)	30 pCi/g
Thorium (Th-232 plus Th-228)	10 pCi/g
Sr-90	1800 pCi/g

If multiple nuclides are present, the sum of the ratios of the concentration of each Radionuclide to its respective guideline must not exceed 1. **If other nuclides are encountered, notify HP Management for release criteria.**

Alert Levels

If the following "alert levels" are exceeded, notify HP Management so an evaluation can be performed to determine if increased survey coverage or decontamination is required.

On Concrete or Asphalt Surfaces

Note: The Alert levels provided below are based on the background cpm plus the meter cpm value taking into account the instrument efficiency and probe surface area. The alert level for each instrument used must be determined prior to performing surveys. The background determination must be performed in building 13 or other HP management approved area.

Alpha Monitoring

>100 cpm alpha using the large area (434 cm^2) probe. If >100 cpm, check with a hand held alpha meter.
>60 cpm using a hand held alpha probe, notify Health Physics Management.

Beta Scanning using 434 cm^2 probe

> ~300 cpm above background using any other 434 cm^2 probe.

Beta Scanning using a 15 cm^2 pancake GM detector

> ~ 80 cpm above background.

Exposure Rate Measurement

Exposure rate measurements at contact (1-2" above the surface) and at 1m above the surface: 20 μR/hr.

Soil Samples

Any Radionuclide above natural background levels (see HP-40 for background levels). All soil sample results must be reviewed by Laura Gonzales, Paul Maschka, or Bill LaBonte.

Confirmatory Survey Requirements

The minimum survey requirements for this final survey are outlined in Table-1, LINAC North Land Area Confirmatory Survey Requirements. The location of the survey points is shown on Figure-3.

Documentation

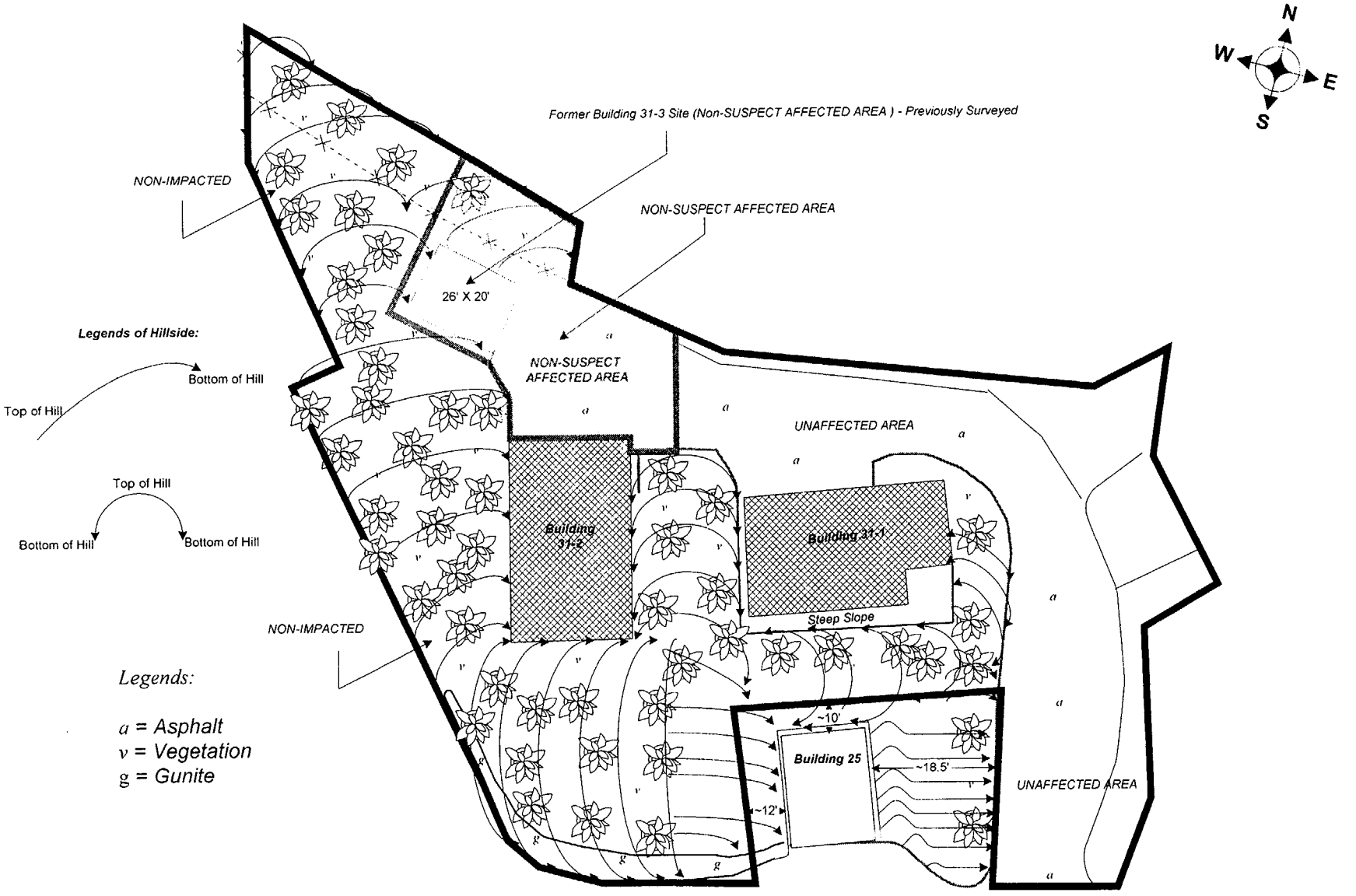
Every survey conducted must be documented on a **daily basis** on a drawing showing the approximate locations surveyed. Include the results (including units), the technicians' signature, date, instrument(s) used, efficiency, background readings (if applicable) and any other applicable information.

Table 1: LINAC North Land Area Confirmatory Survey Requirements				
Area	**Surface Scans**	**Dose Rate Measurements**	**Fixed Measurements (Fixed α, β, or swipes)**	**Soil Samples**
Unaffected Land	Scan 10% of the area for α and β activity.	Take 1 contact and 1 meter reading in the areas shown in Figure 3. Total locations = 9	Take 1 α, 1 β, or a swipe measurement in the areas shown in Figure 3. Total locations = 6 α, 6 β, 5 swipes. **Note: Swipes must be analyzed for α and β activity.**	None
Non-Suspect Affected Area	Scan 10% of the area for α and β activity.	Scan 10% of the area at contact **and** take 1 fixed reading at1 meter in the areas shown in Figure 3. Total locations = 8	Take 1 α, 1 β, or 1 swipe measurement in the areas shown in Figure 3. Total locations = 3 α, 4 β, 4 swipes. **Note: Swipes must be analyzed for α and β activity.**	Take 6 samples at 0-6" as shown on Figure 3.

Figure 1: LINAC LAND Showing the Location and Relationship to Surrounding Area

105

Figure 2: LINAC LAND NORTH



Note:

= Buildings 31-1 and 31-2 have been released to Unrestricted use

= Boundary of LINAC Land North

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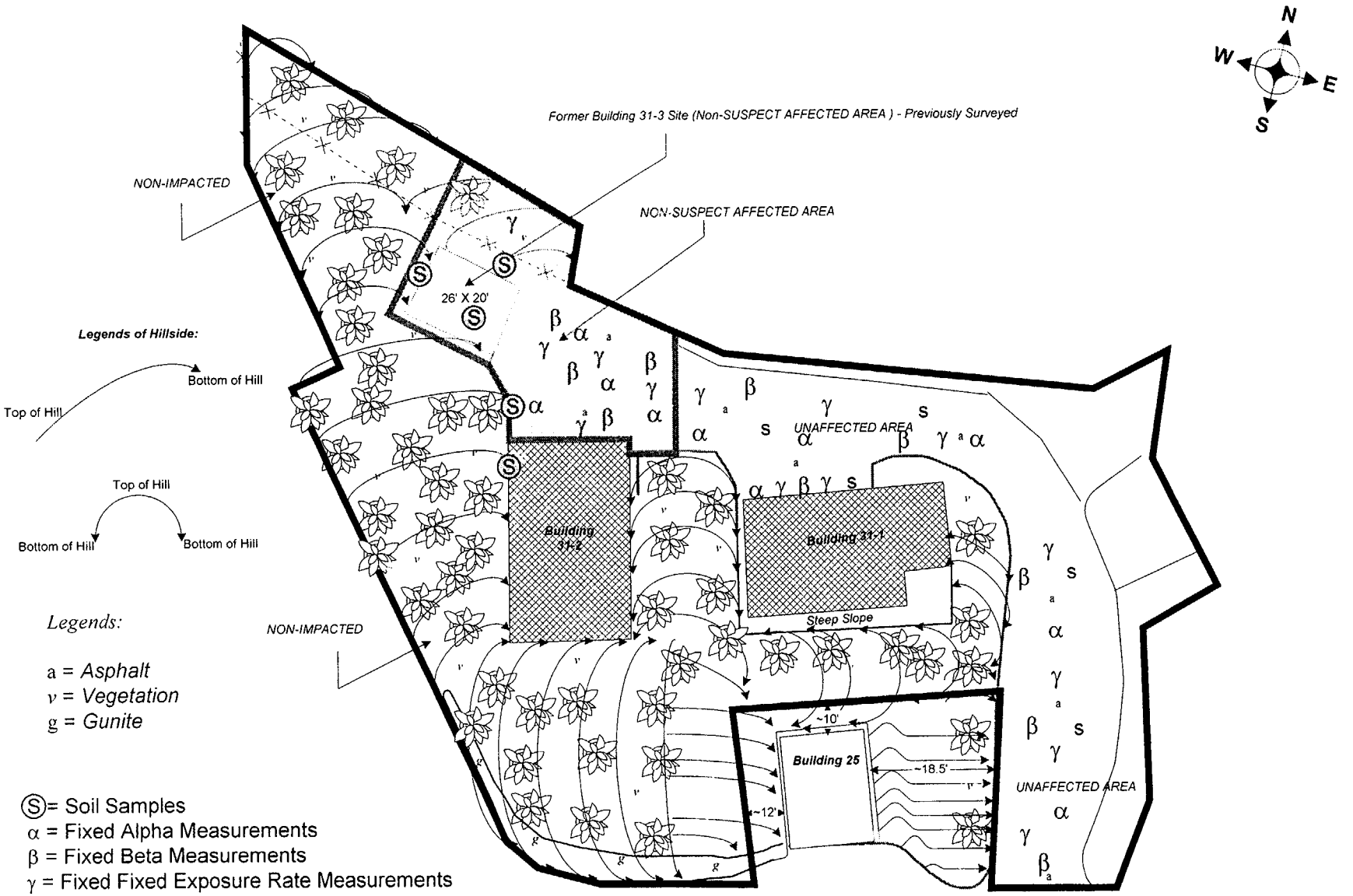
Figure 3: LINAC LAND NORTH Confirmatory Survey Locations



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CONFIRMATORY SURVEY RESULTS

Appendix B

GA Confirmatory Survey Results for LINAC North Land

Introduction

Following the completion of the LINAC North Land Final Survey, a Confirmatory Survey was performed by a Health Physics Technician not associated with the Final Survey, in accordance with an approved Survey Plan (attached).

The purpose of this survey was to confirm that the Final Survey was effective in identifying the radiological conditions of the area.

Surveys Performed

Alpha and Beta Scans

Approximately 10% of asphalt and concrete surfaces were scanned for beta activity using a 434 cm^2 proportional detector. The results ranged from 2,200 to 3,400 cpm. Typical background readings on asphalt for this detector is 2,400 to 2,900 cpm. See Figures 1 and 2 for approximate locations and results.

Approximately 10% of asphalt and concrete surfaces were scanned for alpha activity using a 434 cm^2 proportional detector. The results were not discernable from background levels. The results ranged from 0 - 40 cpm. Typical background readings on asphalt or concrete for this detector is 0 to 40 cpm. See Figures 1 and 2 for approximate locations and results.

Fixed Alpha and Fixed Beta Measurements

Nine (9) 1-minute fixed alpha readings, all of which were <20 cpm (background) were taken. See Figure 3 for locations and results.

Ten (10) fixed 2-minute beta readings were, all of which were ≤ background (554 cpm on concrete and 644 cpm on asphalt for this instrument), were taken. See Figure 3 for approximate locations and results.

Removable Contamination Surveys

Five (5) swipe samples for loose surface contamination, which were < 10 pCi/100 cm^2 alpha and < 10 pCi/100 cm^2 beta activity were taken. See Figure 3 for approximate locations and Table 2 for results.

Exposure Rate Measurements

Exposure rate measurements at 12 locations (at both contact and 1 meter from the surface) were taken. The results ranged from 18-24 μR/hr at contact and 18 - 24 μR/hr at 1 meter from the

Appendix B

GA Confirmatory Survey Results for LINAC North Land

surface. The background ranged from 18-22 μR/hr. See Figure 4 for approximate locations and results.

Soil Samples

Five (5) soil samples were collected in the area, processed and analyzed by gamma spectroscopy. See Table 1 for the results and Figure 4 for the approximate soil sample locations.

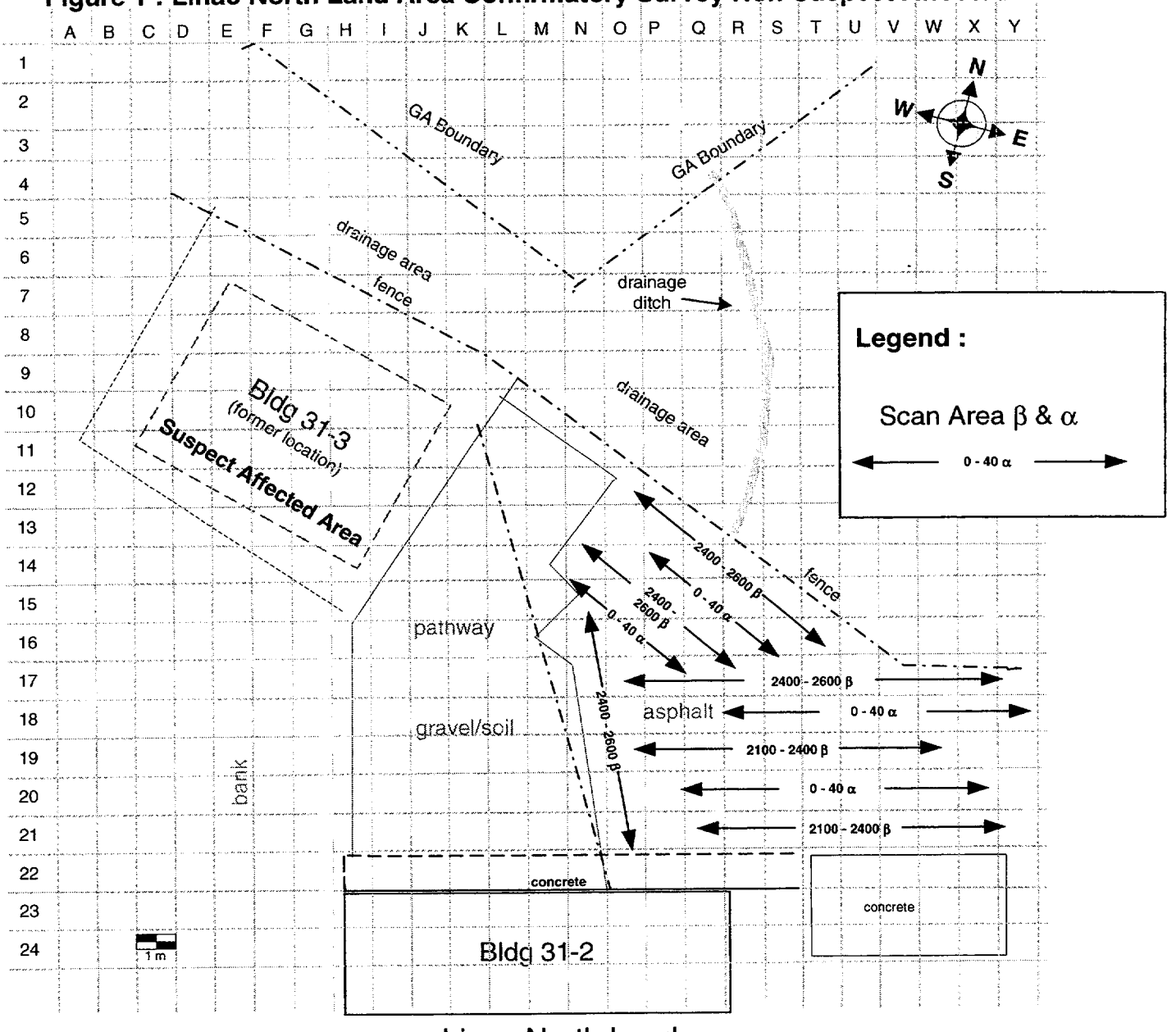
The results showed that the maximum concentration of U-235 measured in any soil sample was 0.43 pCi/g (39% of the enriched uranium limit based on a ratio of U-234:U-235 of 26:1 (see Appendix C for uranium isotopic results) as follows: 0.43 pCi/g U-235 + 26(0.43 pCi/g) U-234 = 11.6/30 (limit) = 0.39 (39% of the enriched uranium limits). The U-235 results ranged from 0.14 ± 0.10 pCi/g to 0.43 ± 0.30 pCi/g), all below the approved soil release criteria for enriched uranium, based on the U-235 concentrations.

The results also showed trace quantities of Cs-137 (levels are within those seen in normal background soil samples). The maximum Cs-137 concentration was 0.12 ± 0.07 pCi/g.

Conclusion

All of the Confirmatory Survey results indicated that activity levels on the LINAC North Land Area are below the approved release criteria, which agrees with the Final Survey results.

Figure 1 : Linac North Land Area Confirmatory Survey Non-Suspect Affected

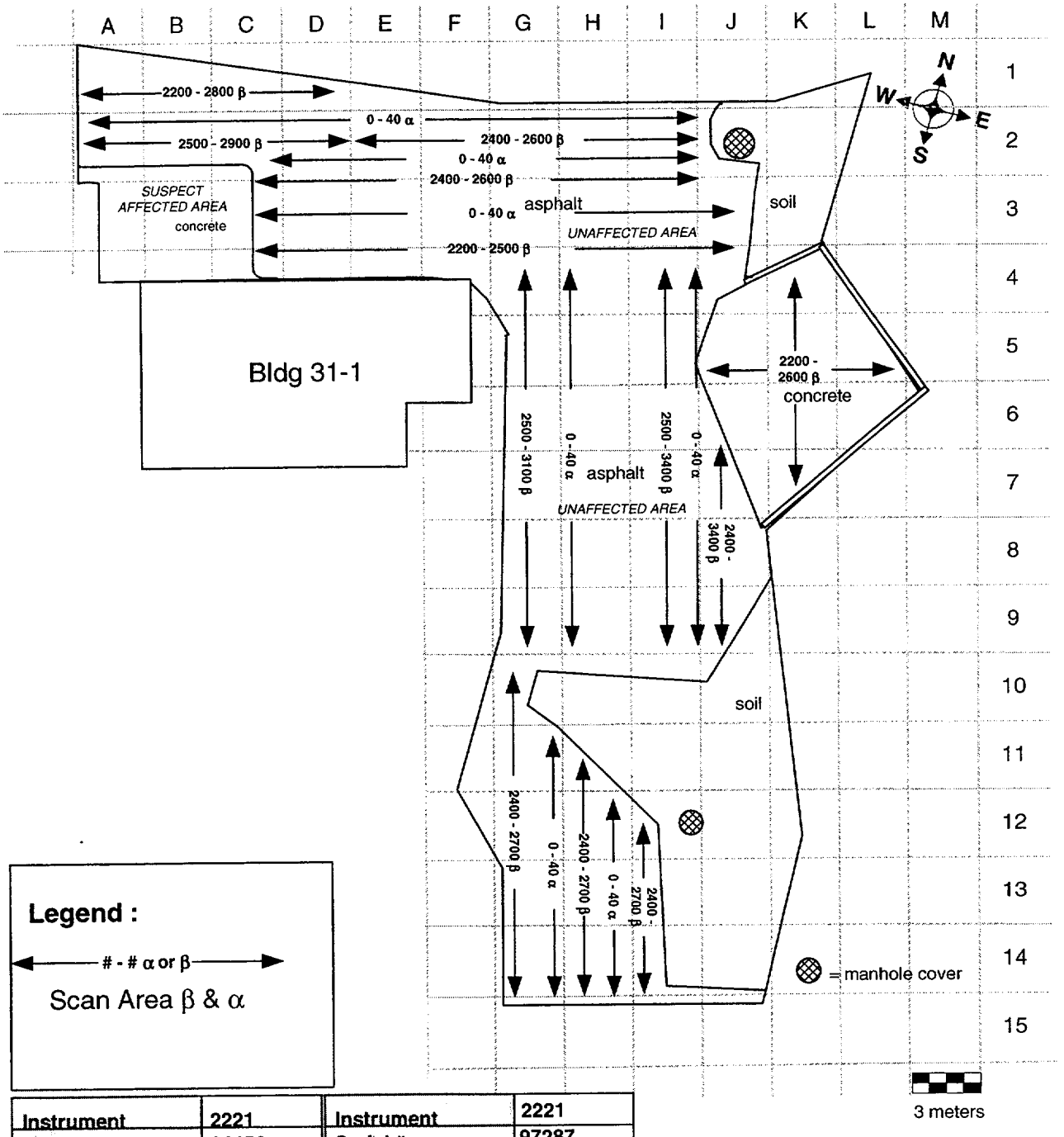


Linac North Land
Fixed Exposure Rate, Alpha And Beta Scans

Instrument	**2221**	**Instrument**	**2221**
Serial #	**84459**	**Serial #**	**97287**
Probe #	**86215**	**Probe #**	**148926**
Size / Type	**434cm² β**	**Size / Type**	**434cm² α**
Cal Due	**09/03/01**	**Cal Due**	**07/23/01**
Eff %	**22.15**	**Eff %**	**24.25**
BKG Asphalt	**2400 - 2900**	**BKG Asphalt**	**0 - 40 cpm**

Survey: Linac North Land
Comments: None
Surveyor(s): J.T Sullivan Date: 03/05/01

Figure 2 : Linac North Land Unaffected Area Confirmatory Survey
Alpha And Beta Scans



Legend :

- # α or β

Scan Area β & α

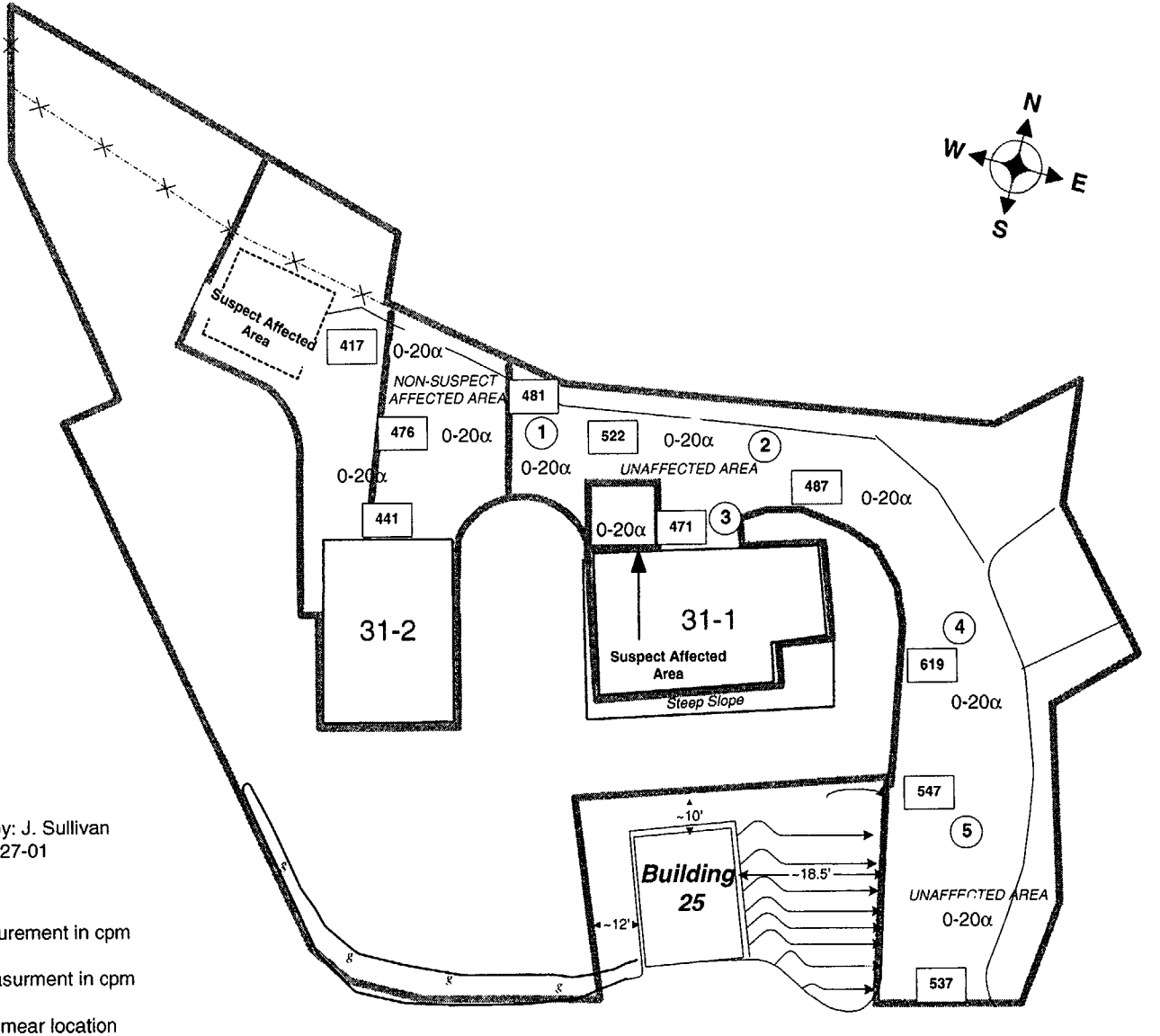
Instrument	2221	Instrument	2221
Serial #	84459	Serial #	97287
Probe #	86215	Probe #	148926
Size / Type	434cm² β	Size / Type	434cm² α
Cal Due	09/03/01	Cal Due	07/23/01
Eff %	22.15	Eff %	24.25
BKG Asphalt	2400 - 2900	BKG Asphalt	0 - 40 cpm

Survey: Linac North Land

Comments: None

Surveyor(s): J.T Sullivan Date: 03/27/01

Figure 3 : Confirmatory Alpha , Beta Fixed and Smear Locations



Surveys Conducted by: J. Sullivan
Dates: 03-26-01 - 03-27-01

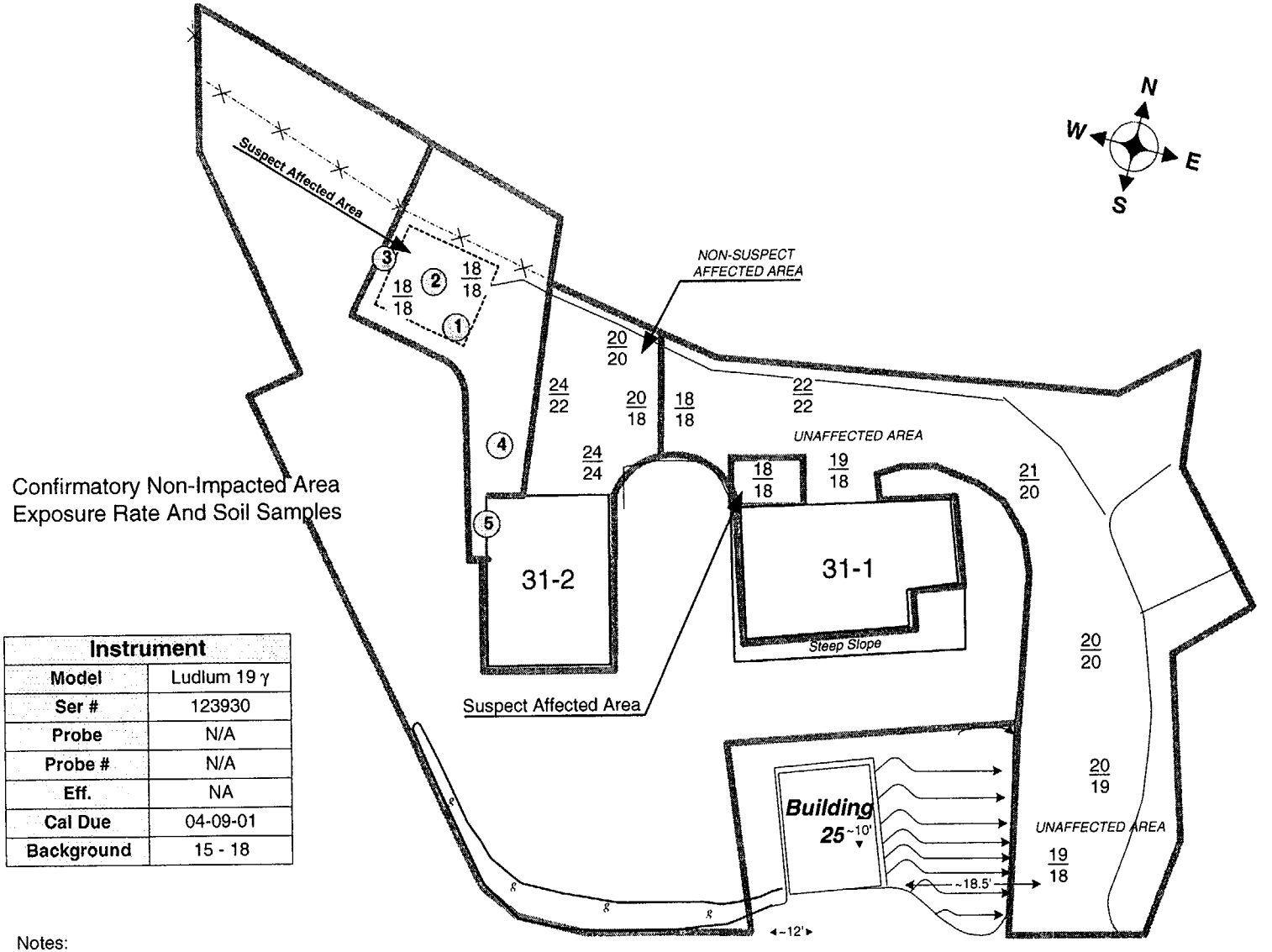
Notes:

1. [XXX] Beta Measurement in cpm
2. 0-20α Alpha Measurment in cpm
3. (5) Denotes Smear location

Instrument	Model 12
Serial #	138738
Probe #	43 - 65
Size / Type	50cm2 α
Cal Due	08/31/01
Eff %	21.58
Background con	0 - 20 μR

Instrument	2221
Serial #	148436
Probe #	120477
Size / Type	100cm2 β
Cal Due	06/06/01
Eff %	27.11
Bkgd concrete	554cpm
Bkgd asphalt	644cpm

Figure 4 : Confirmatory Exposure Rate and Soil Samples



Confirmatory Non-Impacted Area
Exposure Rate And Soil Samples

Instrument	
Model	Ludlum 19 γ
Ser #	123930
Probe	N/A
Probe #	N/A
Eff.	NA
Cal Due	04-09-01
Background	15 - 18

Notes:

1. Soil Sample results are provided in Table 1.
2. All readings are in µR/hr, $\frac{XX}{XX} = \frac{\text{contact}}{\text{at 1 meter}}$.
3. (5) Denotes soil sample location

Surveys Conducted by: J. Sullivan
Dates: 03-05-01 - 03-07-01

Table 1: LINAC North Land Confirmatory Soil Sample Results

#	Sample ID	Radionuclide Concentrations (pCi/g) *Background Not Subtracted*																
		U-238 (63 Kev)			**U-235** (144,186 Kev)			**Cs-137** (662 Kev)			**Co-60** {(1170+1330) /2} Kev			**Th-228** (238 Kev)			**Th-232** (911 Kev)		
		pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g	pCi/g	% error 2σ	± pCi/g
1	LLNA 1	1.19	115.6	1.38	0.25	37.7	0.09	0.12	57.5	0.07	ND	–	0.00	1.41	8.5	0.12	2.08	19.3	0.40
2	LLNA 2	1.24	89.0	1.10	0.22	40.9	0.09	0.10	49.5	0.05	ND	–	0.00	1.47	7.8	0.11	1.96	15.6	0.31
3	LLNA 3	1.40	87.5	1.23	0.21	37.4	0.08	0.11	50.3	0.06	ND	–	0.00	1.52	7.7	0.12	2.04	15.5	0.32
4	LLNA 4	ND	–	0.00	0.43	69.3	0.30	ND	–	0.00	ND	–	0.00	1.55	7.7	0.12	2.05	16.9	0.35
5	LLNA 5	1.23	92.4	1.14	0.14	70.5	0.10	ND	–	0.00	ND	–	0.00	1.33	9.8	0.13	2.25	18.3	0.41

Table 2: LINAC North Land Confirmatory Wipe Survey Results		
Swipe No.	Gross α in dpm/100 cm^2	Gross β in dpm/100 cm^2
1	<10	<10
2	<10	<10
3	<10	<10
4	<10	<10
5	<10	<10

APPENDIX C

"Uranium Analyses"

GENERAL ATOMICS'

FINAL RADIOLOGICAL SURVEY REPORT FOR THE

LINAC NORTH LAND AREA

APPENDIX C

"Uranium Analyses"

Description

Three (3) soil samples were sent to an independent laboratory (Quanterra) for uranium isotopic analyses. From these results, the U-234:U-235 ratio and the approximate U-235 enrichment was calculated.

For two (2) samples collected along the hillside west of Building 31-2, the U-234:U-235 ratio was calculated to be 24:1 and enrichment was ~ 45%.

For a soil sample collected near the former Building 31-3 location, the U-234:U-235 ratio was calculated to be 26:1 and the enrichment was ~60%.

GENERAL ATOMICS

INTERNAL CORRESPONDENCE

From: L. Gonzales

In Reply Refer To: LQG:01:12

To: Distribution

Date: April 10, 2001

Subject: **Uranium Isotopic Results of A Soil Sample Collected from the Outside Area Near Building 31-3**

Soil contaminated with uranium above the approved release levels was detected in a number of soil samples taken in the Outside Area around Building 31-3. The soil was removed and disposed of as radioactive waste. A soil sample was shipped to an outside lab (Quanterra, Inc.) for uranium isotopic analyses. The ratio and enrichment was calculated using the attached results as follows:

Uranium Enrichment Calculation Ratio=26:1

(1107 pCi U-234/g sample) (1 g U-234/6245.75e6 pCi U-234) = 1.77e-7 g U-234/g sample

(41.93 pCi U-235/g sample) (1 g U-235/2.16e6 pCi U-235) = 1.94e-5 g U-235/g sample

(4.217 pCi U-238/g sample) (1 g U-238/0.336e6 pCi U-238) = 1.26e-5 g U-238/g sample

3.22e-5 g U/ g sample

% U-235 = g U-235/total U = 1.94e-5 /3.22e-5 = ~ 0.60 (**~60% enriched uranium**)

Evaluation

1. The results (attached) give an average ratio of ~26:1 (U-234:U-235).
2. The uranium enrichment was calculated to be ~ 60 %.
3. The uranium isotopic result confirms the presence of enriched uranium in the soil.

cc: K. Asmussen
P. Maschka
B. LaBonte

B31-3 Uranium Isotopic Analysis

LB 12/7/98

DATE 20-Oct-98 CALCULATED RESULTS SUMMARY dir$era_caldat:8091870 PAGE 1

(NUM)	IT #	ISOTOPE	RESULT	ERROR*	COUNT ERROR*	YIELD	CALC MDA	UNITS	COMMENTS	DIAGNOSTICS
(3)	80918701	U234	1.551E+03	1.251E+02	1.270E+01	0.797	7.73E-01	PCI/G	for Bsk smeared spectrum "D" Flag	No Contr Values
(5)	80918701	U238	4.038E+01	3.834E+00	2.050E+00	0.797	6.43E-01	PCI/G		No Contr Values
(9)	D0918701	U234	1.107E+03	8.106E+01	9.083E+00	1.032	4.42E-01	PCI/G	31-3 Soil	No Contr Values
(11)	D0918701	U235	4.193E+01	3.525E+00	1.768E+00	1.032	3.40E-01	PCI/G		No Contr Values
(13)	D0918701	U238	4.217E+00	6.408E-01	5.626E-01	1.032	4.21E-01	PCI/G		No Contr Values
(17)	J0918728	U234	1.582E-02	1.346E-02	1.341E-02	0.979	5.03E-02	PCI/G		No Contr Values
(19)	J0918728	U235	-4.521E-03	1.878E-03	1.846E-03	0.979	5.59E-02	PCI/G		No Contr Values
(21)	J0918728	U238	3.391E-03	9.661E-03	9.657E-03	0.979	6.05E-02	PCI/G		No Contr Values
(25)	J0918725	U234	3.308E+00	3.045E-01	1.728E-01	0.925	5.79E-02	PCI/G	104.6%	No Contr Values
	EDJE 386		3.25573 ± .0AA							
(27)	J0918725	U235	1.689E-01	4.131E-02	3.927E-02	0.925	4.49E-02	PCI/G	113.7% OK	No Contr Values
			.148584 ± .003876							
(29)	J0918725	U238	3.362E+00	3.086E-01	1.742E-01	0.925	5.79E-02	PCI/G	98.6%	No Contr Values
			3.410.59 ± .020598							

```
************************** MDA, Uncertainty Calculations **************************
*   Calculations are based on the average background counts (bkg) and          *
*   average sample count times (Ts). Results are in Act/Unit.                  *
*                                                                              *
*        MDA = [(4.65 * sqrt((bkg c/m)/Ts)) + 2.71/Ts] * K,                    *
*              where K is the factor that converts the                         *
*              associated result from CPM/Aliquot to Act/Unit.                 *
*                                                                              *
*   The calculated MDA value may be lower than the True MDA.                   *
*   The MDA is the activity level that can be detected above the mean blank    *
*   value, Xo (Xo is not included)! In addition, only the Poisson counting     *
*   uncertainty is used to estimated the background variability!               *
*                                                                              *
*   * Uncertainty estimates (errors) are one standard deviation (Ts) !         *
*                                                                              *
*   The average error is calculated as follows:                                *
*   SQR(SUM(Random var) / N + SUM(Sym var) / N)                                *
*********************************************************************************
```

~~AR~~ 10-21-98

ATK 10-21-98

[illegible] 10-21-98

U-234 : U-235 Ratio = ~~26.7~~ 26/1 LB 12/7/98

Enriched Uranium

% Enriched =

GENERAL ATOMICS

INTERNAL CORRESPONDENCE

From: L. Gonzales

In Reply Refer To: LQG:00:35

To: Distribution

Date: October 5, 2000

Subject: **Uranium Isotopic Results of Two Soil Samples collected from the Outside Area Near Building 31-2**

Soil contaminated with uranium above the approved release levels was detected in a number of soil samples taken in the Outside Area around Building 31-2. The soil is being removed and disposed of as radioactive waste. Two soil samples (LNLA #1 and LNLA #2) were shipped to an outside lab (Quanterra, Inc.)for uranium isotopic analyses. The ratio and enrichment was calculated using the attached results as follows:

Uranium Enrichment Calculation (LNLA-1) Ratio=22.2:1

(284 pCi U-234/g sample) (g U-234/6245.75e6 pCi U-234) = 4.55e-8 g U-234/g sample

(12.8 pCi U-235/g sample) (g U-235/2.16e6 pCi U-235) = 5.93e-6 g U-235/g sample

(2.5 pCi U-238/g sample) (g U-238/0.336e6 pCi U-238) = 7.44e-6 g U-238/g sample

1.34e-5 g U/ g sample

% U-235 = g U-235/total U = 5.93e-6/1.34e-5 = ~ 0.44 (44% enriched uranium)

Uranium Enrichment Calculation (LNLA-2) Ratio=26.4:1

(283 pU-234/g sample) (g U-234/6245.75e6 pCi U-234) = 4.53e-8 g U-234/g sample

(10.7 pCi U-235/g sample) (g U-235/2.16e6 pCi U-235) = 4.95e-6 g U-235/g sample

(1.94 pCi U-238/g sample) (g U-238/0.336e6 pCi U-238) = 5.77e-6 g U-238/g sample

1.08e-5 g U/ g sample

% U-235 = g U-235/total U = 4.95e-6/1.08e-5 = 0.46 (~ 46 % enriched uranium)

Evaluation

1. The results (attached) give an average ratio of ~24:1 (U-234:U-235).
2. The uranium enrichment was calculated to be ~ 45%.
3. Our U-235 results (obtained by gamma spectroscopy) were in agreement with Quanterra's U-235 results (obtained by alpha spectroscopy).

Sample ID	GA Result	Quanterra Result
LNLA-1	8.5 pCi/g	12.8 pCi/g
LNLA-2	9.5 pCi/g	10.7 pCi/g

4. The uranium isotopic result confirms the presence of enriched uranium in the soil.

cc: K. Asmussen, P. Maschka, Alan Lewis, George Bramblett, R. Stowell, B. LaBonte, R. Noren

APPENDIX D

"NRC Confirmatory Survey on Building 31-3 Site"

GENERAL ATOMICS'

FINAL RADIOLOGICAL SURVEY REPORT FOR THE

LINAC NORTH LAND AREA

APPENDIX D

"NRC Confirmatory Survey on Building 31-3 Site"

Background

During the week of August 2-6, 1999, the NRC performed a confirmatory survey on the Building 31-3 site (the location where the former Building 31-3 was located). Building 31-3 was dismantled and disposed of as radioactive waste (including the concrete pad).

NRC's results agreed with the survey results obtained by GA. The inspection report (99-01) which documents the results of the NRC survey is provided in this appendix.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-8064

October 20, 1999

J. Edwards, Vice President
General Counsel and Secretary
General Atomics
P.O. Box 85608
San Diego, California 92186-9784

SUBJECT: NRC INSPECTION REPORT 70-734/99-01 AND NOTICE OF VIOLATION

Dear Mr. Edwards:

On August 2-6, 1999, the NRC conducted an inspection at your Torrey Pines Mesa and Sorrento Valley facilities. Areas examined during the inspection included emergency preparedness, environmental protection, radioactive waste management and storage, and transportation portions of your site decommissioning activities. Inspection activities consisted of selective examinations of procedures and representative records, interviews with personnel, and observation of activities in progress. The inspection also included confirmatory surveys of the Group 11 Laboratories in Building 2, Building 31-1, the former Building 31-3 ground area, the Sorrento Valley Central Land Area, and various materials to be shipped to a clean landfill. A preliminary exit briefing was conducted onsite on August 6, 1999. A followup telephonic exit briefing was conducted on September 9, 1999, to discuss the results and conclusions of the confirmatory measurements. The enclosed report presents the scope and results of that inspection.

Based on this inspection, activities conducted at the Torrey Pines Mesa and Sorrento Valley facilities were generally characterized by implementation of effective programs for decontamination and decommissioning. However, based on the results of the inspection, the NRC has determined that one violation of NRC requirements had occurred. The violation is cited in the enclosed Notice of Violation (Notice) and the circumstances surrounding this violation are described in detail in the subject inspection report. The violation concerns environmental surveys that were not completed as required by the license. You are required to respond to this letter and should follow the instructions specified in the enclosed Notice when preparing your response. The NRC will use your response, in part, to determine whether further enforcement action is necessary to ensure compliance with regulatory requirements.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be placed in the NRC Public Document Room.

Should you have any questions concerning this inspection, please contact D. Blair Spitzberg at (817) 860-8191 or Wayne Britz at ((817) 860-8194.

Sincerely,

Linda Howell for

Dwight D. Chamberlain, Director
Division of Nuclear Materials Safety

Docket No.: 70-734
License No.: SNM-696

Enclosures:
1. Notice of Violation
2. NRC Inspection Report
   70-734/99-01

cc w/enclosures:
Dr. K. E. Asmussen, Director
Licensing, Safety and Nuclear Compliance
P.O. Box 85608
San Diego, California 92186-9784

California Radiation Control Program Director

ENCLOSURE 1

NOTICE OF VIOLATION

General Atomics
San Diego, California

Docket No.: 70-734
License No.: SNM-696

During an NRC inspection conducted on August 2-6, 1999, a violation of NRC requirements was identified. In accordance with the "General Statement of Policy and Procedure for NRC Enforcement Actions," NUREG-1600, Revision 1, the violation is listed below:

> Safety Condition S-1 of License SNM-696 authorizes the use of the conditions in Part II, License Specifications, dated July 24, 1981, and its supplements.
>
> Part II, Section 6.1, "Environmental Air Sampling," requires that composites of the environmental air sampling filters be gamma scanned monthly.
>
> Contrary to the above, as of August 6, 1999, the monthly gamma scans of composited air filters had not been performed for the previous year.
>
> This is a Severity Level IV violation. (Supplement VI)

Pursuant to the provisions of 10 CFR 2.201, General Atomics is hereby required to submit a written statement or explanation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, D.C. 20555 with a copy to the Regional Administrator, Region IV, 611 Ryan Plaza Drive, Suite 400, Arlington, Texas 76011, within 30 days of the date of the letter transmitting this Notice of Violation (Notice). This reply should be clearly marked as a "Reply to a Notice of Violation" and should include for each violation: (1) the reason for the violation, or, if contested, the basis for disputing the violation, (2) the corrective steps that have been taken and the results achieved, (3) the corrective steps that will be taken to avoid further violations, and (4) the date when full compliance will be achieved. Your response may reference or include previous docketed correspondence, if the correspondence adequately addresses the required response. If an adequate reply is not received within the time specified in this Notice, an order or a Demand for Information may be issued as to why the license should not be modified, suspended, or revoked, or why such other action as may be proper should not be taken. Where good cause is shown, consideration will be given to extending the response time.

If you contest this enforcement action, you should also provide a copy of your response to the Director, Office of Enforcement, United States Nuclear Regulatory Commission, Washington, DC 20555-0001.

Because your response will be placed in the NRC Public Document Room (PDR), to the extent possible, it should not include any personal privacy, proprietary, or safeguards information so that it can be placed in the PDR without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request withholding of such material, you must

specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim of withholding (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.790(b) to support a request for withholding confidential commercial or financial information). If safeguards information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21.

In accordance with 10 CFR 19.11, you may be required to post this Notice within two working days.

Dated at Arlington, Texas
this 20th day of October 1999

ENCLOSURE 2

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket No.:	70-734
License No.:	SNM-696
Report No.:	70-734/99-01
Licensee:	General Atomics
Facility:	Torrey Pines Mesa and Sorrento Valley Facilities
Location:	San Diego, California
Dates:	August 2-6, 1999
Inspectors:	Julie Olivier, Chemical Engineer Wayne L. Britz, Fuel Cycle Inspector
Approved By:	D. Blair Spitzberg, Ph.D., Chief Fuel Cycle/Decommissioning Branch Division of Nuclear Materials Safety
Attachment:	Supplemental Information

EXECUTIVE SUMMARY

General Atomics (GA)
NRC Inspection Report 70-734/99-01

This routine, announced inspection focused on emergency preparedness, environmental protection, radioactive waste management and storage, transportation and validation of portions of the licensee's final radiological survey program for site decommissioning activities. Specific attention was given to decommissioning activities involving the Group 11 Laboratories in Building 2, Building 31-1, the former Building 31-3 ground area, the Sorrento Valley Central Land Area, and various materials to be shipped to a clean landfill.

Decommissioning Inspection (88104)

Radioactive Waste Management, Waste Generator Requirements, & Low-Level Waste Storage

The licensee was adequately monitoring and controlling radioactive gaseous and liquid effluent releases, processing liquid and solid radioactive wastes, and transporting radioactive wastes. Effluents for the period reviewed were well below the limits specified in 10 CFR Part 20, indicating appropriate efforts by the licensee to maintain releases As Low As Reasonably Achievable (ALARA) (Section 2.1).

Emergency Preparedness

The licensees's emergency preparedness program was adequate for the remaining radiological facilities on the site; however, the Radiological Contingency Plan had not been updated to reflect the facilities that have been decommissioned and no longer serve functions as described in the current plan (Section 2.2).

Environmental Protection

With the exception of the monthly gamma scans for the site air samplers, the licensee's environmental monitoring program was conducted in accordance with the license application and the licensee's implementing procedures. Precautions were taken by the licensee to prevent the spread of contamination to the environment during decommissioning (Section 2.3).

A violation of the License Specification 6.1 was identified involving the licensee's failure to perform required monthly gamma scans of composite air filter samples (Section 2.3).

Closeout Inspection and Survey (83890)

Based on the results of this inspection, activities conducted at the Torrey Pines Mesa and Sorrento Valley facilities were generally characterized by implementation of effective programs for decontamination and decommissioning (Section 3.3).

NRC confirmatory surveys conducted at the Group 11 Laboratories in Building 2, Building 31-1, the former Building 31-3 ground area, the Sorrento Valley Central Land Area, and various materials to be shipped to a clean landfill were consistent with licensee measurements. The NRC's confirmatory measurements confirmed the licensee's determination that these areas and facilities met the criteria for unrestricted release (Section 3.3).

The results of NRC split soil sample confirmatory measurements from the former Building 31-3 land area were in good agreement with licensee results. The results of the soil samples taken from the area were less than the criteria established for unrestricted release. The licensee's final survey report for this area and the request for release for unrestricted use will be submitted later (Section 3.3).

Report Details

1 Summary of Facility Status

All production and research activities involving the use of special nuclear material (SNM) had been discontinued. The SNM facilities were being decommissioned according to the Hot Cell Facility Decommissioning Plan, Rev. 4, dated January 1998, and the Site Decommissioning Plan (SDP), dated September 1996.

At the time of the inspection, licensee activities consisted of decontamination and decommissioning (D&D) of various site buildings and structures as outlined in the two plans. Following extensive site characterization, several site areas had been radiologically surveyed for release from the SNM license. D&D was also proceeding for radioactive byproduct materials licensed by the State of California.

The licensee's licensed activities and D&D program attributes were previously discussed in NRC Inspection Reports 70-734/98-03 (February 1999), 70-734/98-02 (July 1998), 70-734/98-01 (January 1998), 70-734/97-05 (December 1997), and 70-734/97-02 (June 1997).

2 Decommissioning Inspection (88104)

The D&D activities were inspected according to Decommissioning Inspection Procedure 88104 and Closeout Inspection and Survey Procedure 83890. Portions of inspection procedures that were applicable during the licensee's operational program and that carry over to the licensee's decommissioning program were selectively used during this inspection as provided for in the Decommissioning Inspection Procedure. The applicable portions of the procedures used were from the Emergency Preparedness Procedure 88050; Environmental Protection Procedure 88045; Radioactive Waste Management Procedure 88035; Waste Generator Requirements Procedure 84850; Low-Level Waste Storage Procedure 84900; and the Transportation Procedure 86740.

Areas reviewed during this inspection which involved D&D of NRC-licensed facilities included:

- The Sorrento Valley Central Land Area categorized as an "unaffected area." The area was never used for work involving radioactive materials. However, the north half of the parking lot had been used for the temporary storage of radioactive waste boxes from the SVA Fuel Manufacturing Facility Decommissioning Project. These radioactive waste boxes had been packaged, sealed and the exteriors surveyed for removable contamination before being stored in this area. Surveying and sampling were performed by the licensee to demonstrate compliance with the approved criteria for release to unrestricted use. The licensee made surface and area measurements and collected and analyzed soil samples to demonstrate compliance. Confirmatory surveys on this area were accomplished during this inspection.

- The Building 2, Group 11 Laboratories, consisting of nine laboratories classified as "unaffected area," "suspect affected areas," and "non-suspect affected areas." The licensee had conducted surface and area measurements to demonstrate compliance with the release criteria. Confirmatory surveys were accomplished in these facilities by the NRC during this inspection.

- Building 31-1 housed offices, laboratories, storage vaults and a control room for a critical facility that was located in another building. The areas were classified as either "non-suspect affected" or "suspect affected areas." The licensee made surface and area measurements and analyses of the walls, floors, roof, and roof tar and gravel layers. Confirmatory surveys were accomplished in these areas by the NRC during this inspection.

- Several D&D building material storage areas had been surveyed by the licensee for disposal to a sanitary landfill. Confirmatory surveys were accomplished in these areas by the NRC during this inspection.

- Building 31-3, a radioactive material storage and fuel element fab/assembly building, had been removed and the ground area had been remediated. As part of the ongoing decommissioning process, soil samples were obtained by the licensee and split with the NRC for confirmatory analysis.

2.1 Radioactive Waste Management, Waste Generator Requirements, & Low-Level Waste Storage (88104, 88035, 84850, and 84900)

a. Inspection Scope

The inspectors reviewed the licensee's program for ensuring that release of liquid, airborne, solid wastes, the storage of radwaste, and the transportation of wastes met the requirements of the license and regulations. The review included facility tours and review of licensee procedures and selected records.

b. Observations and Findings

Responsibilities and controls required by Section 6.3, "Stack Monitoring," Part I of the license; Section 6.2, "Water Sampling," Part II of the license; and as further described in the licensee's Health Physics Procedures HP-77, *Environmental Air Sampling* and HP-167, *Disposal of Liquids into Sanitary Sewage System* were reviewed. The monitoring, sampling, and analysis programs were being conducted as required. The instrumentation, calibrations, and procedures were adequate.

The effluent release records reviewed included radioactive gaseous effluent sampling and liquid releases to the sewer. The releases were well below the limits specified in 10 CFR Part 20 indicating appropriate efforts by the licensee to maintain releases ALARA. The inspectors had no concerns with the releases and records.

The facilities for treatment of liquid (Building 25, Liquid Waste Treatment Facility) and solid (Building 41, Nuclear Waste Processing Facility) radioactive wastes were reviewed. The processes were reviewed and discussed with the licensee. The facilities were inspected for radiological practices and good housekeeping. The inspectors found the facilities and processes adequate and had no concerns.

The procedures for the receipt and shipment of radioactive material as specified in the SDP, Section 4.9.1, *Conformance to Requirements of 10 CFR 61, 10 CFR 71, and 10 CFR 20.2006,* were reviewed and discussed with the licensee. The training records for transportation personnel were reviewed. The inspectors found the transportation program and training met license requirements.

c. Conclusions

The licensee was adequately monitoring and controlling radioactive gaseous and liquid effluent releases, processing liquid and solid radioactive wastes, and transporting radioactive wastes. Effluents for the period reviewed were well below the limits specified in 10 CFR Part 20 indicating appropriate efforts by the licensee to maintain releases ALARA.

2.2 Emergency Preparedness (88104 and 88050)

a. Inspection Scope

The inspectors reviewed the licensee's facilities for supporting the Radiological Contingency Plan and the changes resulting from the decommissioning of the site.

b. Observations and Findings

The inspectors reviewed the site facilities in place to support emergencies. The Emergency Support Center located in Building 1, Room 103, was inspected. The station was manned by a security officer. The room is also designated as Security Station No. 1. The inspectors discussed the functions of the Emergency Support Center under certain emergency situations.

The inspectors reviewed the training provided to personnel as required by Section 10.2, Training of the Radiological Contingency Plan. The training records of the personnel were reviewed. It was noted that several personnel were overdue on their training requirements and were thus prohibited from responding to an emergency. These individuals had been notified of the overdue training by a memorandum.

The inspectors reviewed Health Physics Procedures #17, Emergency Vehicle Inventory and Maintenance Procedure; #149, *Action to be Taken When Criticality Klaxon Horn Sounds;* and #164, *Classification and Assessment of Radiological Emergencies.* The inspectors also reviewed the equipment and designated locations for emergency response equipment. It was noted that since the Radiological Contingency Plan was last updated, locations of some emergency facilities have been eliminated due to the site decommissioning in process. For example, the Building 27-1 decontamination facility is no

longer in service due to decommissioning. The remaining decontamination facility is in the radwaste yard. Other equipment such as the meteorological system in Building 10 will be removed, leaving one system in Sorrento Valley. These facilities are currently referenced in the Radiological Contingency Plan. The licensee indicated that the Radiological Contingency Plan will be reviewed and revised during the annual plan review to reflect the current status of site decommissioning and needs.

The facilities and provisions for emergency preparedness were found to be adequate.

c. Conclusions

The licensees's emergency preparedness program was adequate for the remaining radiological facilities on the site; however, the Radiological Contingency Plan had not been updated to reflect the facilities that have been decommissioned and no longer serve functions as described in the current plan.

2.3 Environmental Protection (88104 and 88045)

a. Inspection Scope

The inspectors reviewed the licensee's implementation of the environmental protection program to determine compliance with the license. This included facility tours and review of licensee procedures, selected records of environmental sampling and internal audit results for the past year.

b. Observations and Findings

Responsibilities, controls, and the environmental surveillance program required by Section 6.1, "Air Sampling," of Part II of the license; Chapter 3 of the Hot Cell Decommissioning Plan; and the licensee's Health Physics Procedures HP-40, *Environmental Monitoring Program - Alert Levels*; HP-77, *Environmental Air Sampling*; HP-78, *Environmental Radiation - Thermoluminescent Dosimeter;* and HP-167, *Disposal of Liquids into Sanitary Sewage System* were reviewed.

The environmental records reviewed included:

- waste effluent monitoring and sampling for the wastes to the municipal sewage system;
- soil and vegetation samples;
- air sampling and analysis;
- water and sediment sampling and analysis;
- radiation level surveys (TLDs).

The inspectors reviewed the type of equipment used, the type of samples collected, the type of analysis performed and the results. In addition, an example of a temporary procedure for performing decommissioning type work (excavation of the hot cells) was examined.

The license in Part II, "Licensee Specifications," Section 6.1, "Environmental Air Sampling," requires the licensee to collect air filters weekly from each of the 10 site air samplers, to analyze the weekly air sample filters for long-lived alpha and beta radioactivity and to composite the filters for a gamma scan monthly. A review of the air sampler data indicated there were no composited gamma scan data for the past year. The licensee stated that the monthly gamma analyses had been discontinued. An acceptable reason for this omission was not determined. The licensee's failure to comply with an analysis required by the licensee was identified as a violation of the License Specifications, Section 6.1, "Environmental Air Sampling" (70-734/9901-01).

The licensee had a system in place to prevent the spread of contamination from temporary activities (including soil excavation) which support decommissioning. Temporary procedures for controlling and monitoring radioactive contamination were approved by the Radiation Safety Manager. Air samplers were strategically placed around the perimeter of the work area and samples were collected and analyzed weekly.

c. Conclusions

A violation of the License Specifications, Section 6.1, "Environmental Air Sampling" was identified involving the licensee's failure to perform required monthly air filter sample composite gamma scans.

With the exception of the monthly gamma scans for the site filter air samples, the licensee's environmental monitoring program was conducted in accordance with the license application and the licensee's implementing procedures. Precautions were taken by the licensee to prevent the spread of contamination to the environment during decommissioning.

3 Closeout Inspection and Survey (83890)

3.1 Scope

The licensee's preparations, final survey plan, conduct of the final survey, and analysis of the results for selected areas within the Group 11 Laboratories in Building 2, Building 31-1, the former Building 31-3 ground area, the Sorrento Valley Central Land Area, and various materials to be shipped to a clean landfill, were reviewed to determine their agreement with the methodologies contained in NUREG-5849, the licensee's SDP, and the requirements of 10 CFR 70.38(j).

Confirmatory surveys for surface alpha, beta and gamma, and ambient gamma radiation exposure levels of selected areas within the aforementioned buildings and areas were conducted by the inspectors to determine the radiological status of the facilities being considered for release.

During the confirmatory surveys, NRC inspectors used the following radiation detection instruments:

Eberline Model E-600 to measure for alpha, beta and gamma radiations with gas-proportional, Geiger-Mueller (GM) and alpha scintillation probes; and

Ludlum Model 19 to measure low level gamma rays.

Model	NRC Serial #	Calibration Due
Eberline E-600	063472	2/05/00
Ludlum Model 19	015534	5/3/00

The inspectors performed operational checks of NRC radiation instruments with National Institute of Standards and Technology (NIST) traceable radiation check sources.

Release Criteria for Unrestricted Release as approved in the licensee's SDP are shown below:

Alpha- and Beta/Gamma Emitters

5,000 dpm/100cm^2	Fixed and removable natural uranium, U-235, U-238, and associated decay products
1,000 dpm/100cm^2	Removable natural uranium, U-235, U-238, and associated decay products

General Area Gamma Exposure Rate Limit

Less than 10 microRoentgen per hour (μR/hr) above background when measured at approximately 1 meter (~3 feet) above surfaces/floors.

3.2 Observations and Findings

a. Building 2 Laboratories - Group 11 (nine laboratories)

The licensee's "Final Radiological Surveys of Selected Building 2 Laboratories for Release to Unrestricted Use," dated July 1999 was reviewed and found acceptable.

The inspectors performed a confirmatory survey of five of the nine laboratories using a gas-proportional counter and a sodium iodide micro-R meter. These five laboratories, Nos. 238, 240, 242, 443 and 445 were the most likely to be contaminated due to prior use. The beta readings ranged from 108-482 dpm/100 cm^2 above background. The alpha readings ranged from 0 to 10 dpm/100 cm^2 above background. The gamma readings at one meter equal to or less than background. The results were consistent with the licensee's measurements which demonstrated that the area met the criteria for unrestricted release.

b. Building 31-1, Radiochemistry Labs/Radiography Building

The licensee's "Final Radiological Survey Performed at General Atomics' Building 31-1," dated August 24, 1999, was reviewed and found acceptable.

The inspectors performed a confirmatory survey of the building's five rooms using a gas-proportional counter and a sodium iodide micro-R meter. The beta readings ranged

from 154-572 dpm/100 cm^2 above background. The alpha readings ranged from 0 to 34 dpm/100 cm^2 above background. The gamma readings at one meter ranged from 0-5 μR/hr above background. The results were consistent with the licensee's measurements which demonstrated that the area met the criteria for unrestricted release.

c. Sorrento Valley Central Land Area

The licensee's report, "Final Radiological Survey Performed at General Atomics' Sorrento Valley Central Land Area," dated July 28, 1999, was reviewed and found acceptable. The inspectors performed a confirmatory survey of the land area. The survey consisted of alpha, beta and gamma measurements over several portions of the land area. No soil samples were taken. The beta readings ranged from 0-216 dpm/100 cm^2 above background. The alpha readings ranged from 0 to 4 dpm/100 cm^2 above background. The gamma readings at 1 meter ranged from 0-2 μR/hr above background. The results were consistent with the licensee's measurements which demonstrated that the area met the criteria for unrestricted release.

d. Former Building 31-3 area

Building 31-3 had been removed and the ground area remediated. The licensee will be submitting the final survey of the area and a request for unrestricted release later.

Four soil samples were obtained and split for analysis by the licensee and the NRC as part of the confirmatory survey process during decommissioning. The comparison results of the licensee's analysis with the NRC's analysis of the soil samples, as presented in the following tables, were all in agreement when compared with the criteria in NRC Inspection Procedure 84525, "Quality Assurance and Confirmatory Measurements."

Acceptance Criteria[1]

Resolution[2]	Ratio[3]
<4	0.4 - 2.5
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

[1] Criteria from Inspection Procedure 84525, Quality Assurance and Confirmatory Measurements for In-Plant Radiochemical Analysis
[2] Resolution is the NRC result divided by its associated 1σ uncertainty.
[3] Ratio is the licensee result divided by NRC result.

Soil Sample Analysis Comparison
Site at Former Building 31-3

Sample# / Isotope	GA Analysis pCi/gram	NRC Analysis pCi/gram +/- 1σ	Resolution[1]	Ratio[1]	Agreement[1] Status
#B31-3 1B	Location 1 at Former Building 31-3 Site				
U-238	2.70	3.7+/-0.8	4.6	0.73	OK
U-235	0.31	0.25+/-0.06	4.2	1.2	OK
Am-241	Not Detected	Not Detected			
#B31-3 2B	Location 2 at Former Building 31-3 Site				
U-238	2.32	2.7+/-0.5	5.4	0.86	OK
U-235	0.25	0.15+/-0.07	2.1	1.7	OK
Am-241	Not Detected	Not Detected			
#B31-3 3B	Location 3 at Former Building 31-3 Site				
U-238	2.25	2.6+/-0.47	5.5	0.86	OK
U-235	0.31	0.27+/-0.06	4.5	1.1	OK
Am-241	Not Detected	Not Detected			
#B31-3 3B	Location 4 at Former Building 31-3 Site				
U-238	2.24	2.1+/-0.6	3.5	1.1	OK
U-235	0.25	0.17+/-0.07	2.4	1.5	OK
Am-241	Not Detected	Not Detected			

[1]Resolution, ratio and agreement status determined from above criteria.

e. Materials for Sanitary Landfill Disposal

Several storage locations consisting of a variety of materials designated for disposal at a clean landfill were surveyed. Confirmatory surveys were performed on the following materials and location designations:

S-1,a,b, Building 27-1 concrete in dumpsters
S-4, Building 30 concrete in dumpsters
S-5, Building 39 concrete slabs
T-5 and T-7, Building 27-1 concrete slabs
T-13, 14 & 15, gunite, concrete/soil, and steel
T-17, Building 23 asphalt, concrete
T-20, Building 30 concrete shield door and metal door
T-24, Building 23 concrete blocks

The alpha-beta-gamma readings on the various materials made with the HP 360 GM probe ranged from 0-255 dpm/100 cm^2 above background. The gamma readings at one meter ranged from 0-7 μR/hr above background. The results were consistent with the licensee's measurements which demonstrated that the area met the criteria for unrestricted release.

3.3 Conclusion

Based on the results of this inspection, D&D activities conducted at the Torrey Pines Mesa and Sorrento Valley facilities were generally characterized by implementation of effective programs for decontamination and decommissioning.

Confirmatory surveys conducted at the Group 11 Laboratories in Building 2, Building 31-1, the former Building 31-3 ground area, the Sorrento Valley Central Land Area, and various materials to be shipped to a clean landfill were consistent with licensee measurements. The NRC's confirmatory measurements confirmed the licensee's determination that these areas and facilities met the criteria for unrestricted release.

The results of NRC split soil sample confirmatory measurements from the former Building 31-3 land area were in good agreement with licensee results. The results of the soil samples taken from the area were less than the criteria established in Table 6-2, *Soil and Concrete/Asphalt Rubble Release Criteria,* of the SDP for unrestricted release. The licensee's final survey report for this area and the request for release for unrestricted use will be submitted later.

4 Followup (92702)

4.1 (Closed) Violation 70-734/9803-01, Contaminated material found in decontaminated area to be decommissioned. Required survey not performed.

The inspectors reviewed the licensees's "Investigation of the Hot Pipe at Bldg. 21" dated February 2, 1999, the licensee's response to the Notice of Violation dated March 18, 1999, and the licensee's corrective actions to the violation. The licensee's corrective actions were to: 1) remove the pipe section, 2) investigate the incident and determine the cause, 3) issue an oral and written reminder to all health physics technicians on survey techniques and the survey requirements of the SDP, and 4) purchase a small detector to use in surveying inside drain pipes and/or other small spaces.

The inspectors found that the licensee had implemented the corrective actions identified. The violation is closed.

5 Exit Meeting Summary

The inspectors presented the inspection results to members of licensee management at the conclusion of the inspection period on August 6, 1999. A telephonic followup exit briefing was conducted on September 9, 1999, to discuss the results of the split soil sample confirmatory measurements performed as part of the inspection. The licensee did not identify as proprietary any information provided to, or reviewed by, the inspectors.

ATTACHMENT

SUPPLEMENTAL INFORMATION
PARTIAL LIST OF PERSONS CONTACTED

Licensee

Keith Asmussen, Director, Licensing, Safety and Nuclear Compliance
George Bramblett, Project Manager, GA D&D
Fritz Dahms, Project Manager, GA D&D
Laura Gonzales, GA Radiation Safety Officer/Health Physics Manager
John Greenwood, Principal Investigator, TRIGA
Barbara Hunter, Health Physics, Hot Cell Facility
William LaBonte, Lead Health Physicist, Hot Cell Facility
Brian Laney, Licensing and Compliance
Paul Maschka, Senior Health Physicist
Bob Noren, Manager, GA D&D
John Turner, Health Physics

INSPECTION PROCEDURES USED

IP 83890 Closeout Inspection and Survey
IP 84525 Quality Assurance and Confirmatory Measurements
IP 84850 Waste Generator Requirements
IP 84900 Low-Level Waste Storage
IP 88035 Radioactive Waste Management
IP 88045 Environmental Protection
IP 88050 Emergency Preparedness
IP 88104 Decommissioning Inspection

ITEMS OPENED, CLOSED AND DISCUSSED

Opened

70-734/9901-01 VIO Required environmental sample analysis not performed.

Closed

70-734/9803-01 VIO Contaminated material found in decontaminated area to be decommissioned. Required survey not performed.

Discussed None

LIST OF ACRONYMS USED

ALARA	as low as reasonably achievable
cm^2	square centimeters
cpm	counts per minute
dpm	disintegrations per minute
D&D	decontamination and decommissioning
GA	General Atomics
GM	Geiger Mueller
HP	health physics
NIST	National Institute of Standards and Technology
1σ	one standard deviation
pCi/gram	pico Curies per gram
PDR	Public Document Room
SDP	Site Decommissioning Plan
SNM	special nuclear material
SVA	Sorrento Valley "A" Building
TLD	thermoluminescent dosimeter
μR/hr	microRoentgen per hour