RADIOLOGICAL SCOPING SURVEY OF THE CURTIS BAY DEPOT, CURTIS BAY, MARYLAND

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Prepared for the
Defense National Stockpile Center
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ABBREVIATIONS AND ACRONYMS

ε_i	instrument efficiency
ε_s	surface efficiency
ε_{total}	total efficiency
b_i	number of background counts in the interval
AEC	Atomic Energy Commission
BKG	background
CBD	Curtis Bay Depot
cm	centimeter
cm^2	square centimeter
cpm	counts per minute
d'	index of sensitivity
DCGL	derived concentration guideline level
DLA	Defense Logistics Agency
DNSC	Defense National Stockpile Center
DOE	U.S. Department of Energy
$dpm/100\ cm^2$	disintegrations per minute per 100 square centimeters
GPS	global positioning system
GSA	General Services Administration
HSA	historical site assessment
ITP	Intercomparison Testing Program
MAPEP	Mixed Analyte Performance Evaluation Program
MDC	minimum detectable concentration
MDCR	minimum detectable count rate
MeV	million electron volts
m	meters
m^2	square meter
mg/cm^2	milligram per square centimeter
min	minute
mm	millimeter
NaI	sodium iodide
NIST	National Institute of Standards and Technology
NORM	naturally occurring radioactive material
NRC	U.S. Nuclear Regulatory Commission
NRIP	NIST Radiochemistry Intercomparison Program
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocuries per gram
s	second
TAP	total absorption peak
ThN	thorium nitrate

RADIOLOGICAL SCOPING SURVEY OF THE CURTIS BAY DEPOT CURTIS BAY, MARYLAND

INTRODUCTION AND SITE HISTORY

The land area that is currently the Curtis Bay Depot (CBD) in Curtis Bay, Maryland was originally a U.S. Army Depot built in 1918 on 798 acres of farmland. Additional acreage was acquired, increasing the site size to 815 acres. From 1918 to 1954 the site was used for receiving, shipping and storage, and as an ordnance depot (storing ammunition).

In 1946, a National Stockpile program was established as an attempt to mitigate dependence on foreign sources of vital materials during times of national emergencies. In the late 1950s, the Defense National Stockpile Center (DNSC) became a tenant at the CBD and began storing strategic materials (bulk ores, minerals, and metals). Included in the materials stored at the CBD were chromite, ferromanganese, and ferrochrome. Additional stored materials were thorium nitrate (mantle and reactor grades, average 47 percent thorium nitrate (ThN) by weight) in fiber and steel drums, monazite sands, and sodium sulfate—radioactive materials that required a U.S. Atomic Energy Commission (AEC), predecessor to the U.S. Nuclear Regulatory Commission (NRC), source material license (License STC-133).

Since the establishment of the CBD, there have been a number of land transfers reducing the footprint of the site and also changes in government agency caretakers. Approximately 37 acres were transferred to the U.S. Army Reserve Command between 1958 and 1966. The remaining 778 acres were excessed to the General Services Administration (GSA) which had assumed accountability for the facility. In 1966, GSA sold CBD land that included the area of an old burial site to Anne Arundel County for development into an industrial park (Bay Meadows Industrial Park). Material that was in this pit was removed in 1966 and transferred to an on-site burial area. In 1977, GSA notified NRC of its intention to excess empty warehouses on the site as part of a sale of U.S. Government land and buildings. In 1980, GSA sold approximately 87 acres to Anne Arundel County. This property had contained nine warehouses that were used to store thorium nitrate. The site was cleaned up and that portion released from the NRC license. The County eventually built a detention center and ball fields on the property. In 1988, National Defense Stockpile responsibility was transferred from the GSA to the Defense Logistics Agency (DLA).

The DNSC of the DLA is now in the process of closing out many of its depots across the country and seeking to terminate its NRC license for those facilities. Although there have been a number of building and soil remedial actions at CBD over the past three decades, the CBD license was recently amended to conduct final site cleanup activities. The initial phases of the current cleanup activities have been initiated. These initial activities included the recent removal of ThN source material from the site—monazite sands and sodium sulfate had been previously removed—and at the request of the DLA, the Oak Ridge Institute for Science and Education (ORISE) performed a historical site assessment (HSA) of the CBD in order to plan for future site investigations and eventual remediation activities (ORISE 2005a). Additionally, ORISE was tasked to conduct scoping surveys of the site to validate the results of the HSA and to provide information for the complete site characterization survey. The scoping survey was conducted in two phases during the periods of June 13 through 22 and October 24 through 27, 2005. Phase 1 included land areas, previously demolished building pads, and buildings deemed structurally sound for safe entry. Phase 2 included surveys of those building pads that required partial deconstruction to allow for survey access and the resultant debris. The deconstruction of 24 buildings at the site was completed by the DLA contractor, PIKA International, Inc., on October 14, 2005.

SITE DESCRIPTION

The CBD site is located approximately one mile south of Baltimore, Maryland in an industrialized area of Anne Arundel County, Maryland. The property currently consists of approximately 483 acres bounded on the north by the Army Reserve Facility and Curtis Creek, on the east by Curtis Creek, on the south by Furnace Creek, and on the west by Back Creek and the Anne Arundel County Facility. A 1,955-foot long dock belonging to the U.S. Army Reserve lies along Curtis Creek; a security fence encloses the facility. Figure 1 shows the site plot plan.

In general, the CBD terrain is mostly flat to gently hilly with large grassy, open areas, and some lightly wooded areas. A number of roads, mostly asphalt, traverse the site; there are approximately six miles of paved roads. Also noteworthy are the large stockpiles of various ores. Most of the stockpiled materials at CBD are raw ores with no history of radioactive material storage. Ores are primarily piled on concrete pads or directly on the ground. Some piles are covered to reduce erosion through weathering and oxidation. There are two miles of railroad tracks that cross the site, a stream, and two leach fields—one in use. There are two wetland areas on the southwest and south sides of the site. Two former burial areas—for medical supplies and radioactive waste—and ordnance areas were also identified on the western sector of the site.

The site contains various structures (buildings and warehouses)—some functional, others that were in a serious state of disrepair and were partially deconstructed in the fall of 2005. A few buildings are surrounded by man-made berms of earth, that over the years since their construction have been vegetated with small trees and brush. A number of these buildings/warehouses have been used to store the thorium, generally in containers. There are five different building construction types ranging in size from 10 meters (m) by 30 m to as large as 73 m by 183 m. Construction is either a pitched roof building with transite or asphalt shingles, concrete floor, and terra cotta block walls; or constructed with a flat roof, wooden or concrete floor, and transite or terra cotta block walls. A number of the buildings have been demolished and only the concrete pad remains. Two of the buildings/warehouses were known to be contaminated, some were potentially contaminated, and the others have no known history of radioactive materials use.

There are two large warehouses on the site designated as Buildings 1021 and 1022 that measure 73 m by 183 m. Building 1021 has no history of radioactive material storage. Building 1022 is known to have formerly stored thorium and a "clean-up action" was noted in historical documentation. The remaining storage buildings, a number of which have stored radioactive materials, are designated according to groupings as A through I Line Buildings. Two additional building lines, J and K Lines, have been completely demolished. Lastly, Building 821 was a former change house and Building 825 housed machining and carpentry equipment, neither of which have had a history of radioactive material use. Table 1 provides a summary of the building nomenclature designation, current condition, and radioactive material use. Figure 1 shows the pad/building locations.

OBJECTIVES

The objectives of the radiological scoping surveys were to collect adequate field data for use in evaluating the radiological condition of land areas and buildings at the CBD site. The data generated were used to validate the results of the HSA regarding classification of areas by radiological contamination potential, validate the radiological contaminants of concern (thorium and uranium, or thorium only), determine whether contamination present warrants further evaluation, provide site reconnaissance for site-specific derived concentration guideline level (DCGL) modeling inputs, and provide input information for the development of a complete site characterization plan.

DOCUMENT REVIEW

ORISE reviewed the HSA during the preparation of the scoping survey plans that were employed at the site.

PROCEDURES

A survey team from ORISE visited the CBD during two phases and performed visual inspections, and measurement and sampling activities. Phase 1 addressed the land areas and buildings that were safe to enter and Phase 2 addressed the buildings that required deconstruction. Scoping survey activities were conducted in accordance with the ORISE Survey Procedures and Quality Assurance Manuals and site-specific scoping survey plans (ORISE 2004 and 2005b, c, and d).

ORISE divided the CBD site into three categories, based on contamination potential, as either Class 1, 2, or 3 in accordance with the Multi-Agency Radiation Survey and Site Investigation Manual (NRC 2000). A description of each is as follows:

Class 1: Buildings or land areas that have a significant potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiological surveys) that exceeds the expected $DCGL_W$.

Class 2: Buildings or land areas, often contiguous to Class 1 areas, that have a potential for radioactive contamination but at levels less than the expected $DCGL_W$.

Class 3: Remaining buildings and land areas that are expected to contain little or no residual contamination based on site operating history or previous radiological surveys.

Table 1 provides the classification for each pad/building on the site and Figure 2 shows pad/building and land area classifications. Because the buildings that were addressed during Phase 2 were partially deconstructed, areas of debris made portions of the buildings inaccessible. However, the area made accessible for survey satisfied the nominal percentages discussed below.

BUILDING SURVEY PROCEDURES: CLASS 1

The following survey procedures were applicable to Class 1 pads/buildings where contamination had been previously identified or the potential existed for contamination based on operating history. Additional pads/buildings where residual surface activity was detected during the course of the survey were also surveyed in this manner. None of the buildings requiring deconstruction were Class 1. Buildings initially designated as Class 1 were:

- B-911 and B-912
- F-731 and F-737

Reference Grid

ESSAP established a grid system consisting of 10 m × 10 m grid blocks on the concrete pads or floors and lower walls (up to 2 m) in each Class 1 building. Areas of residual contamination were referenced to either a specific grid sub-division and coordinate or plotted on site drawings. The ceiling and upper walls (above 2 m) were not gridded. Measurements and samples collected on ungridded surfaces were referenced to the floor and/or lower wall grid coordinates or to prominent building features.

Surface Scans

Concrete pads/floors and lower walls were scanned for alpha plus beta or beta-only and gamma radiation. Because the objective of the scoping survey was to validate the results of the HSA and obtain data of the general radiation levels for future characterization survey planning, the scanning percent coverage of surfaces was highly variable. However, the minimum surface scan coverage was 25% of accessible surfaces, with several pads/building floors being scanned 100% for gamma and/or alpha plus beta radiation. The total area covered was dependent upon results as the survey progressed. Lower walls were also scanned for beta-only radiation in structurally sound buildings, with scanning concentrated in those areas where floor contamination was identified. Scans of accessible upper surfaces concentrated on horizontal surfaces where material may have accumulated. Because of difficulties encountered with accessing upper surfaces, the number of Phase 1 building upper surface locations judgmentally selected for survey was reduced from the planned 10 to 20 locations to three to nine locations. An area of 1 m^2 was scanned within each of these selected locations.

Additional areas were scanned, as necessary to delineate contamination boundaries, when residual contamination was detected. Particular attention was given to cracks and joints in the floor and walls, ledges, and other horizontal surfaces where material may have accumulated. Scans were performed using NaI scintillation detectors for direct gamma radiation and gas proportional detectors for direct alpha plus beta and beta-only radiation, coupled to ratemeters or ratemeter-scalers with audible indicators. Locations of elevated direct radiation were marked for further investigation. Identification of areas requiring additional investigation was based on instrument count rate action levels established at the site.

Surface Activity Measurements

Initially, construction material-specific backgrounds were determined in areas of similar construction but without a history of radioactive material use. These construction material-specific measurements were used to correct pad/building direct measurement for background contributions. Direct measurements to quantify total beta activity levels, with supplementary measurements of total alpha activity, were performed within areas of residual contamination identified by surface scans, at contiguous locations to delineate contamination boundaries, and also at systematic locations. In cases where wide-spread contamination and/or multiple hot spots were identified, measurements were only made systematically. The number of direct measurements on pads or floor and lower wall surfaces within each Class 1 pad/building ranged from 17 to 27. On upper surfaces, direct measurements were performed within each of the three to nine areas that were selected for judgmental scanning. Direct measurements were made using gas proportional detectors coupled to ratemeter-scalers. A smear sample, to determine removable gross alpha and gross beta activity levels, was collected from each building direct measurement location. Smear samples were not collected from Class 1 pad measurement locations as these surfaces had been subject to weathering. Measurement locations are shown on Figures 3 through 6.

BUILDING SURVEY PROCEDURES: CLASS 2

The following procedures were used for the scoping surveys of Class 2 pads/buildings/building debris indicated in Table 1. Figure 2 illustrates the Class 2 pads/buildings. Pads/buildings identified during the course of this investigation as containing residual contamination were reclassified as Class 1 and surveyed in accordance with the Class 1 procedures. Buildings initially designated as Class 2 were:

- A-921
- B-913
- F-734, F-735, and F-736
- G-721
- H-711, H-712, H-713, H-714, and H-715
- 1022

Reference Grid

Class 2 pads/buildings were not gridded. Measurements and samples collected in Class 2 areas were referenced to prominent features or general debris pile area and documented on site drawings.

Surface Scans

Pads/building floors and lower walls were scanned for alpha plus beta or beta-only and gamma radiation. Up to 50% of the accessible Phase 1 structure surfaces were scanned. Professional judgment was used during the Phase 1 surveys to select scan areas dependent upon visual inspections and historical records of spills or cleanups. In buildings, upper walls and overhead structures were also scanned with emphasis on horizontal surfaces where residual contamination may have settled and accumulated when access could be achieved and if elevated activity was identified on the floor.

Phase 2 scan surveys of the Class 2 deconstructed buildings with concrete floors (F Line) involved scanning up to 100% of the building floor section made accessible by the deconstruction contractor. The amount of floor area available for each of these deconstructed buildings ranged from 30 to 60%. The wooden floors were required to be removed and staged in debris piles for all but one (H-711) of the H Line buildings. Scans were conducted on approximately 75% of the accessible floor area of building H-711 and on 10 to 20% of the individual floor planks for the remaining H Line buildings. The floor of building H-715 had degraded to such an extent that it could not be removed intact and in fact had collapsed into the crawl space of the building. Therefore the number of planks available for scan surveys was minimal. Deconstructed wall debris from the F and H Line buildings were also staged in piles and scanning covered 10 to 50% of the accessible wall debris surfaces.

Scans were performed using NaI scintillation detectors for direct gamma radiation and gas proportional detectors for alpha plus beta or beta-only radiation, coupled to ratemeters or ratemeter-scalers with audible indicators. Any locations of elevated direct radiation were investigated and, in some cases, required reclassification of the pad/building.

Surface Activity Measurements

Direct measurements of total beta surface activity during Phase 1, with a number of supplementary alpha surface activity measurements, were made at a minimum of 10 to 30 locations on the Class 2 pad/building surfaces. The number of measurements correlated to the size of the pad/building and measurements were located systematically based on a random start location. Additional measurements were also made at any locations of elevated direct radiation detected by surface scans. The previously discussed construction material-specific background measurements were used to correct pad/building measurements for background contributions.

Direct measurements for the Phase 2, Class 2 deconstructed buildings were made at 20 random start/systematic locations on each F Line building pad and at five random locations on the wall debris. Direct measurements were made at 10 random start/systematic locations on the building H-711 floor and at five random locations on the wall debris pile. For the remaining H Line buildings, excluding Building H-715, 10 and five random measurements were made on each floor and wall debris pile, respectively. Ten measurements were made on the H-715 debris piles, one on the floor and nine on the wall debris. Additional measurements were also made at judgmental locations when warranted by surface scans.

Measurements were made using gas proportional detectors coupled to ratemeter-scalers. A smear sample, to determine removable gross alpha and gross beta activity levels, was collected from most direct measurement locations. Figures 7 through 18 show measurement locations.

BUILDING SURVEY PROCEDURES: CLASS 3

The following procedures were used for the survey of pads/buildings/building debris shown in Table 1 and Figure 2 as Class 3 structures. The following buildings were designated as Class 3:

- A-922
- C-1131, C-1132, C-1133, and C-1134
- D-1121, D-1122, D-1123, D-1124, and D-1125
- E-1111, E-1112, E-1113, E-1114, E-1115, and E-1116
- F-732 and F-733
- G-722, G-723, G-724, G-725, and G-726
- I-531, I-631, I-632, I-633, I-634, I-636, I-641, and I-634 Igloo
- 821, 825, and 1021

Reference Grid

Measurements and samples collected were referenced to prominent pad/building features or the general debris pile area and documented on site drawings.

Surface Scans

Pads/floors and lower walls were judgmentally scanned for alpha plus beta, or beta-only, and gamma radiation. Up to 25% of the accessible Phase 1, Class 3 surfaces were scanned.

Phase 2 scan surveys of the Class 3 deconstructed buildings with concrete floors (D, E, F and G Lines) involved scanning up to 100% of the building floor section made accessible by the deconstruction contractor. The amount of floor area available for each of these deconstructed buildings ranged from 15 to 40%. The wooden floors were removed and staged in debris piles for I Line buildings and the deconstructed walls also staged in separate debris piles for all deconstructed buildings. Scans were conducted on approximately 10 to 20% of the individual floor planks for the I Line buildings and 10 to 20% of the accessible surfaces in each of the deconstructed wall debris piles.

Scans were performed using NaI scintillation detectors for direct gamma radiation and gas proportional detectors for direct alpha plus beta or beta-only radiation, coupled to ratemeters or ratemeter-scalers with audible indicators. Locations of elevated direct radiation distinguishable from background were marked for further investigation.

Surface Activity Measurements

Direct measurements were made at 14 to 18 randomly generated or judgmental locations on Phase 1, Class 3 structures. Direct measurements for the Phase 2, Class 3 deconstructed buildings were made at 10 random and/or judgmental locations on each building pad or floor plank debris pile and at five random and/or judgmental locations on the wall debris. Measurements were made at 10 floor and five wall locations in the I-634 Igloo. The construction material-specific measurements were used to correct data for background contributions.

Measurements were made using gas proportional detectors coupled to ratemeter-scalers. A smear sample for determining removable surface activity levels was collected from representative Phase 1 building measurement locations and from all Phase 2 measurement locations. Figures 19 through 52 show measurement locations.

EXTERIOR SURVEY PROCEDURES: CLASS 1

The following survey procedures were applicable to areas associated with locations where contamination previously was identified or where the potential existed for contamination due to operating history (Figure 2). Specifically, the land areas designated as Class 1 included the former radiological waste burial area and the land areas surrounding buildings that were suspected to be contaminated. Any additional areas where residual activity was detected during the course of the survey were reclassified and surveyed in this manner.

Reference Grid

A site grid system was not established. Measurement and sampling locations were referenced using a global positioning system (GPS) and/or referenced to prominent site features.

Surface Scans

Surface scans for direct gamma radiation were performed over approximately 100% of accessible surfaces out to a 5 to 10-meter perimeter of each Class 1 structure. A number of the structures on the F Line had collapsed wall debris that precluded complete scan coverage around the buildings. Gamma scans were performed using NaI scintillation detectors coupled to ratemeters with audible indicators. Locations of elevated direct gamma radiation were marked for further investigation and documented on site drawings (Figure 53).

Within the boundaries of the former radiological waste burial area, gamma scans were performed over the ground surface. Test pits were excavated within the burial area and gamma scans were performed of the sidewalls, pit bottoms, and suspect soils brought to the surface. The approximate depths of elevated gamma radiation zones detected were documented for further evaluation.

Soil Sampling

Surface (0 to 15 cm) soil samples were collected from judgmental locations where elevated direct gamma radiation was detected by surface scans. Specific sampling locations corresponded to the area of maximum direct radiation within discrete areas of suspected contamination. When multiple areas were identified in any one survey zone—e.g. perimeter of a given building—samples were not collected from all areas, but from three to five areas that were representative of the range of gamma radiation encountered. Subsurface samples were collected where subsurface contamination was suspected within the burial area test pits. Twelve soil samples were collected from the Class 1 areas, 10 of which were collected from the subsurface strata of the disposal area. Figure 54 shows soil sampling locations.

EXTERIOR SURVEY PROCEDURES: CLASS 2

The following survey procedures were applicable to accessible, exterior land areas identified as Class 2 (Figure 2). Specifically, this included the bulk of the land surrounding the B Line through I Line Buildings, the dump located near the former Ordnance Depot Incinerator, as well as roadways and current and former railroad lines that cross the site. Many of the areas required clearing and grubbing of overgrown vegetation, to provide access for survey activities. Areas identified during the course of the survey as having elevated direct radiation were reclassified as Class 1, either during this scoping survey or will be at the time of the characterization survey.

Reference System

ESSAP referenced survey results to prominent site features and/or GPS coordinates.

Surface Scans

Scans for gamma radiation were performed judgmentally around perimeters of Class 2 and 3 pads/buildings, along center lines and edges of roadways and railroad lines, and judgmental locations of remaining Class 2 land areas. Scans were performed using NaI scintillation detectors coupled to ratemeters with audible indicators. Locations of elevated direct gamma radiation were marked for further investigation (Figure 53).

Soil Sampling

Surface soil samples were collected from judgmental locations where elevated direct gamma radiation was detected above background. The number of samples was determined as the survey progressed. Definable areas—e.g. the land areas surrounding each building line, a specific road, etc.—where there are no distinct indications of residual contamination were sampled judgmentally at two to five locations. Twenty-four samples were collected from Class 2 land areas. Figure 54 shows soil sampling locations.

EXTERIOR SURVEY PROCEDURES: CLASS 3

The remaining portions of the site that were not designated as either Class 1 or 2 as illustrated in Figure 2, were considered as Class 3 areas. Gamma surface scans were performed judgmentally around roadways, railroad lines, and any buildings using NaI scintillation detectors. Sample locations and the number of samples ultimately collected were determined as the survey progressed and in a manner similar to the process described above for Class 2 areas. Locations of direct gamma radiation distinguishable from background in a Class 3 area were judgmentally selected for surface soil sampling. Six samples were collected. Figures 53 and 54 show areas of elevated gamma activity and soil sampling locations.

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data were returned to ORISE's laboratory in Oak Ridge, Tennessee for analysis and interpretation. Samples were analyzed in accordance with the ORISE Laboratory Procedures Manual (ORISE 2005e). Soil samples were analyzed by gamma spectroscopy for thorium and uranium and results reported in units of picocuries per gram (pCi/g). Smears were analyzed for gross alpha and gross beta activity using a low background gas proportional counter. Smear data and direct measurements for total surface activity were converted to units of disintegrations per minute per 100 square centimeters (dpm/100 cm^2). Additional information regarding survey and laboratory equipment and procedures is provided in Appendices A and B.

Site-specific DCGLs for building surfaces and soils had not been developed at the time of the scoping surveys. However, preliminary DCGL modeling using default parameters provided in the RESRAD and RESRAD-BUILD computer codes had been performed. The scoping survey thorium surface activity and Th-232 soil sample results were compared with a resultant action level of 350 dpm/100 cm^2 for Th-232 surface activity and 2 pCi/g for Th-232 in soil.

FINDINGS AND RESULTS

BUILDING SURFACE SCANS

Surface scans results for both Phase 1 and 2 scoping surveys are discussed below under the respective survey classification sections.

Class 1 Pads/Buildings

Gamma scans of Buildings B-911 and B-912 identified that most of the floor areas exhibited generally elevated gamma radiation levels. There were numerous localized hot spots exhibiting count rates ranging from 20,000 to greater than 500,000 counts per minute (cpm) as compared to a general gamma radiation detector background of 3,000 to 4,000 cpm. One additional area was identified on the exterior dock of Building B-911. The gamma scans of remaining Class 1 buildings did not identify gamma radiation discernable from background that was not otherwise associated with a terra cotta block wall material that exhibited an elevated gamma radiation signature as a result of naturally occurring radioactive materials (NORM). Two samples of this material were collected to verify the presence of the elevated NORM. The terra cotta block was also suspected to have caused elevated activity air sampling results during the building deconstructions.

Alpha plus beta/beta-only scans of the Class 1 pads/buildings identified significant elevated radiation levels in Buildings B-911 and B-912 that covered most of the floor, one area on the wall of Building B-911, and several locations on the exterior dock of Building B-911. Alpha plus beta scans also identified localized, above background radiation levels on the pads of Buildings F-731 and F-737. Alpha plus beta and beta-only scans of the remaining Class 1 pads/buildings did not identify radiation levels distinguishable from background.

Class 2 Pads/Buildings

The gamma scans of the Class 2 structures and debris piles identified two small locations of elevated gamma radiation on the floor of Building B-913. Visible oily stains were associated with both locations. Alpha plus beta/beta-only scans also identified these two locations with significant radiation levels and as a result, the scan coverage was increased to 100% of the floor in accordance with the Class 1 survey procedures. Alpha plus beta radiation distinguishable from background was identified at a single location on the north side loading dock of Building 1022. The scans of the remaining Class 2 structures and debris piles did not identify any elevated direct gamma not associated with the terra cotta block or alpha plus beta/beta-only elevated radiation levels.

Class 3 Pads/Building

Gamma scans did not identify any elevated direct radiation levels associated with pads/buildings or debris piles, with the exception of the terra cotta block. Alpha plus beta scans identified one location each of elevated radiation on the pads of both Buildings D-1125 and G-723 and scans were increased with no additional findings. Beta-only scans identified one location of elevated radiation on a piece of metal within the building G-722 wall debris pile. A sample of the metal was collected for gamma spectroscopy analysis to determine if the observed activity was the result of thorium or deposited radon-222 progeny that has been noted in the past on similar materials. Elevated levels of naturally occurring Pb-210 were identified with no indications of the presence of thorium. The remaining alpha plus beta/beta-only scans did not identify any other locations with radiation levels distinguishable from background.

SURFACE ACTIVITY LEVELS

Total and removable surface activity levels are provided in Tables 2 and 3 for the Phase 1 and Phase 2 surveys, respectively and total beta activities are summarized below for each building line according to classification. All surface activity data presented represents net activity values above background.

Class 1 Pads/Buildings

Total and removable beta activity ranges are summarized in the table below. Individual measurement results are provided in Table 2.

Pads/Buildings	Total Beta Activity Range (dpm/100 cm^2)	Number of Measurements > 350 dpm/100 cm^2
B-911 and B-912	-210 to 620,000	46 of 64
F-731 and F-737	-200 to 1,400	8 of 41

The above results, Table 2 data, and Figures 3 and 4 clearly show the presence of widespread contamination covering most of the Buildings B-911 and B-912 floors. Additionally, predominantly low-level contamination was evident on the lower walls and overheads (wooden trusses) of both of these buildings, with one noted lower wall location with much higher level activity in Building B-911. Removable activities ranged from 0 to 340 dpm/100 cm^2 for gross alpha and from -6 to 170 dpm/100 cm^2 for gross beta. For the F Line structures, low-level contamination was identified in four areas totaling less than 1 m^2 in both Building F-731 and the southern half of the Building F-737 pad. Figures 5 and 6 illustrate the surface activity associated with these areas. Removable activities for Building F-731 ranged from 0 to 3 and -2 to 24 dpm/100 cm^2 for gross alpha and gross beta, respectively. Smear samples were not collected from the Building F-737 pad.

Class 2 Pads/Buildings

Total beta activity ranges are summarized in the table below. Individual measurement location results are provided in Tables 2 and 3.

Pads/Buildings	Total Beta Activity Range (dpm/100 cm^2)	Number of Measurements > 350 dpm/100 cm^2
A-921	-180 to 230	0 of 17
B-913	-91 to 190,000	2 of 35
F-734, F-735, and F-736	-150 to 130	0 of 65
G-721	-8 to 220	0 of 20
H-711, H-712, H-713, H-714, and H-715	-440 to 110	0 of 70
1022	-210 to 660	1 of 37

The results shown above and detailed in Table 2 show the contamination identified in Buildings B-913 (two small areas shown on Figure 8) and a single location on the outside dock of Building

1022 (Figure 18). Removable activity for the Class 2 group ranged from 0 to 4,000 dpm/100 cm^2 and -5 to 2,900 dpm/100 cm^2 for gross alpha and gross beta, respectively. The maximum removable activity for Class 2 structures, excluding the two smear samples collected from the two contaminated locations identified in Building B-913, were 20 dpm/100 cm^2 for alpha and 42 dpm/100 cm^2 for beta.

Class 3 Pads/Buildings

Total beta activity ranges for Class 3 building groups are summarized in the table below. Individual measurement location results are provided in Tables 2 and 3.

Pads/Buildings	Total Beta Activity Range (dpm/100 cm^2)	Number of Measurements > 350 dpm/100 cm^2
A-922	-380 to 230	0 of 15
C-1131, C-1132, C-1133, C-1134	-110 to 170	0 of 62
D-1121, D-1122, D-1123, D-1124, D-1125	-800 to 370	1 of 75
E-1111, E-1112, E-1113, E-1114, E-1115, E-1116	-250 to 250	0 of 94
F-732, F-733	-240 to 290	0 of 29
G-722, G-723, G-724, G-725, G-726	-190 to 510	2 of 76
I-531, I-631, I-632, I-633, I-634, I-636, I-641, Igloo	-320 to 220	0 of 120
821, 825, 1021	-140 to 270	0 of 40

The results shown above and in Tables 2 and 3 indicate one location each on pads D-1125 and G-723 with beta activity potentially above background (Figures 28 and 38). One additional location was identified in the G-722 debris pile. As discussed previously, this location was determined by laboratory analysis to be the result of radon-222 progeny. Removable activity for the Class 3 group ranged from 0 to 9 dpm/100 cm^2 and -5 to 25 dpm/100 cm^2 for gross alpha and gross beta, respectively.

Miscellaneous Sample Results

The gamma spectroscopy results for the samples of terra cotta block and metal previously discussed are provided in Table 4.

EXTERIOR SURFACE SCANS

Surface scan results for exterior land areas are described below under the respective survey classification sections.

Class 1 Areas

Gamma scans of the Class 1 land areas identified elevated gamma radiation levels in soils that were excavated from the former disposal area test pits and at the northwest corner of Building F-735. Figure 53 shows these locations.

Class 2 Areas

Gamma scans of the land areas that had initially been designated as Class 2 identified numerous locations of elevated gamma radiation. These locations were within the railroad tracks on the southeast and northeast side of the site, on Yard Office Road and East Avenue, within the F and G Lines near Furnace Creek Road and also along F Line Road, due east of Building B-912, and on the edge of the Building 821 driveway (Figure 54). For the F Line locations, although Class 1 Buildings were nearby, the locations identified were outside of the Class 1 footprint of the buildings (Figure 53).

Class 3 Areas

Surface scans of the remaining Class 3 land areas also identified locations of elevated direct gamma radiation. In each case, these locations were immediately outside the Class 2 boundary. These areas were associated with the J and K Lines (Figure 53).

RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES

The concentrations of Th-232 and U-238 for individual soil samples are provided in Table 5. The table below provides a summary of the range of activities. All radionuclide concentration data presented are gross data that have not been corrected for background contributions. Suitable background reference areas will be identified and sampled during future site characterization activities.

Area	Radionuclide Concentration (pCi/g)		
	Th-232	U-238	Number of Samples >2 pCi/g Th-232
Class 1 Samples	0.40 to 46.7	0.30 to 2.90	3 of 11
Class 2 Samples	0.67 to 453	0.02 to 29	12 of 23
Class 3 Samples	0.77 to 3.38	1.14 to 2.13	5 of 8

The analytical results identified residual contamination to be present beginning at around the one meter (100 cm) depth in the former disposal area. Distributed areas of contamination were also identified near buildings and roads of the F and G Lines. Small areas of contamination were also located near Buildings B-912 and 821 and also Yard Office Road. Lower concentrations of probable contamination were associated with the H, K and J Lines and East Avenue. Th-232 and U-238 concentrations within samples collected from the railroads are less conclusive and may be the result of increased NORM concentrations in the railroad ballast.

DISCUSSION OF RESULTS

The contaminant of concern for the Curtis Bay Depot is primarily thorium with the potential for lesser quantities of uranium. The results of the scoping survey identified definitive or suspected contamination on pads/floors of the following pads/buildings shown with the associated initial classification: B-911 (extensive/Class 1), B-912 (extensive/Class 1), B-913 (isolated/Class 2), D-1125 (isolated/Class 3), F-731 (isolated/Class 1), F-737 (isolated/Class 1), G-723 (isolated/Class 3), and Building 1022 (isolated/Class 2). Low-level contamination was also determined to be present on the overhead trusses in Buildings B-911 and B-912 and one location of significant lower wall contamination in Building B-911. The activity levels identified on Class 2 Buildings F-731, F-737, and 1022 surfaces were low-level, ranging from 350 to 1,400 dpm/100 cm^2, and were localized. The contamination in Class 2 Building B-913 was significant but localized to two small areas. The activity measured on the Class 3 structures, D-1125 and G-723, was limited to one location on each structure measuring 370 and 420 dpm/100 cm^2, respectively. Surveys did not identify any indications of residual activity on all the remaining pads/buildings or debris piles.

Contaminated surface soils were determined to be present over a broad area on the F Line road and at the juncture of the F Line Road with Furnace Creek Road (Class 1 and Class 2 areas). Contaminated subsurface (<1 meter in depth) soil is present within what is believed to be a broad area within the former radiological waste disposal area (Class 1 area). Other isolated "hot spots" were noted in Class 2 areas next to roadways at Buildings B-912 and 821 with several other locales identified at levels 2 to 3 times typical background.

SUMMARY AND RECOMMENDATIONS

At the request of the Defense Logistics Agency, the Oak Ridge Institute for Science and Education conducted radiological scoping surveys of the Curtis Bay Depot in two phases during the periods June 13 through 22 and October 24 through 27, 2005. The scoping survey included visual inspections and limited radiological surveys performed in accordance with area classification that included surface scans, total and removable activity measurements, and soil sampling.

The overall results of the scoping survey validated the initial findings for building classifications provided in the historical site assessment. Extensive contamination was confirmed in Buildings B-911 and B-912. Of the remaining 48 pads/buildings that were surveyed, contamination was confirmed or suspected in six additional pads/buildings, four of which had been initially designated as Class 2 or 3. Soil area surveys identified numerous locations of contamination and suspected contamination in Class 1, 2, and 3 areas. For the Class 2 areas, the contamination identified was typically in the vicinity of a Class 1 building. None of the samples from Class 3 areas contained significant—defined as greater than 5 pCi/g—concentrations of Th-232 activity. Thorium was the predominant licensed material identified in samples.

Recommendations for future building characterizations include expanded surveys of the overheads and lower and upper walls in Buildings B-911 and B-912; 100% surface scan coverage and direct measurements as required of the Building F-731 floor and the Building F-737 pad; reclassification and expanded scan surveys and direct measurements in Buildings B-913 and 1022; and confirmation of the suspect contamination, followed by reclassification, and expanded surveys as deemed required on the Building D-1125 and G-723 pads. For the remaining pads/buildings/debris piles, the scoping survey data were collected to fulfill the requirements for final status survey data quantity and quality, and will be evaluated further once a site-specific DCGL is approved. Further reclassifications and characterization surveys of land areas are recommended to include subsurface sampling of the former radiological waste disposal area; reclassification, expanded gamma surface scans, and additional soil sampling of land areas around Building 821, the B, F, G, H, K, and J Lines, and the associated roadways; and expanded gamma surface scans and soil sampling of the remaining site land areas to further evaluate the initial HSA land area classifications. Furthermore, collection of off-site reference railroad ballast is recommended to determine whether the slightly elevated Th-232 and U-238 concentrations observed in the samples collected from on-site ballast were the result of NORM or licensed material.

FIGURES

431-001b (2)

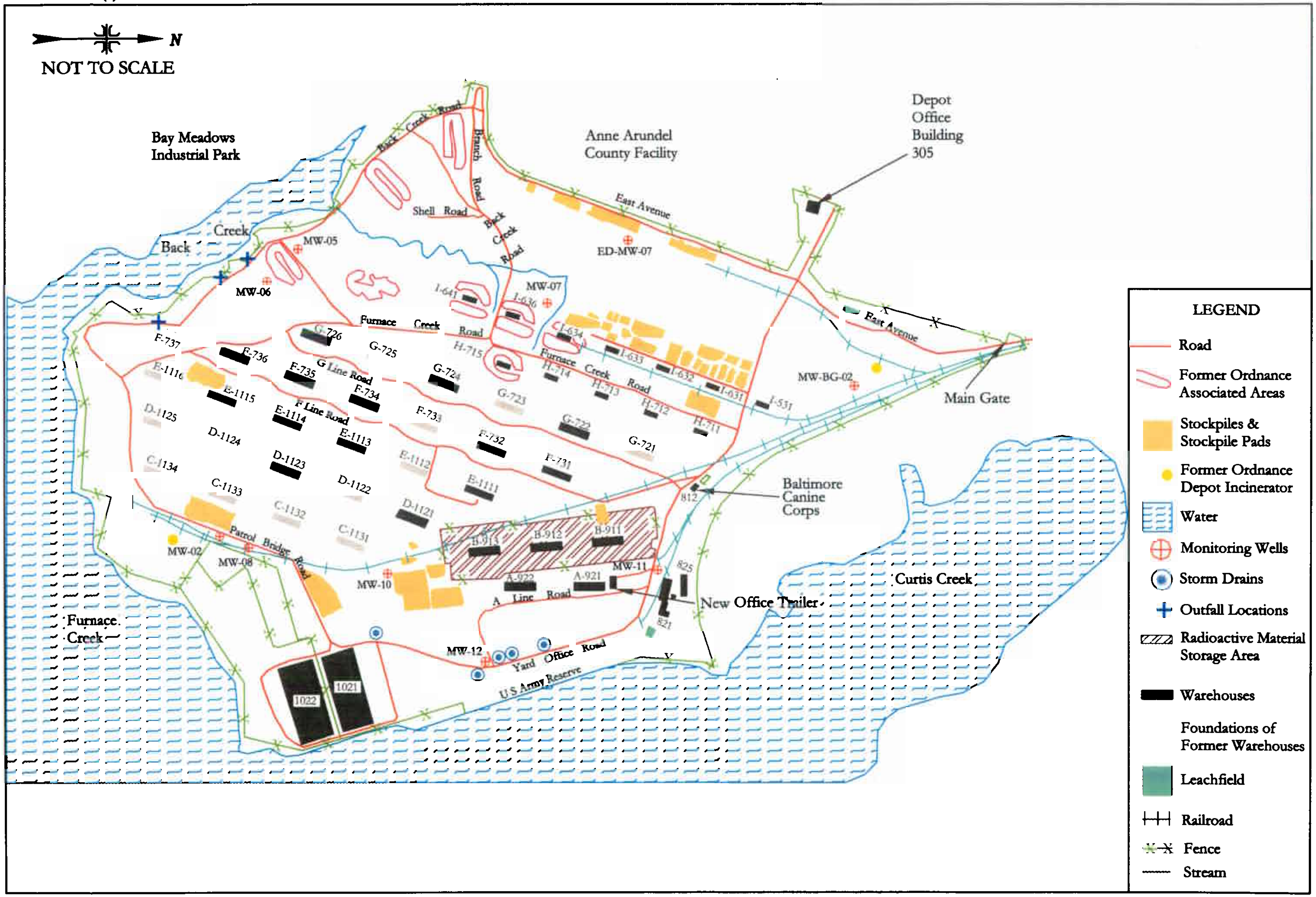


FIGURE 1: Curtis Bay Depot, Curtis Bay Maryland - Plot Plan

431-002b (2)

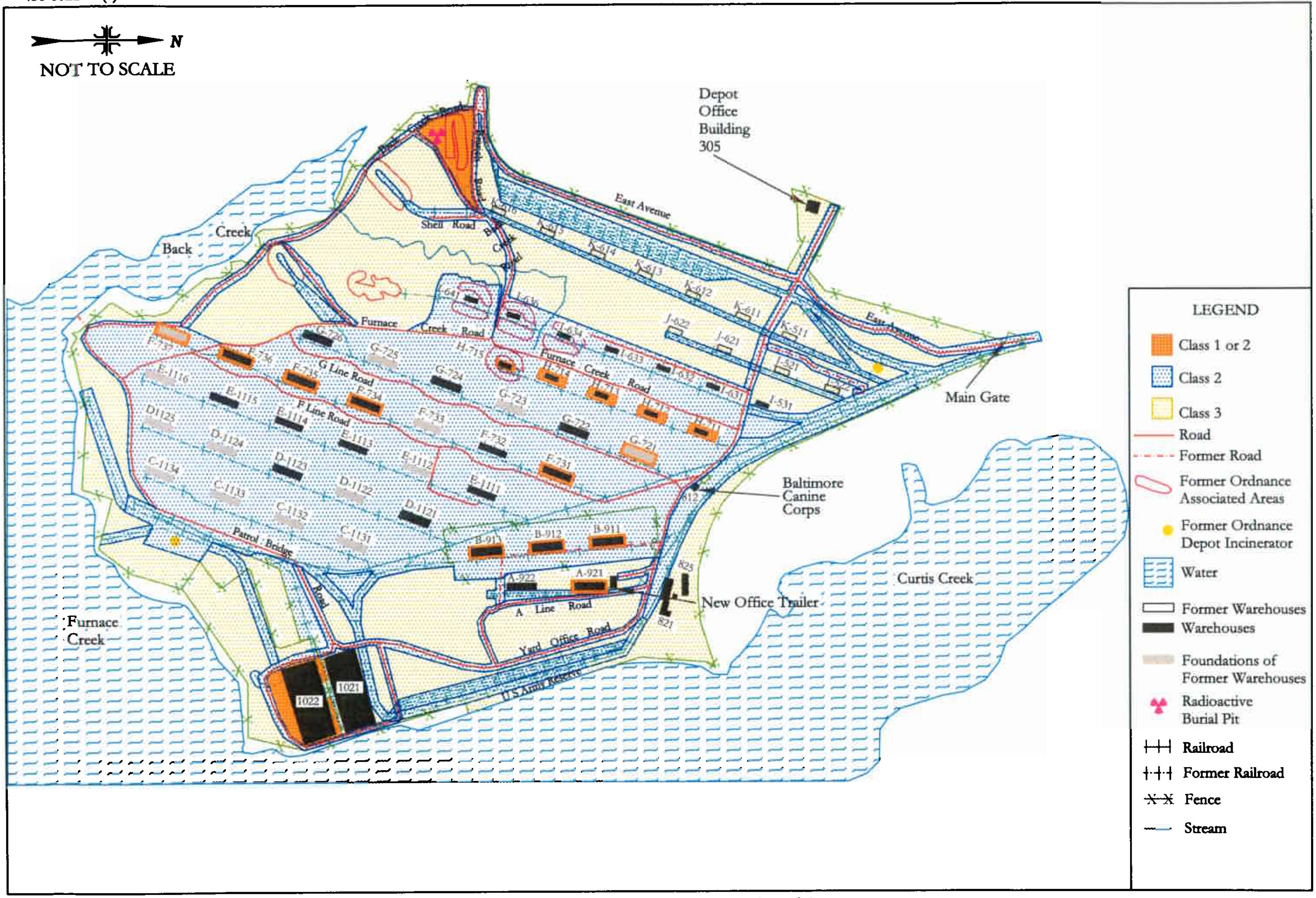


FIGURE 2: Curtis Bay Depot - Conceptual Model

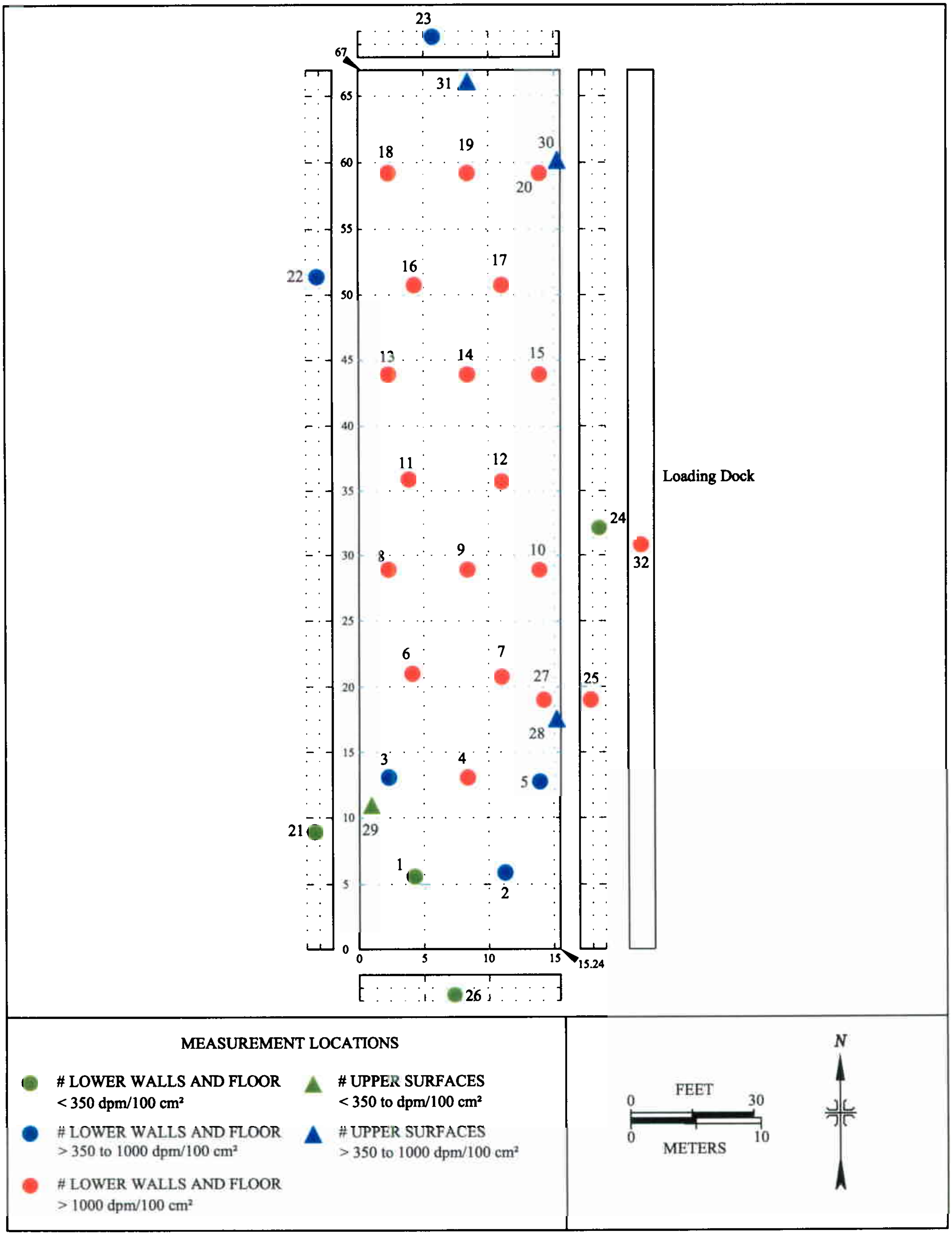


FIGURE 3: Building B-911 - Measurement Locations

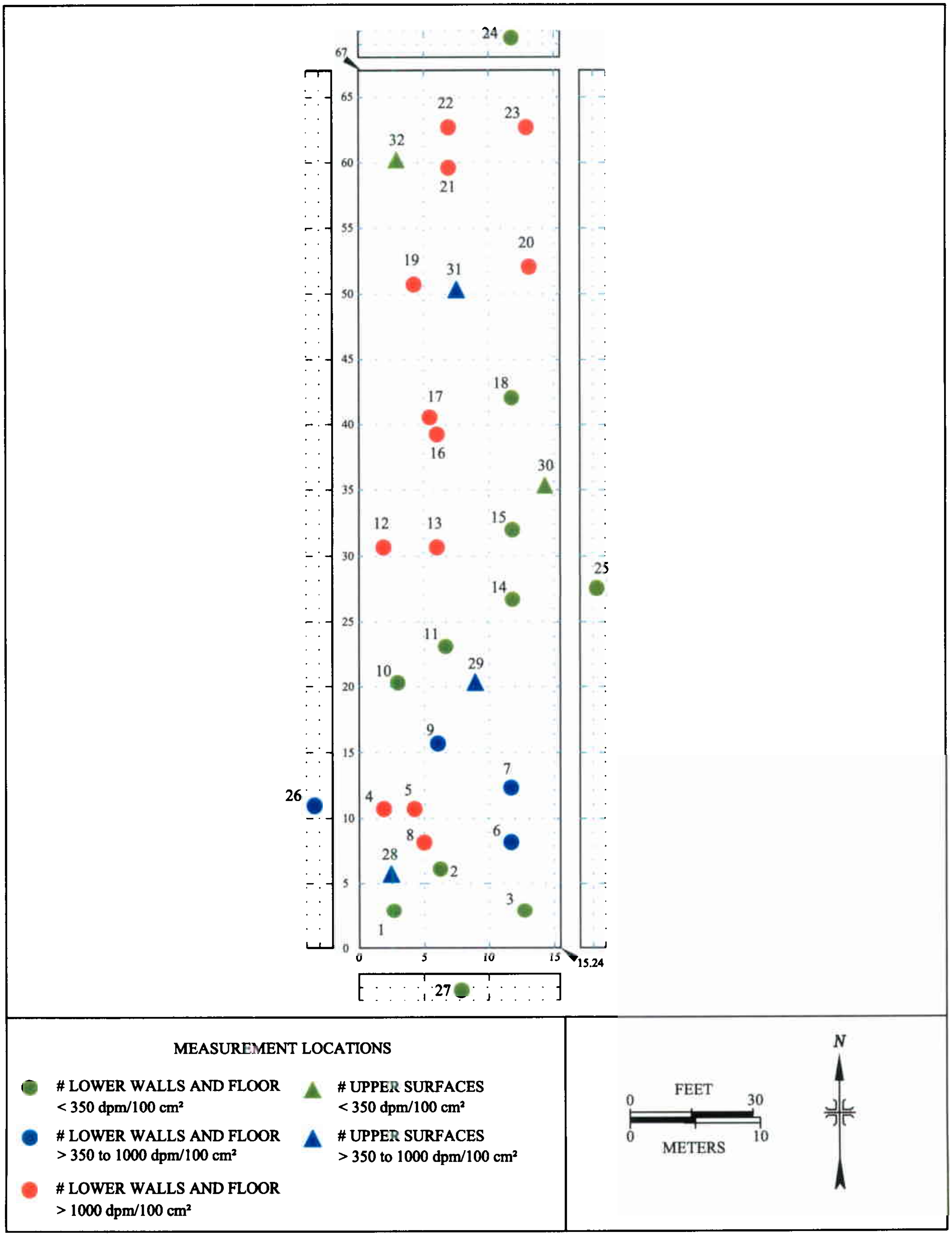


FIGURE 4: Building B-912 - Measurement Locations

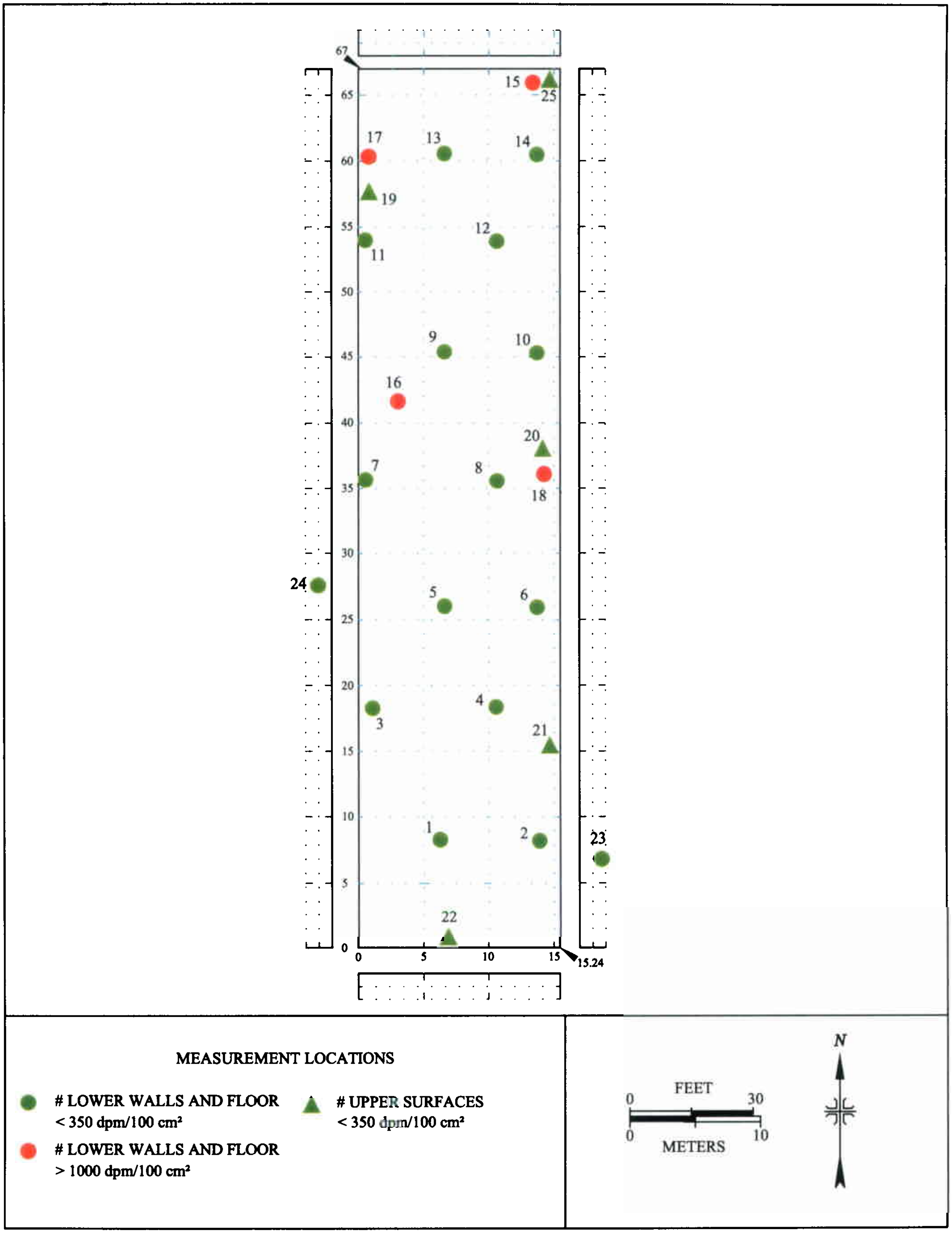


FIGURE 5: Building F-731 - Measurement Locations

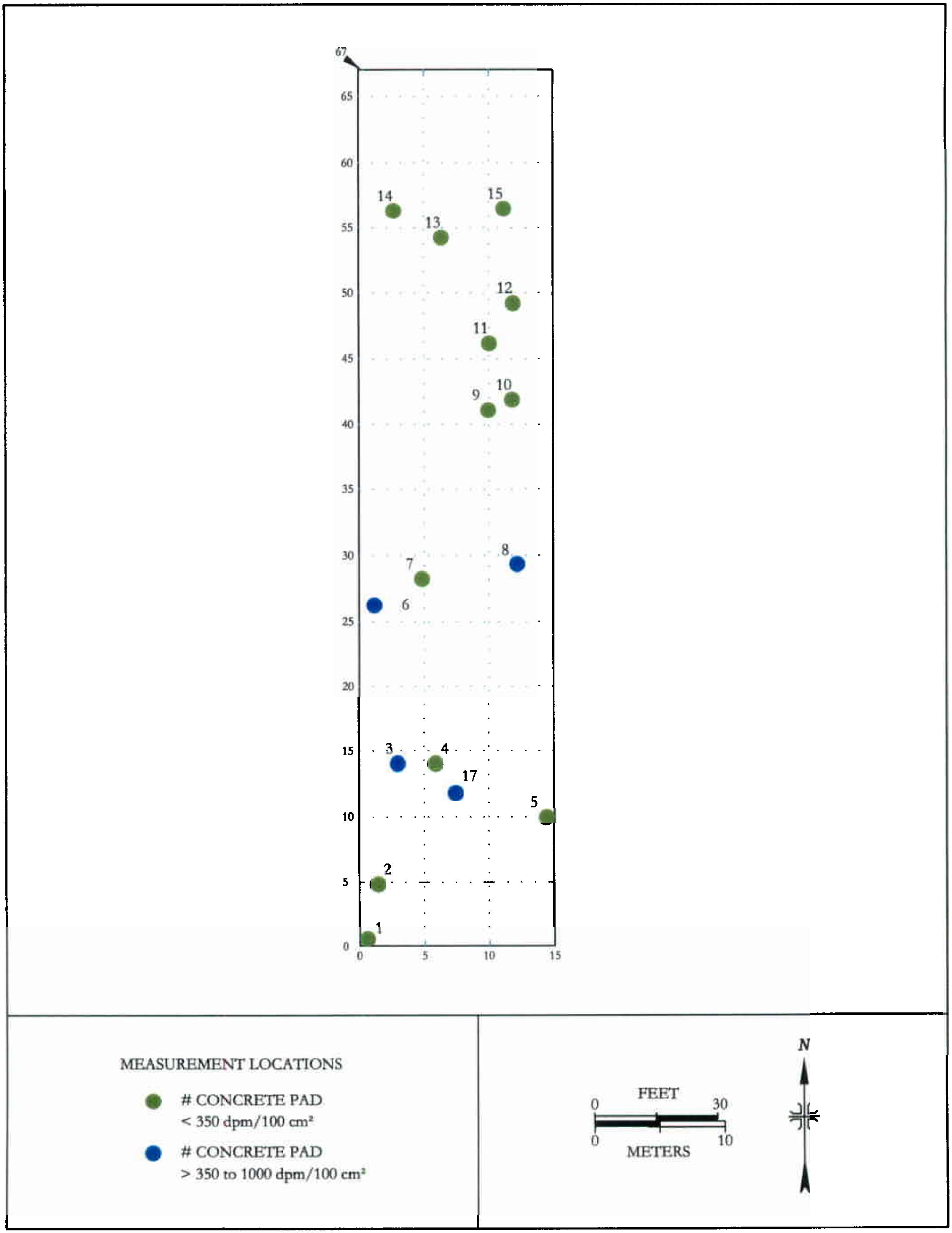


FIGURE 6: Building F-737 - Measurement Locations

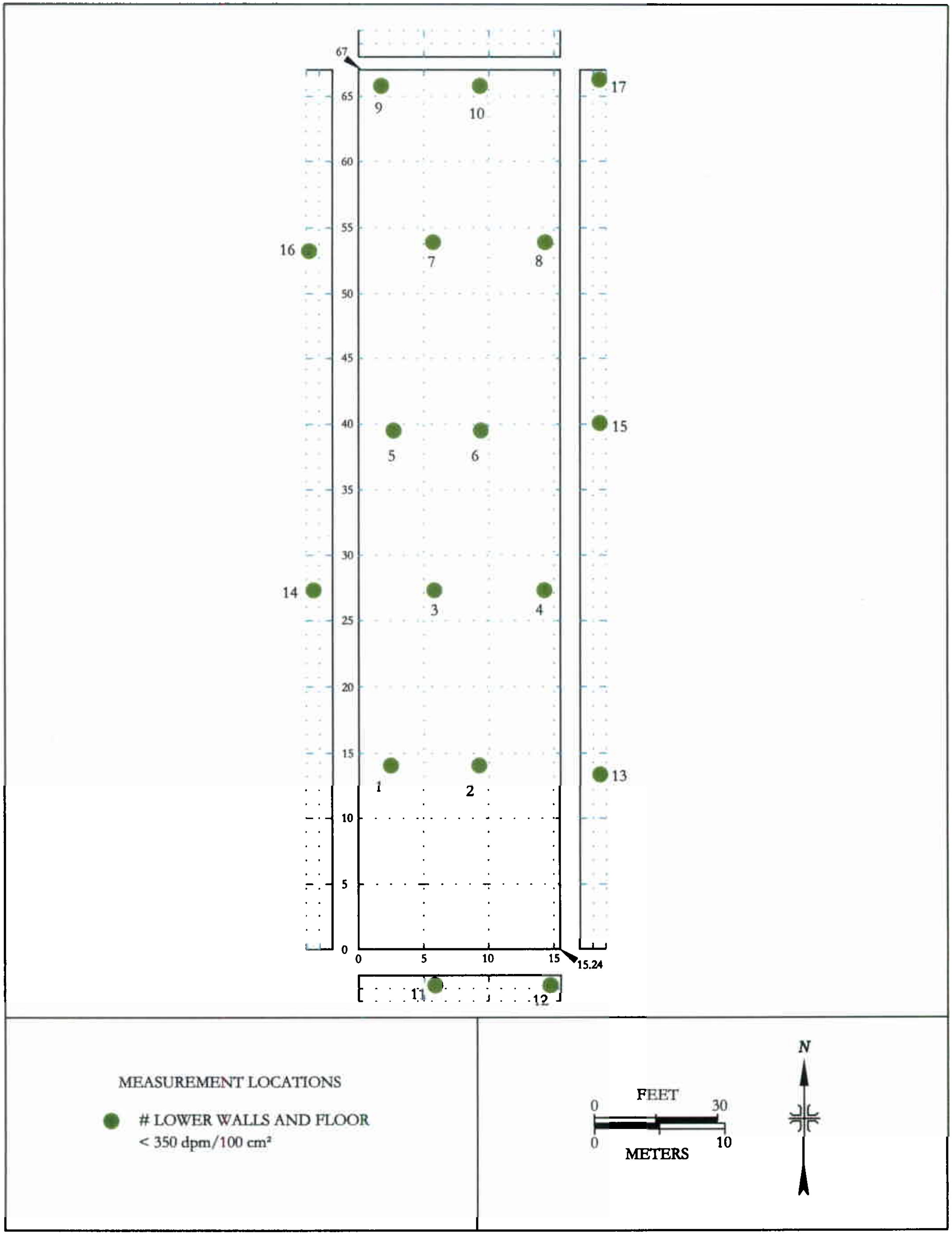


FIGURE 7: Building A-921 - Measurement Locations

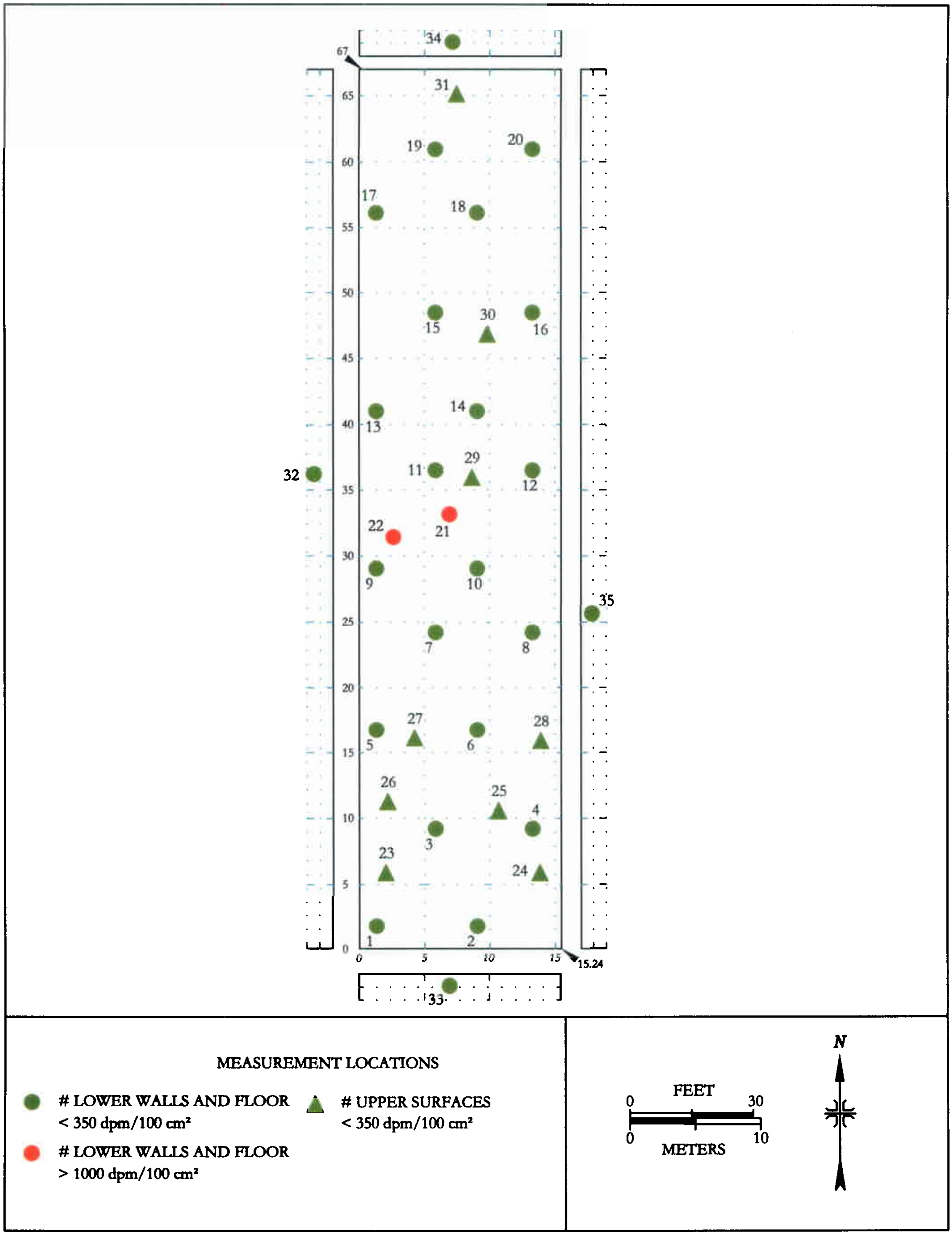


FIGURE 8: Building B-913 - Measurement Locations

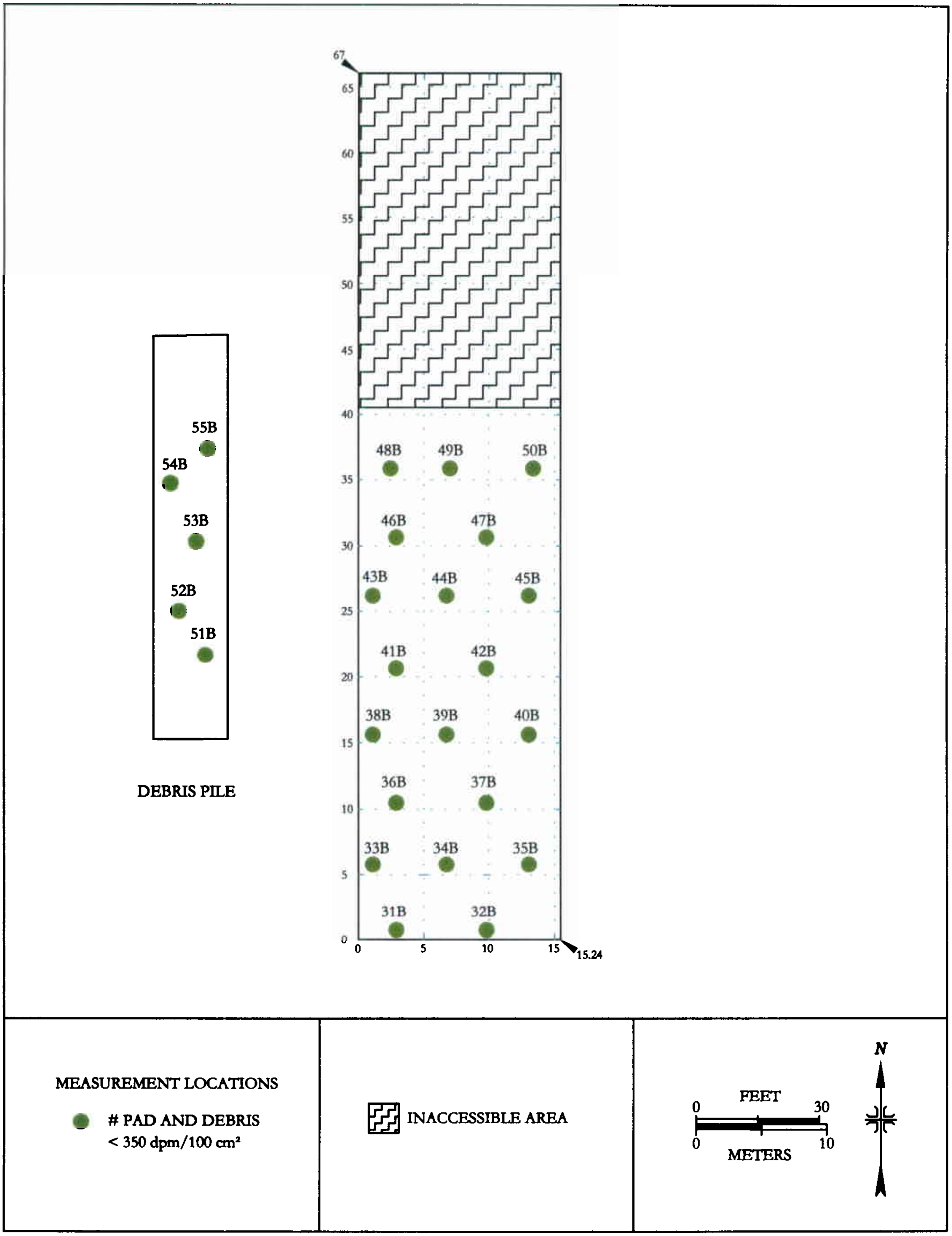


FIGURE 9: Building F-734 - Measurement Locations

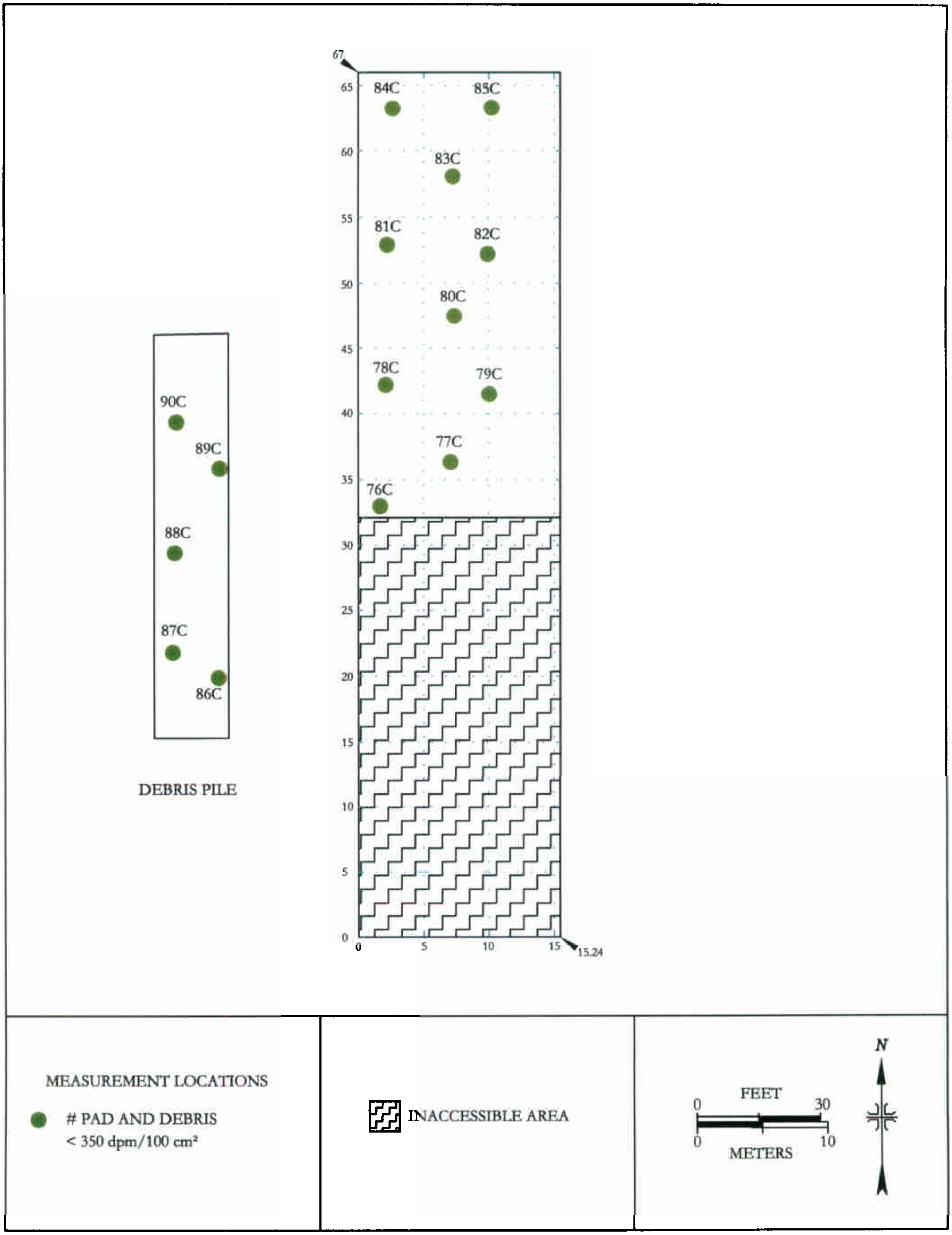


FIGURE 10: Building F-735 - Measurement Locations

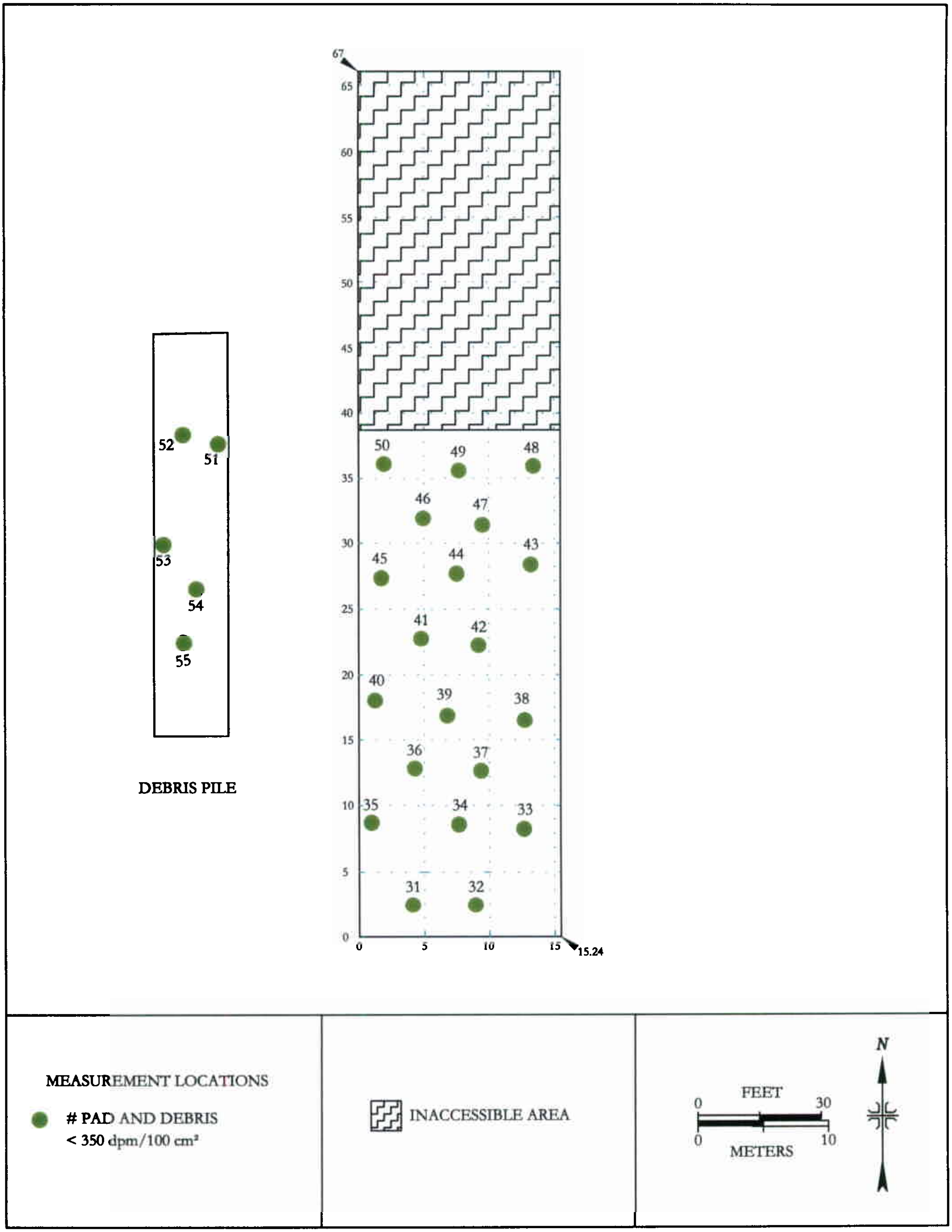


FIGURE 11: Building F-736 - Measurement Locations

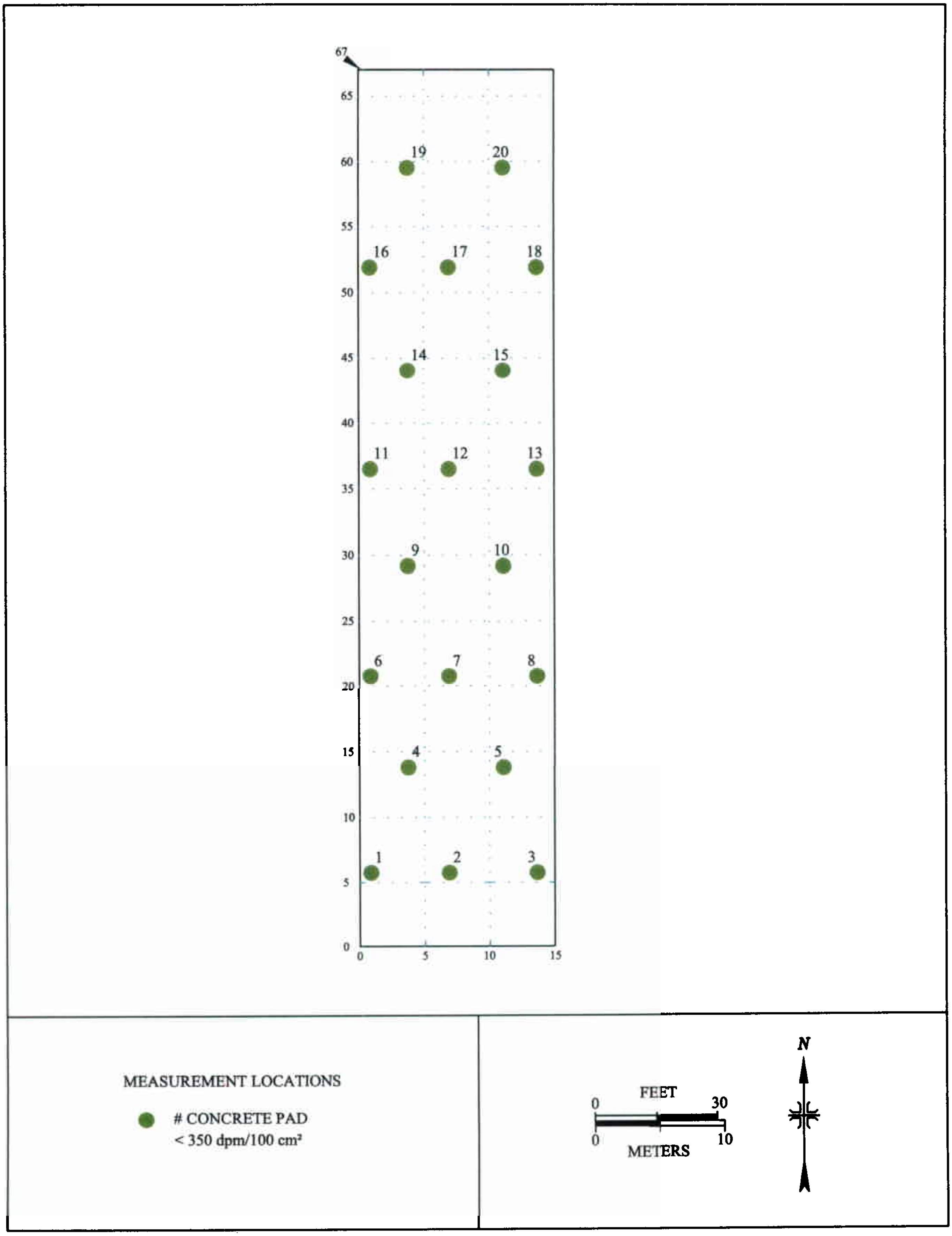


FIGURE 12: Building G-721 - Measurement Locations

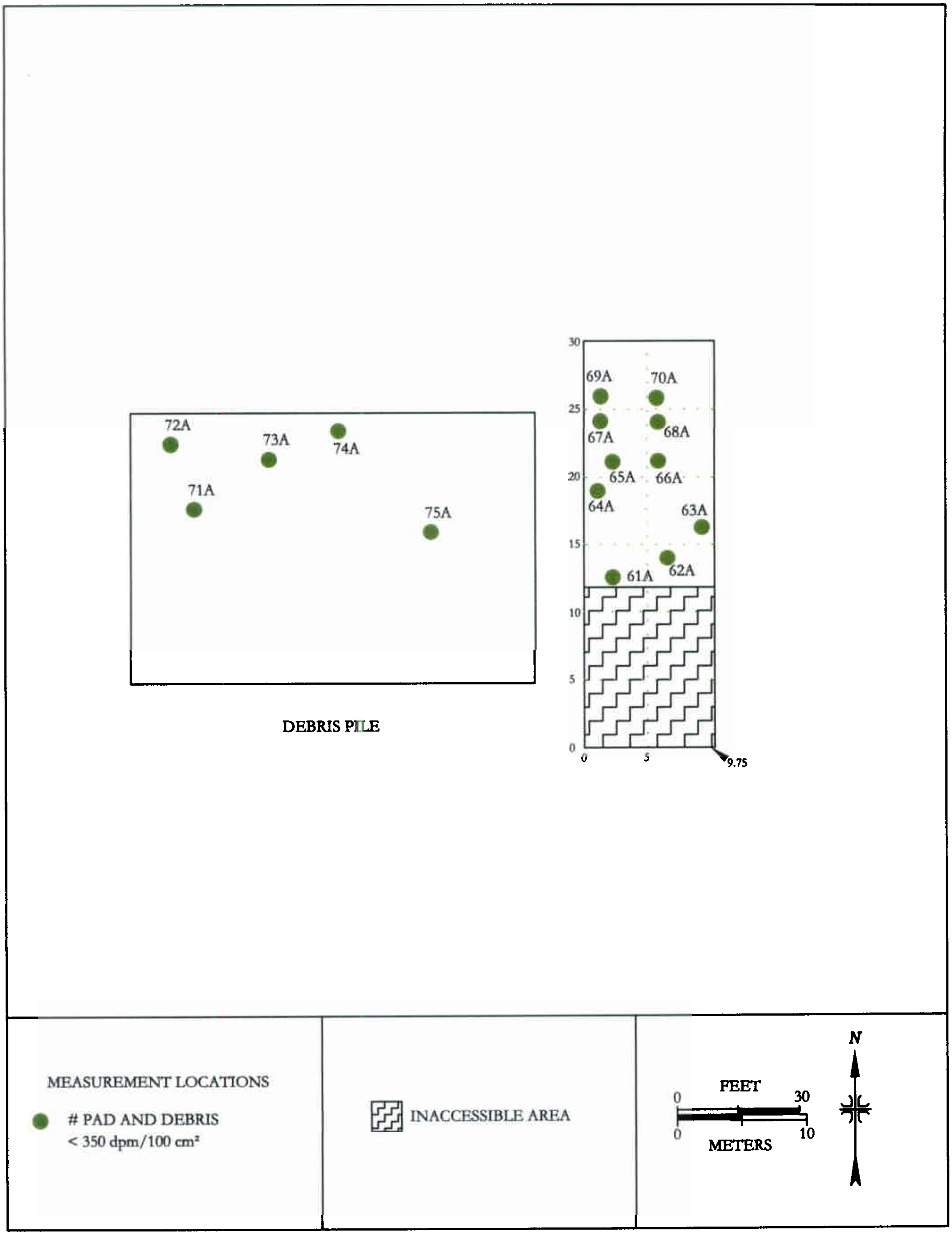


FIGURE 13: Building H-711 - Measurement Locations

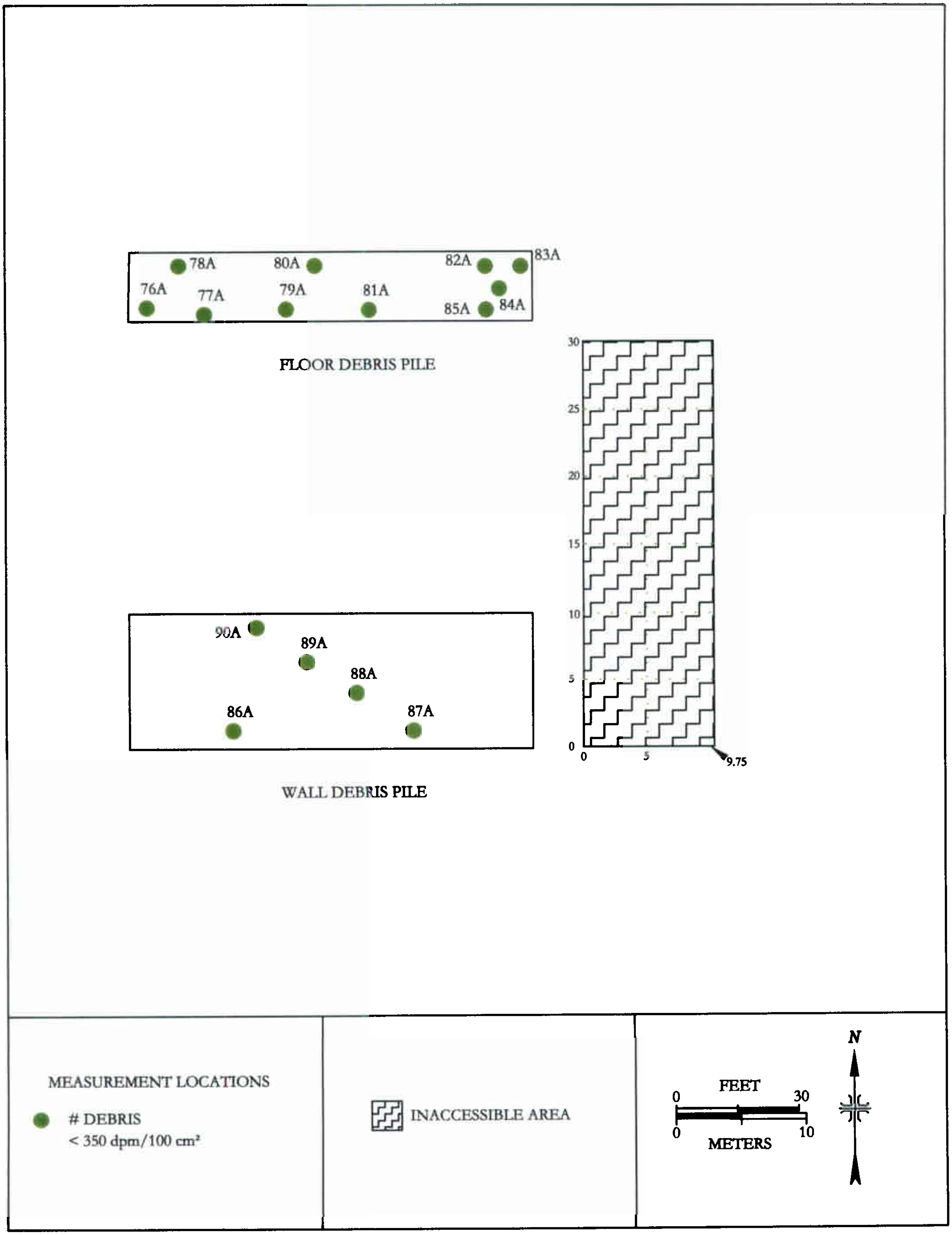


FIGURE 14: Building H-712 - Measurement Locations

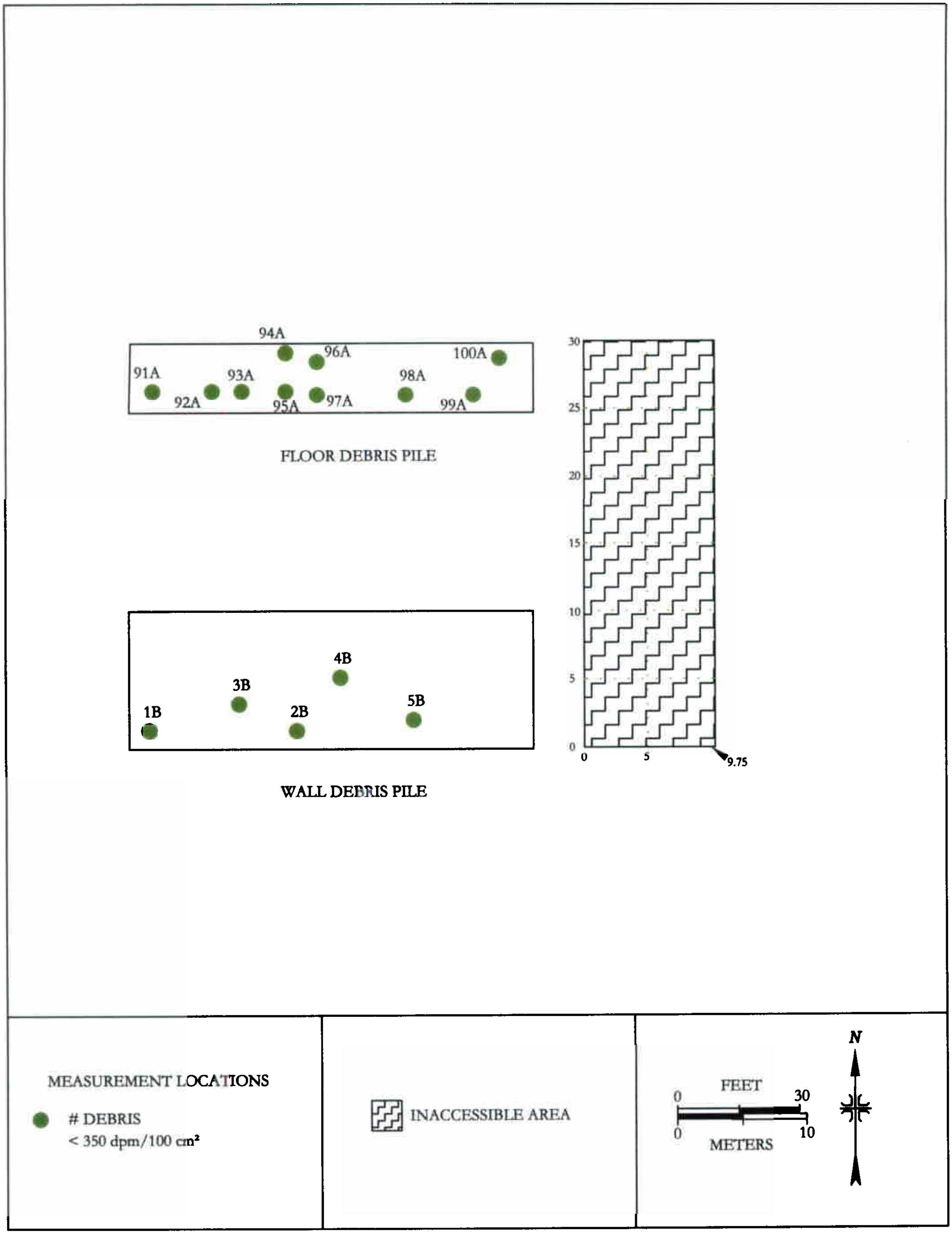


FIGURE 15: Building H-713 - Measurement Locations

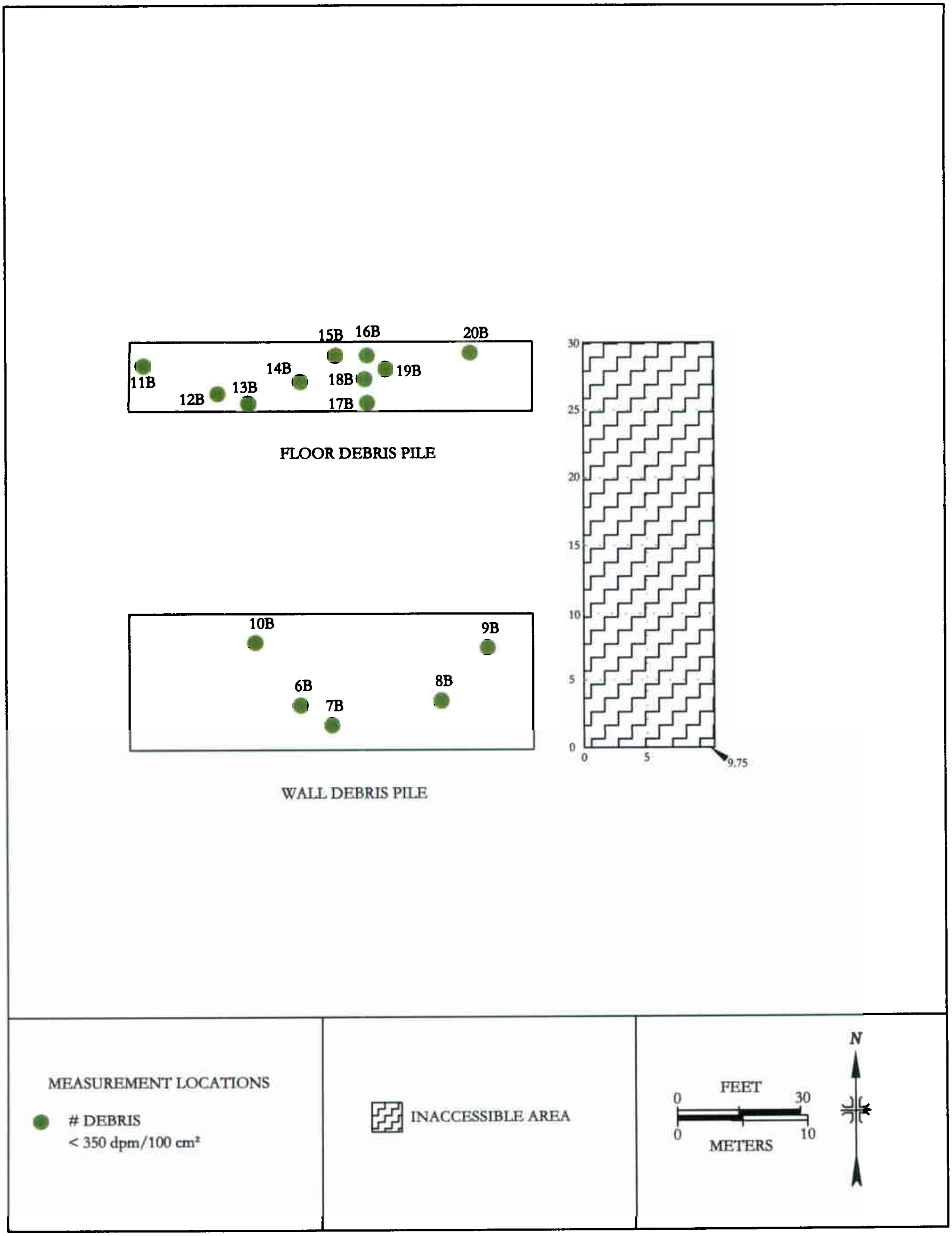


FIGURE 16: Building H-714 - Measurement Locations

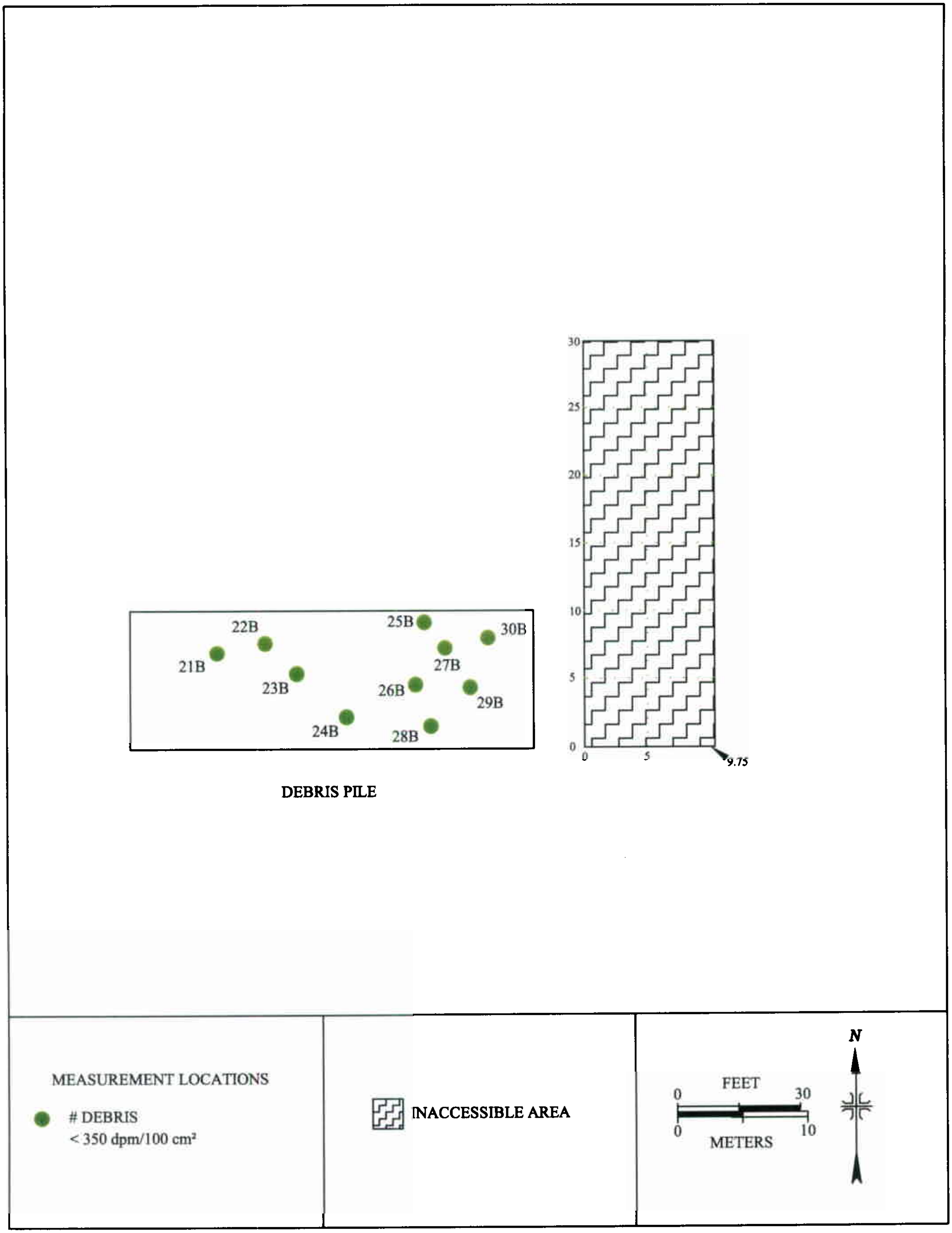


FIGURE 17: Building H-715 - Measurement Locations

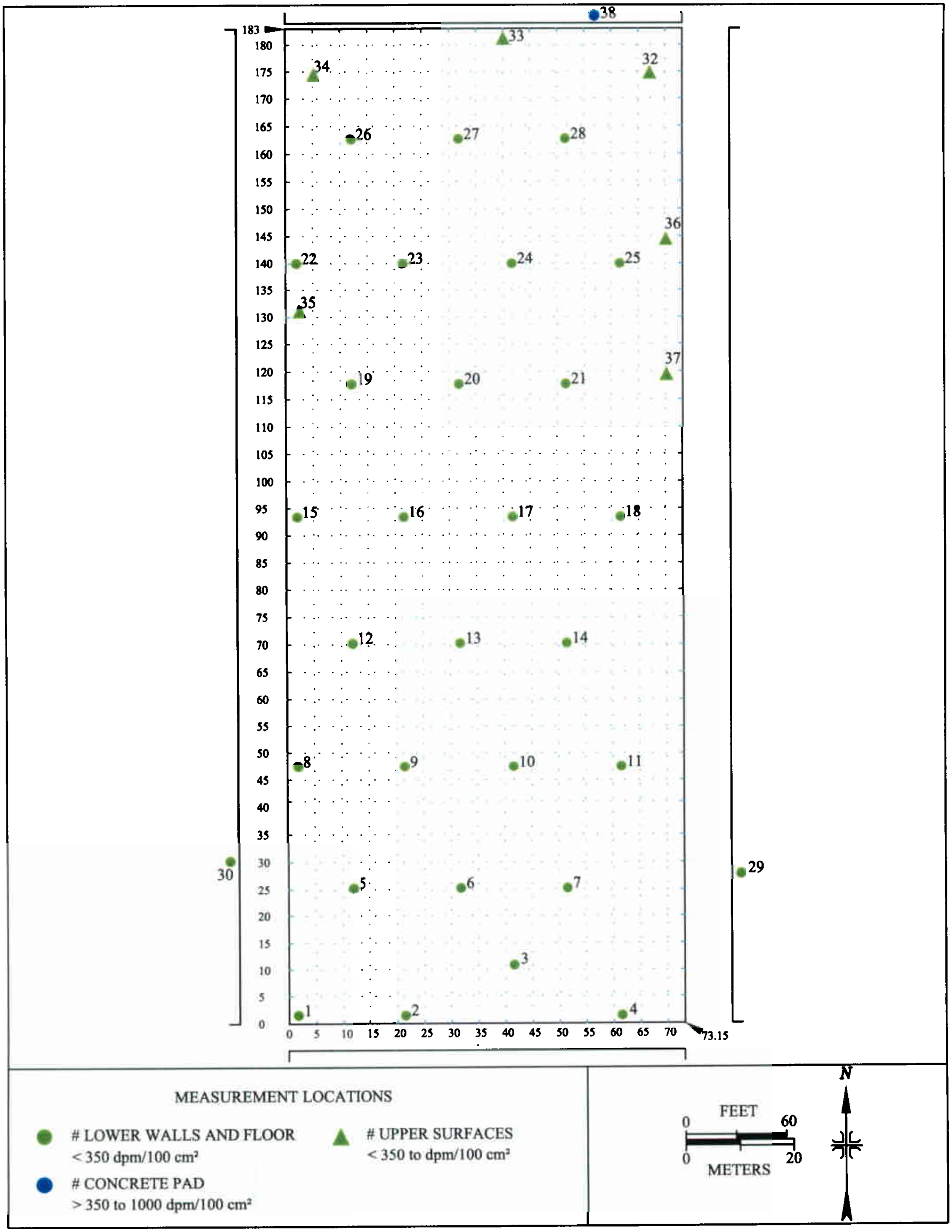


FIGURE 18: Building 1022 - Measurement Locations

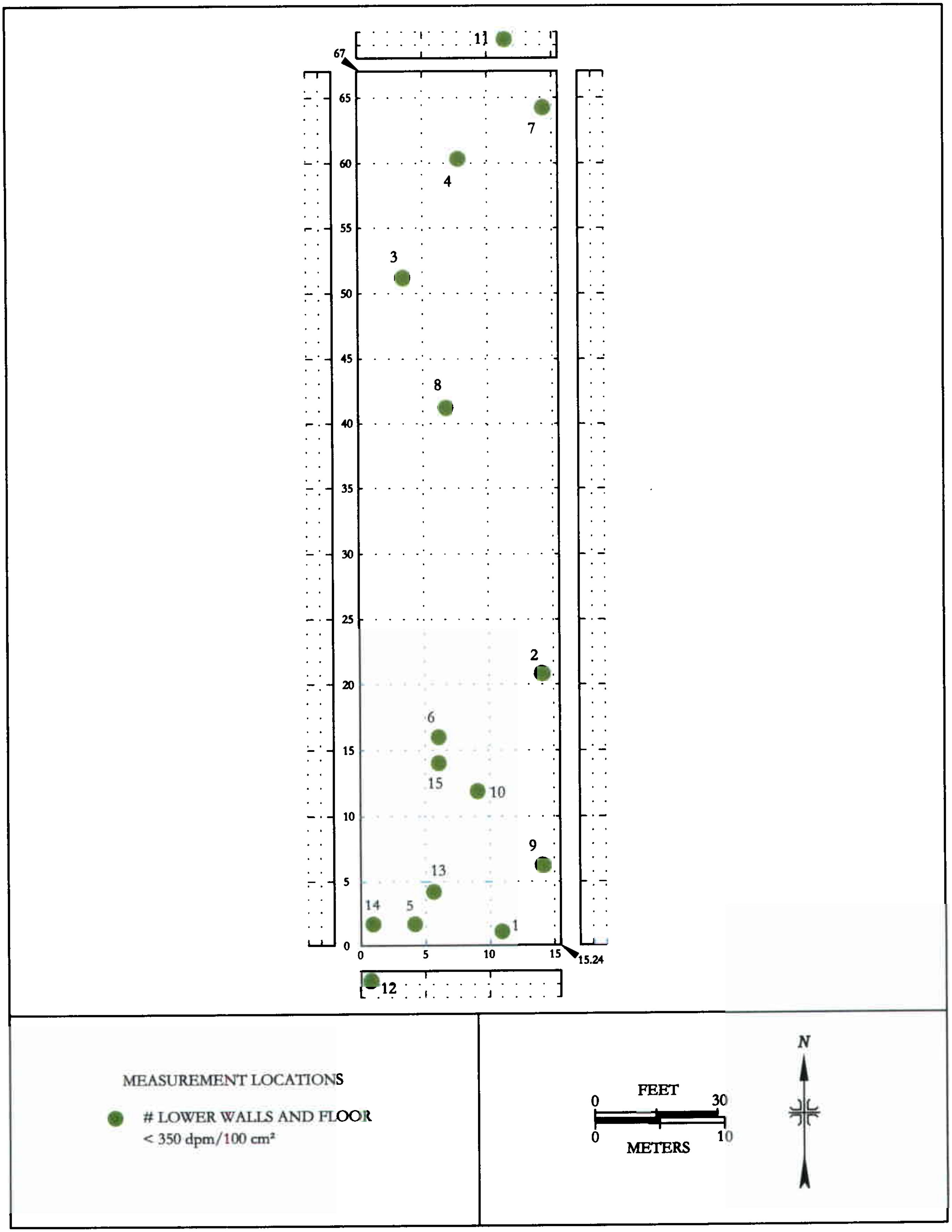


FIGURE 19: Building A-922 - Measurement Locations

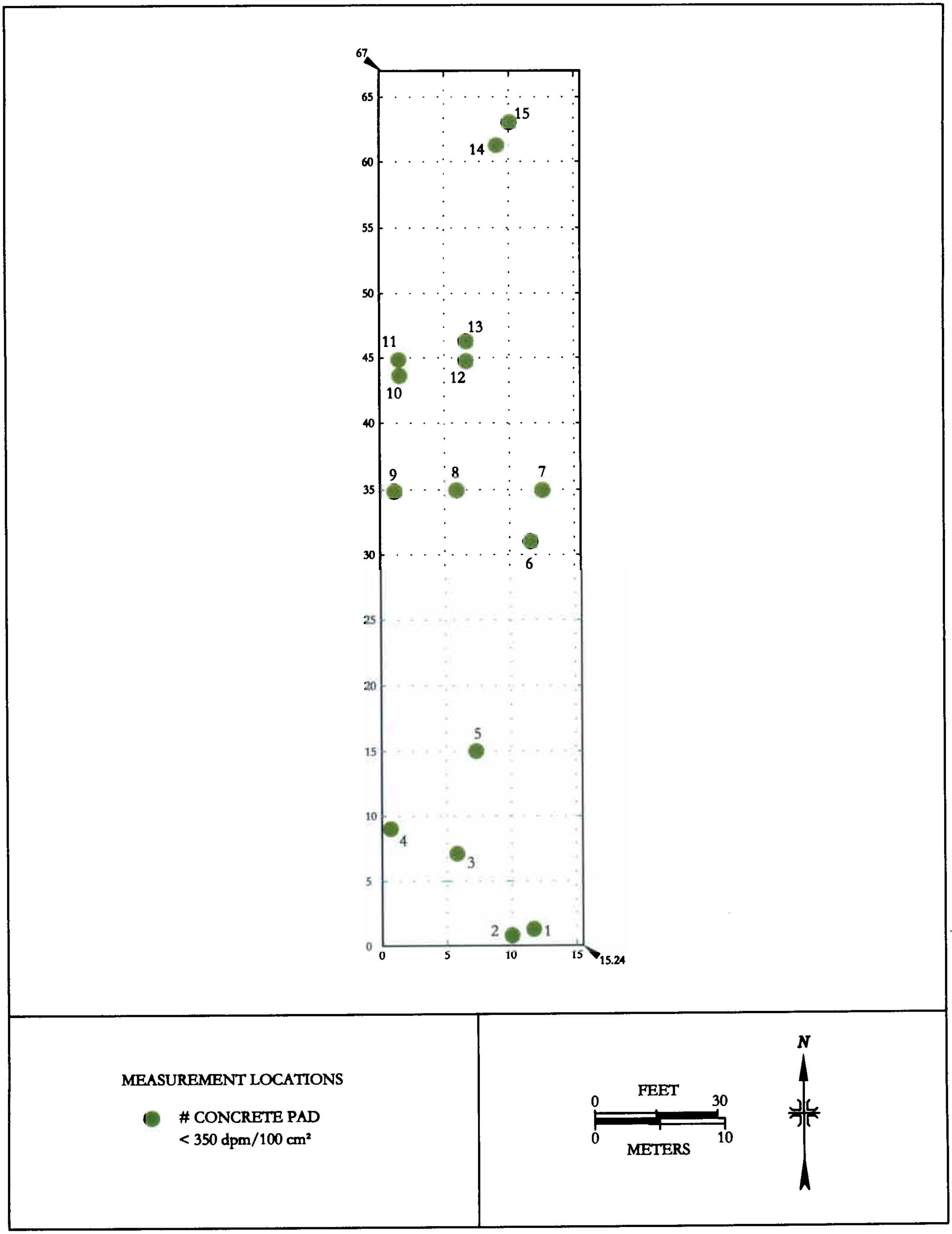


FIGURE 20: Building C-1131 - Measurement Locations

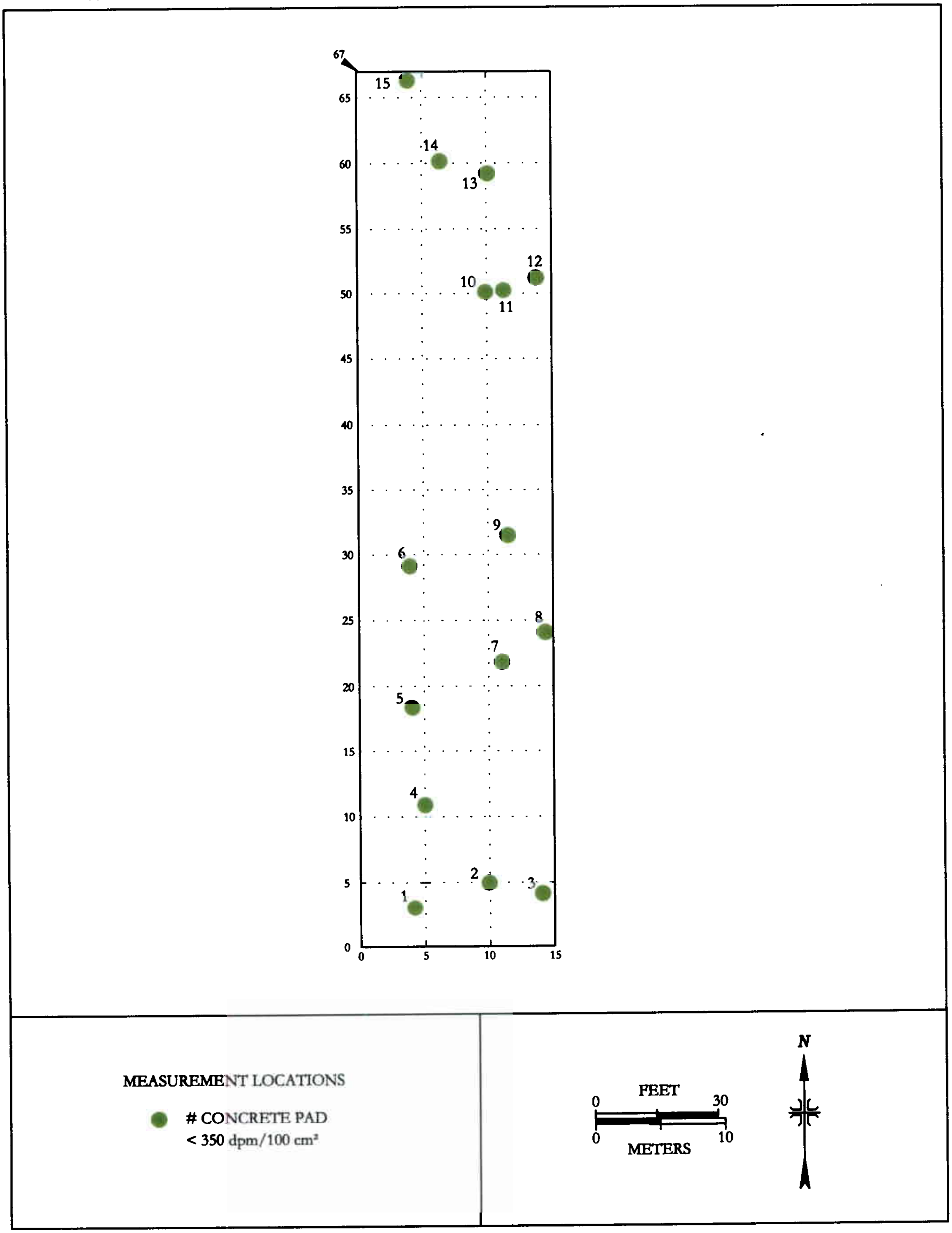


FIGURE 21: Building C-1132 - Measurement Locations

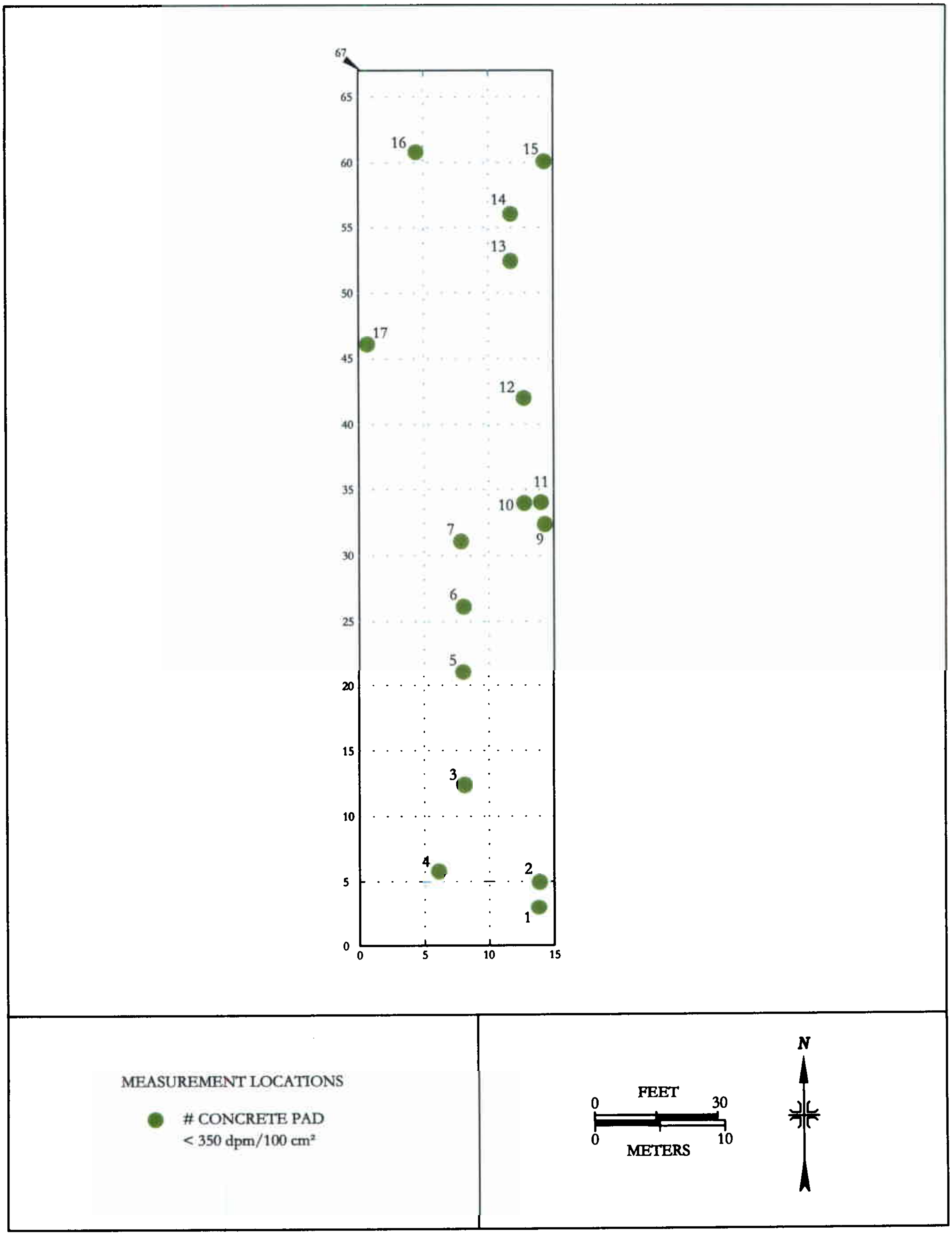


FIGURE 22: Building C-1133 - Measurement Locations

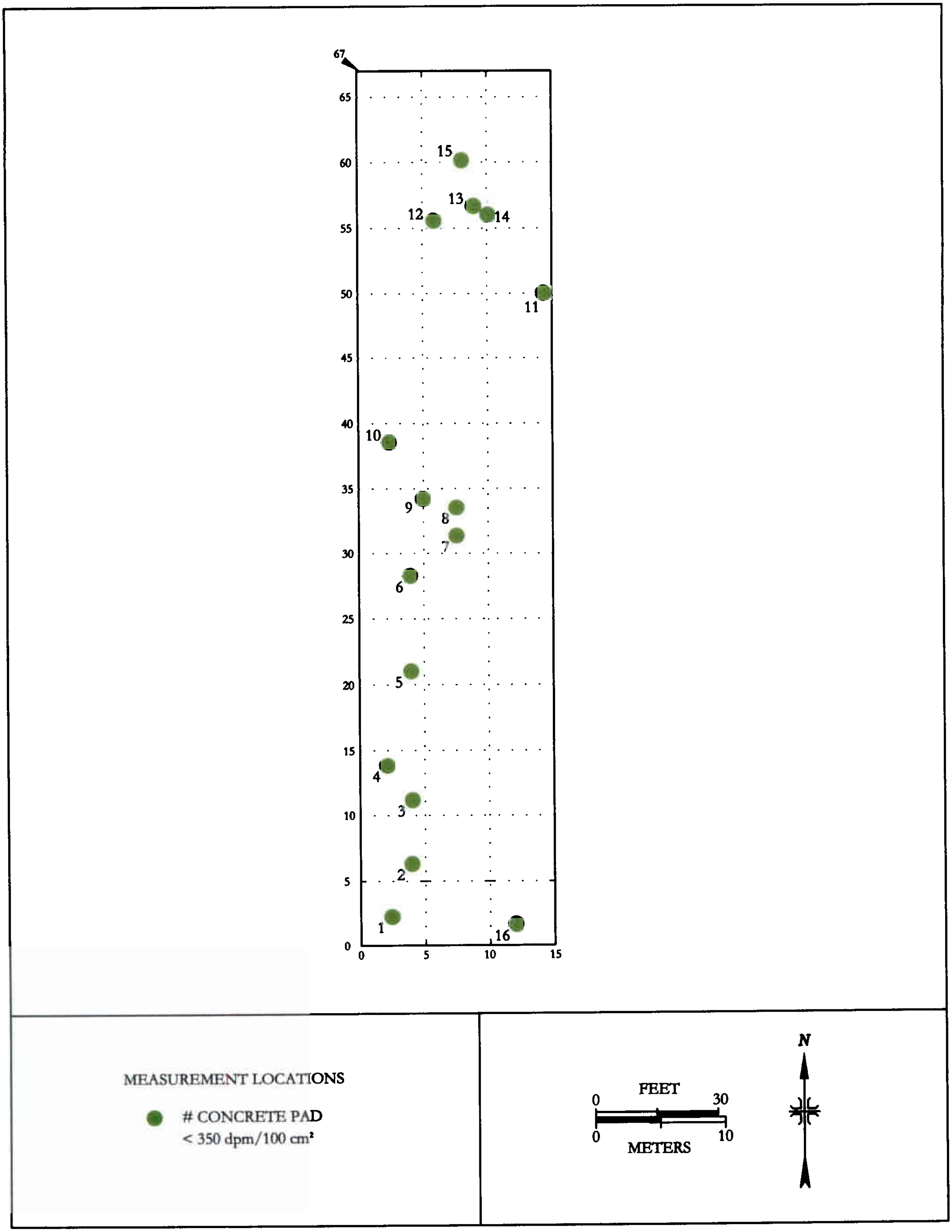


FIGURE 23: Building C-1134 - Measurement Locations

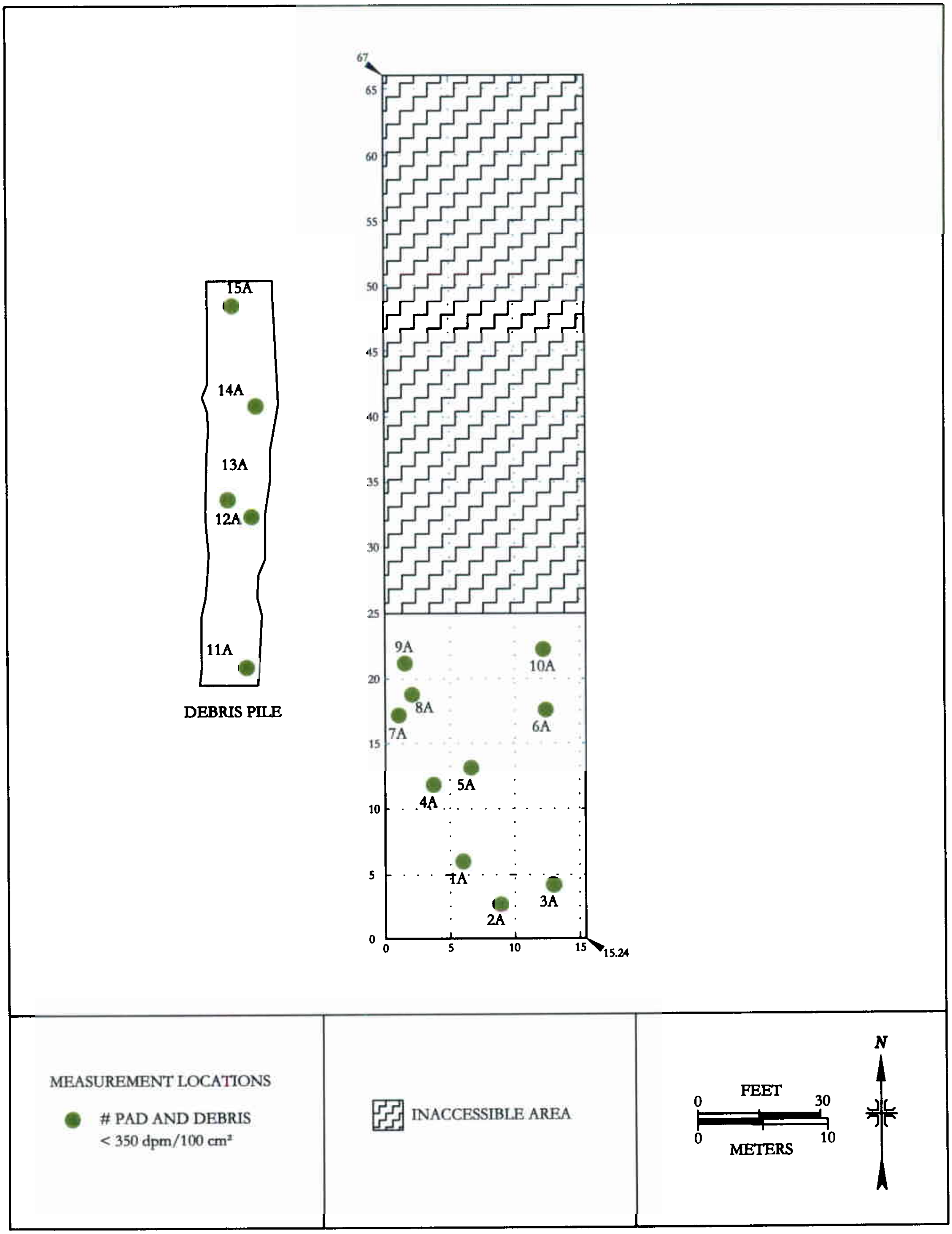


FIGURE 24: Building D-1121 - Measurement Locations

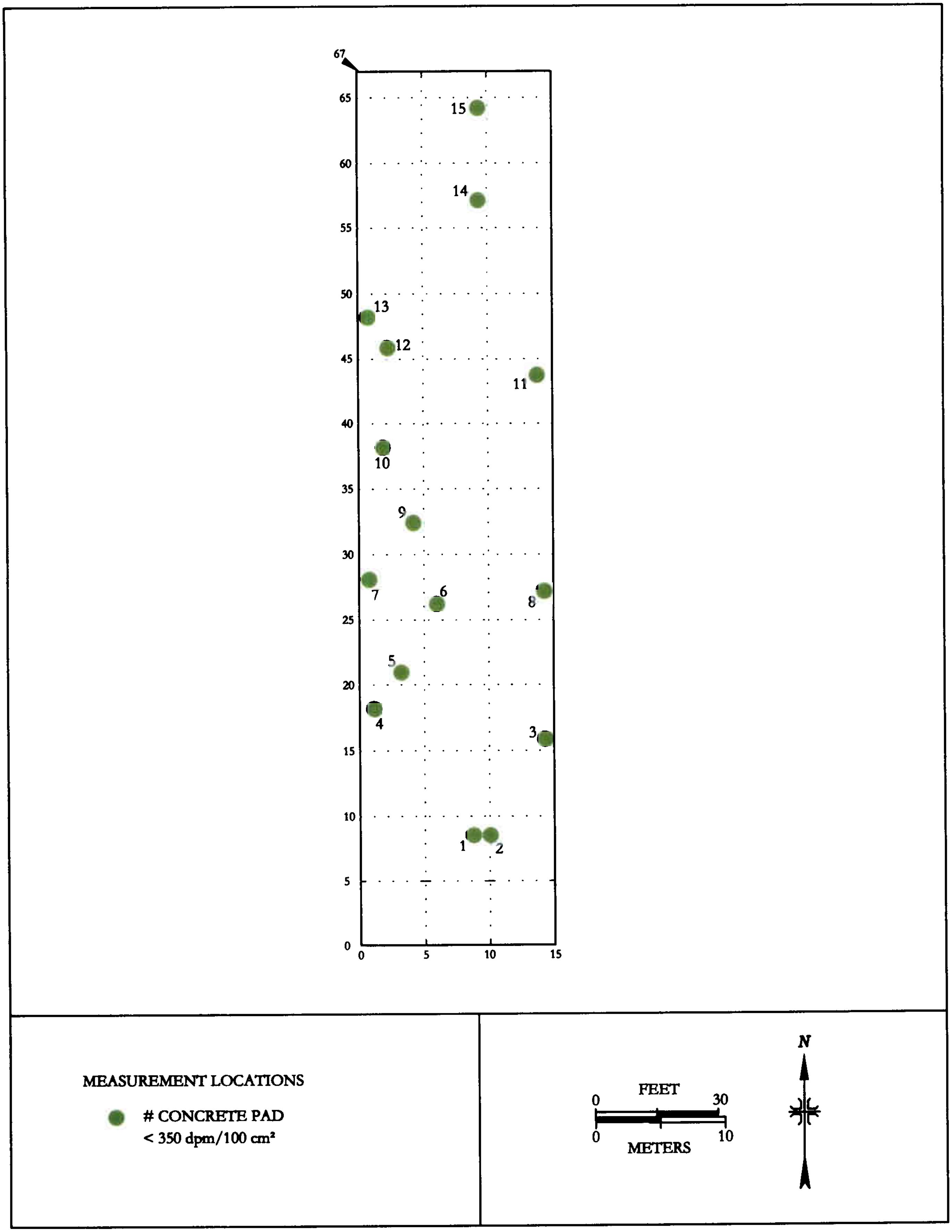


FIGURE 25: Building D-1122 - Measurement Locations

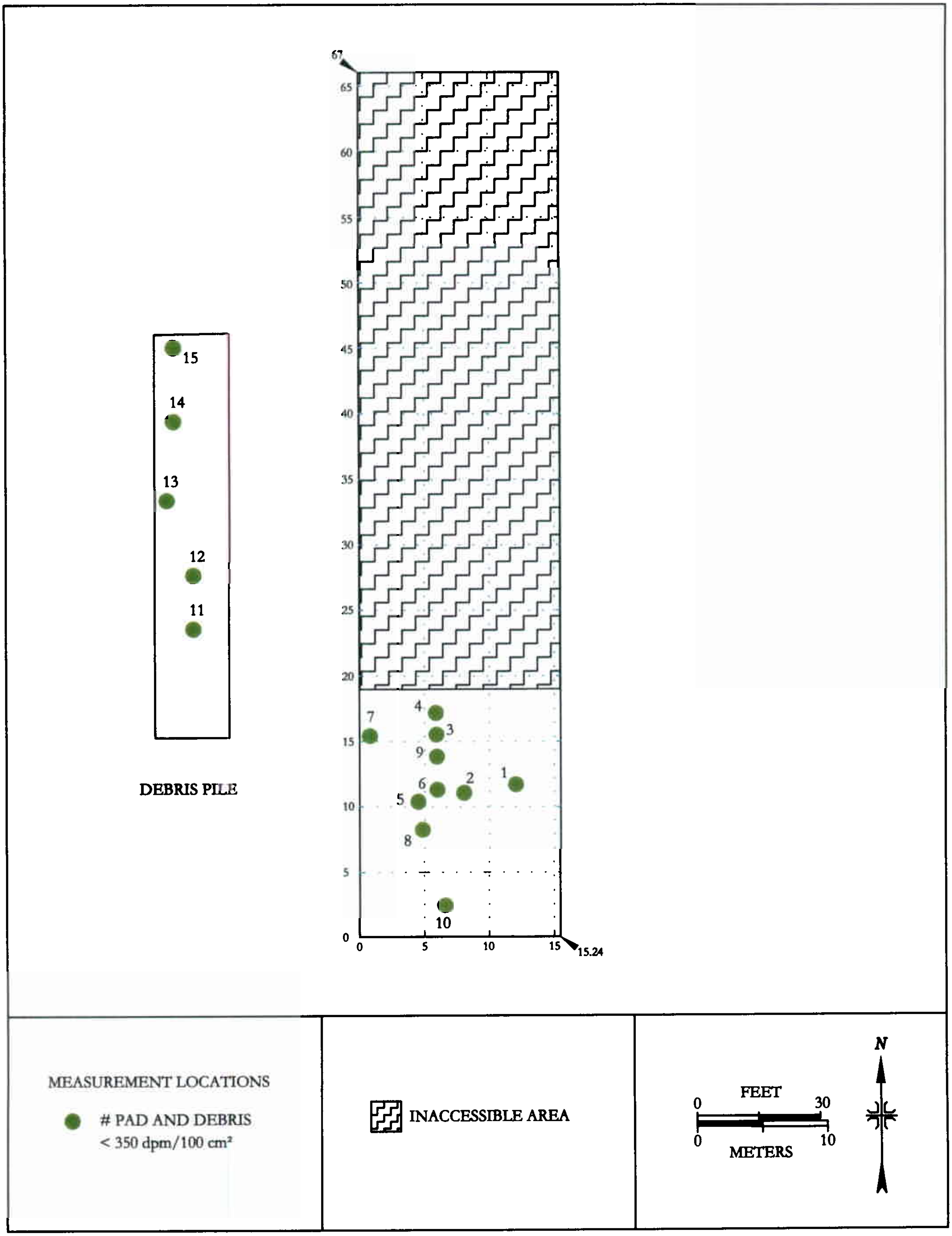


FIGURE 26: Building D-1123 - Measurement Locations

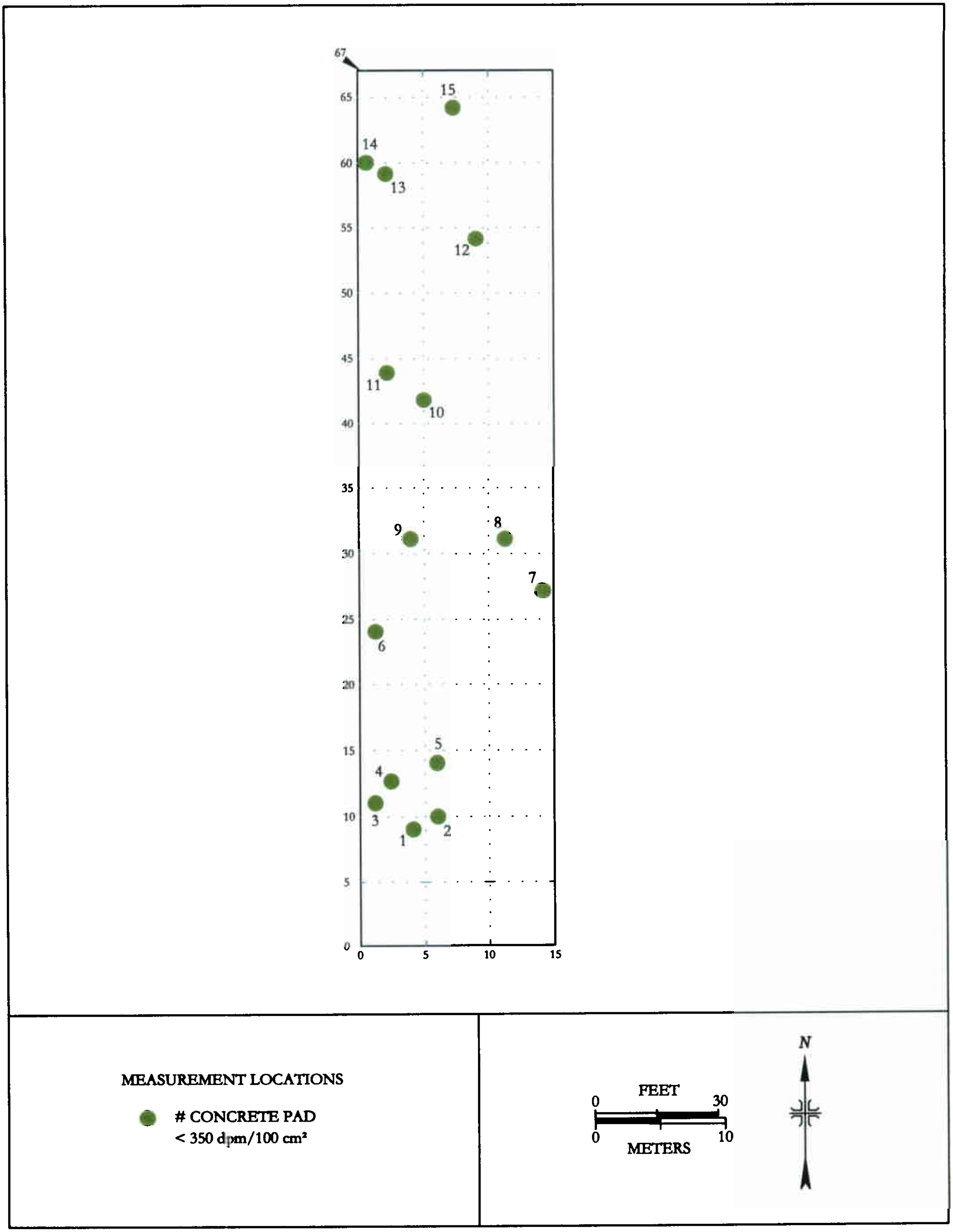


FIGURE 27: Building D-1124 - Measurement Locations

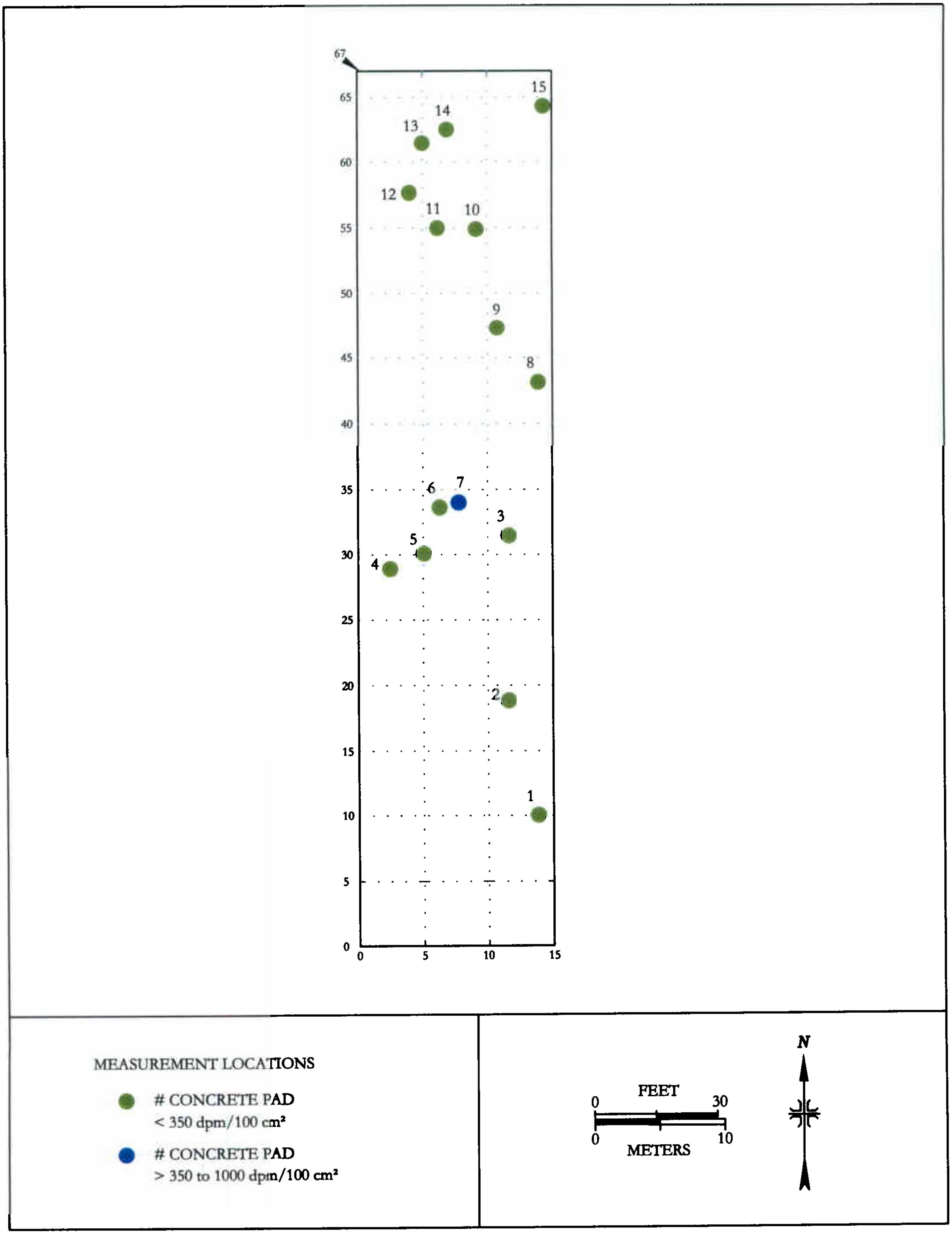


FIGURE 28: Building D-1125 - Measurement Locations

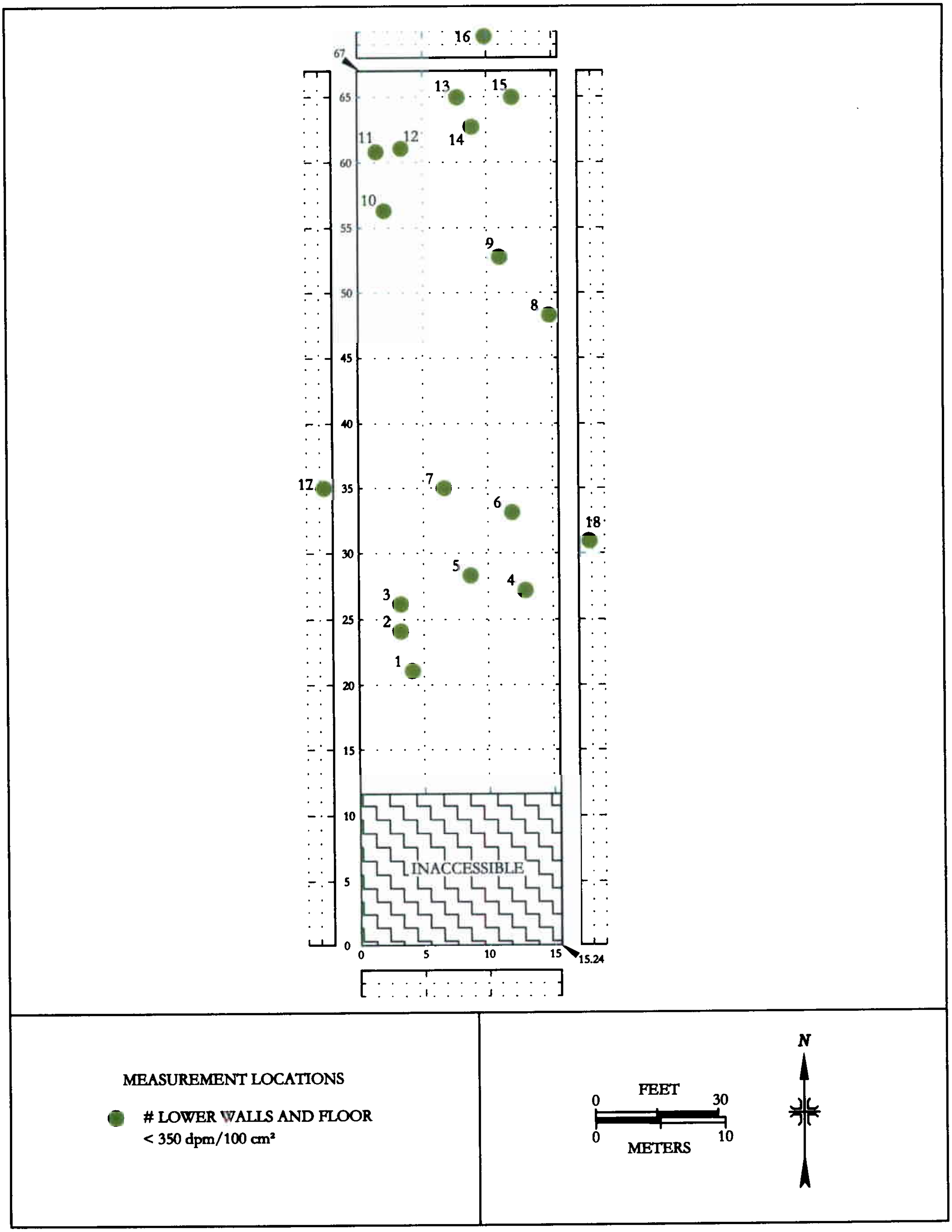


FIGURE 29: Building E-1111 - Measurement Locations

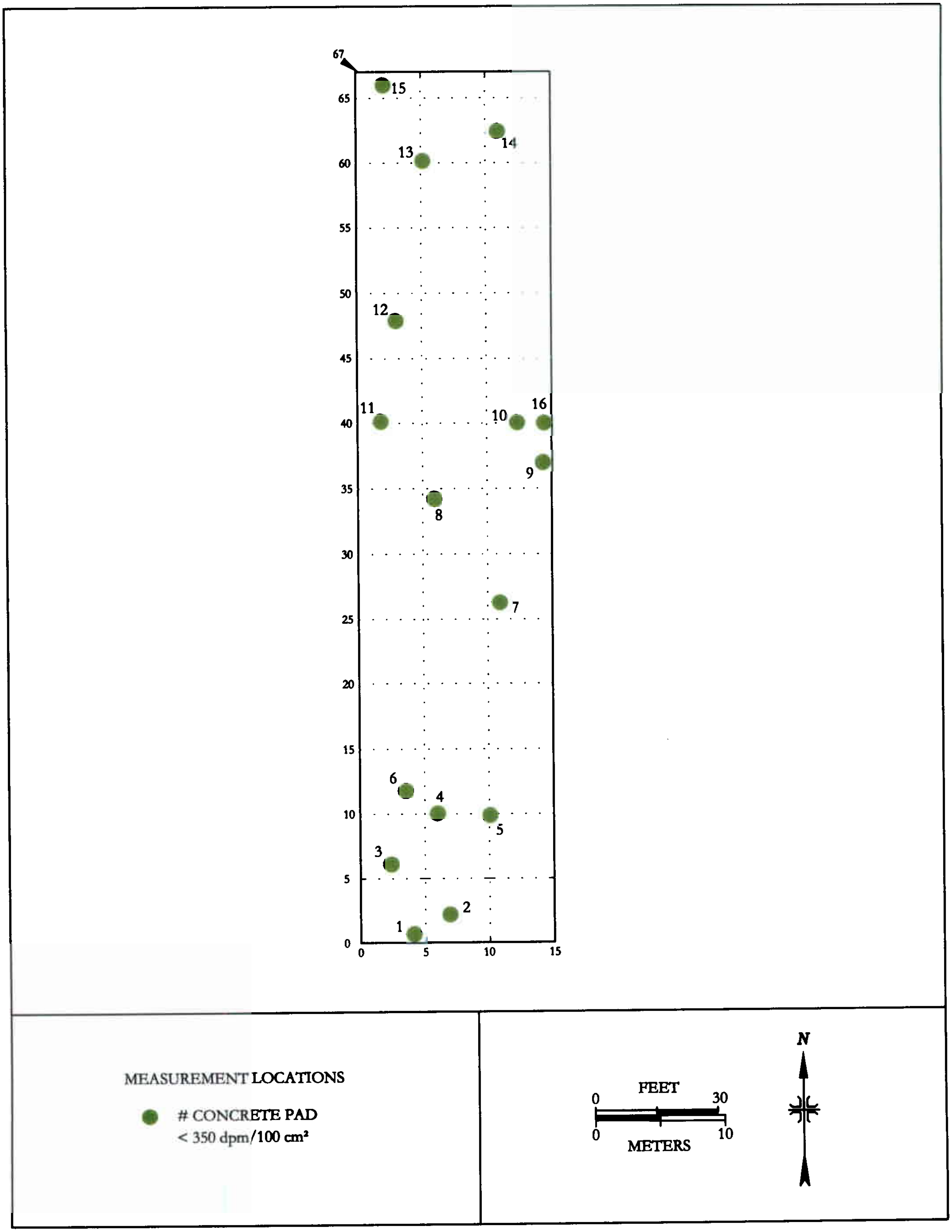


FIGURE 30: Building E-1112 - Measurement Locations

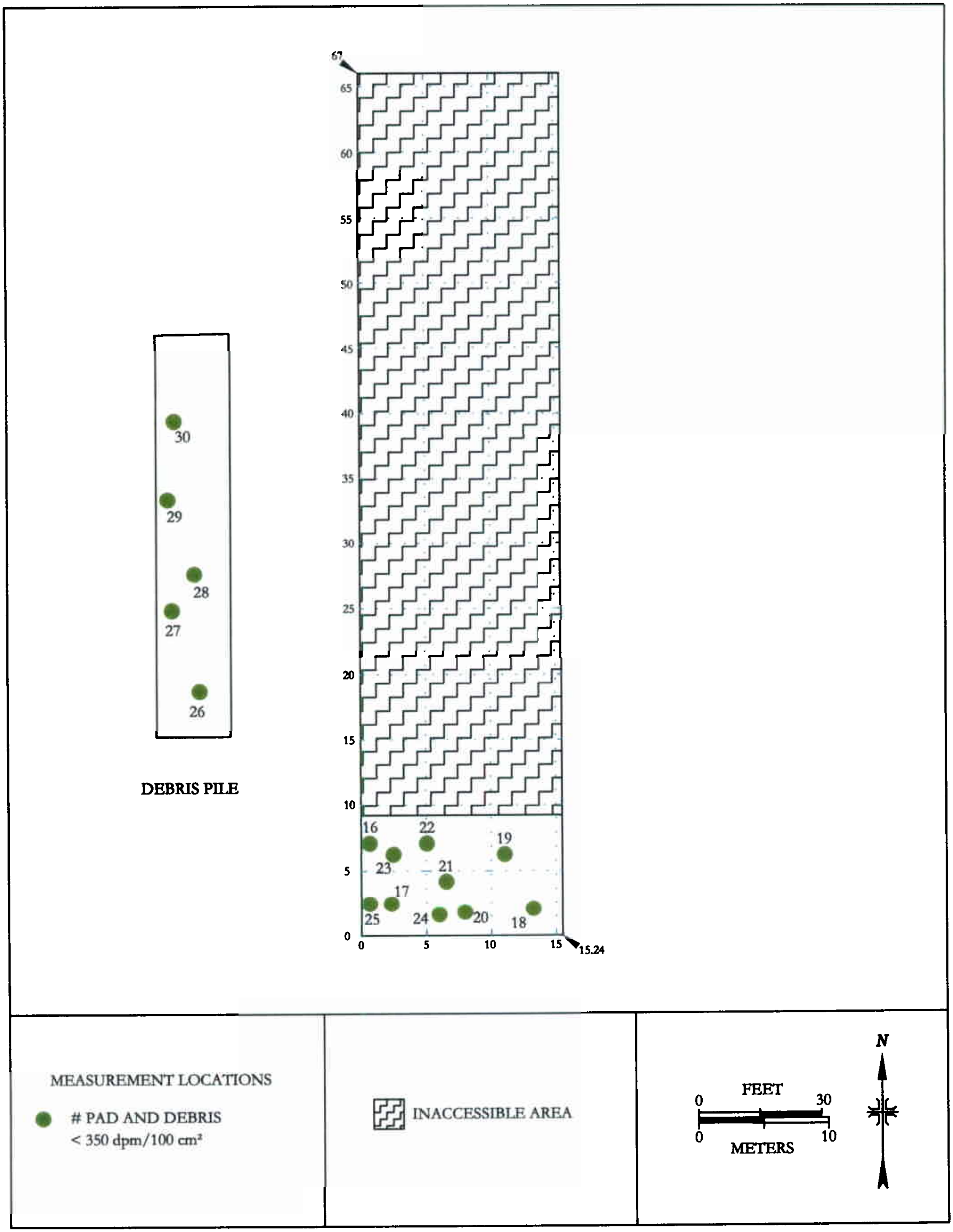


FIGURE 31: Building E-1113 - Measurement Locations

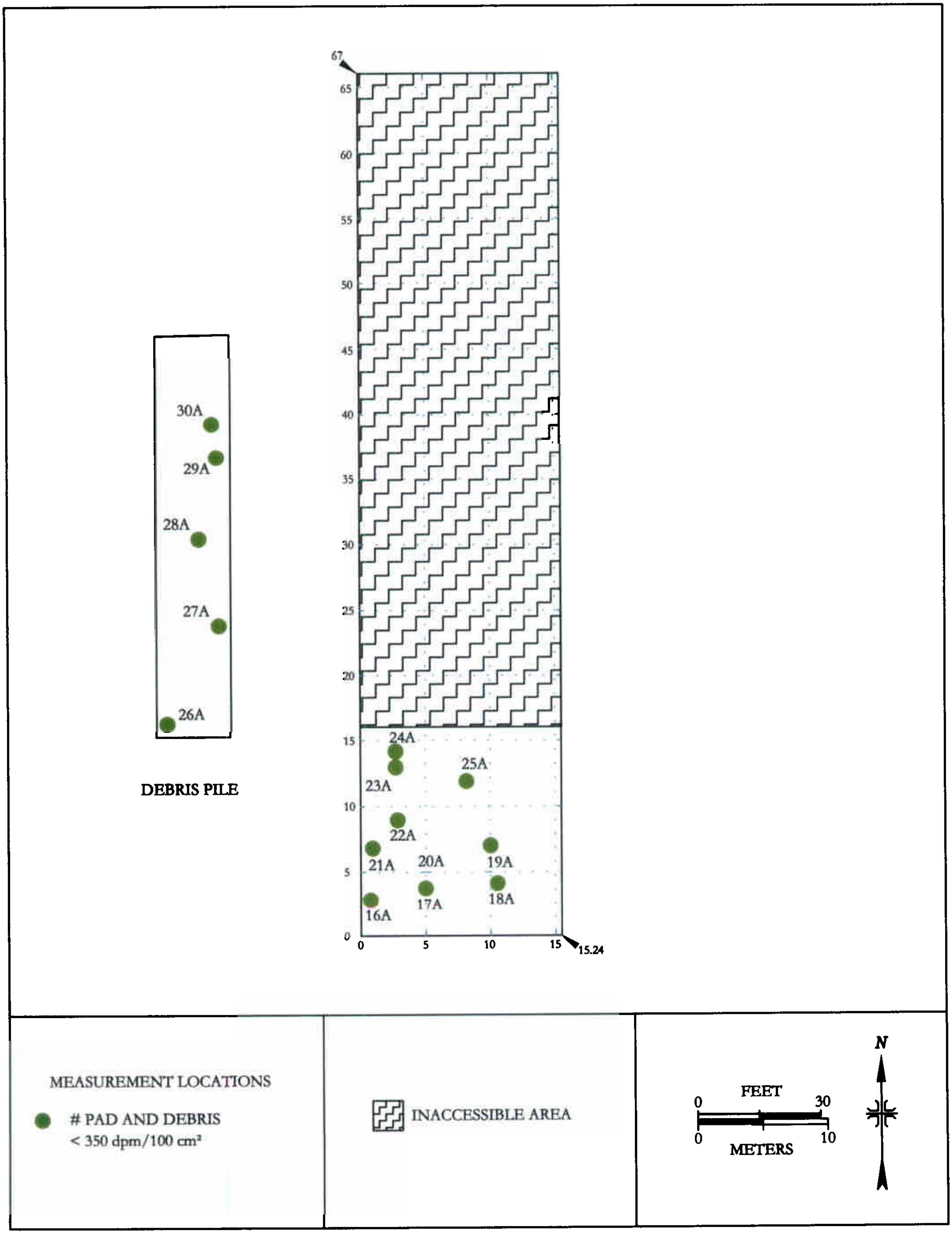


FIGURE 32: Building E-1114 - Measurement Locations

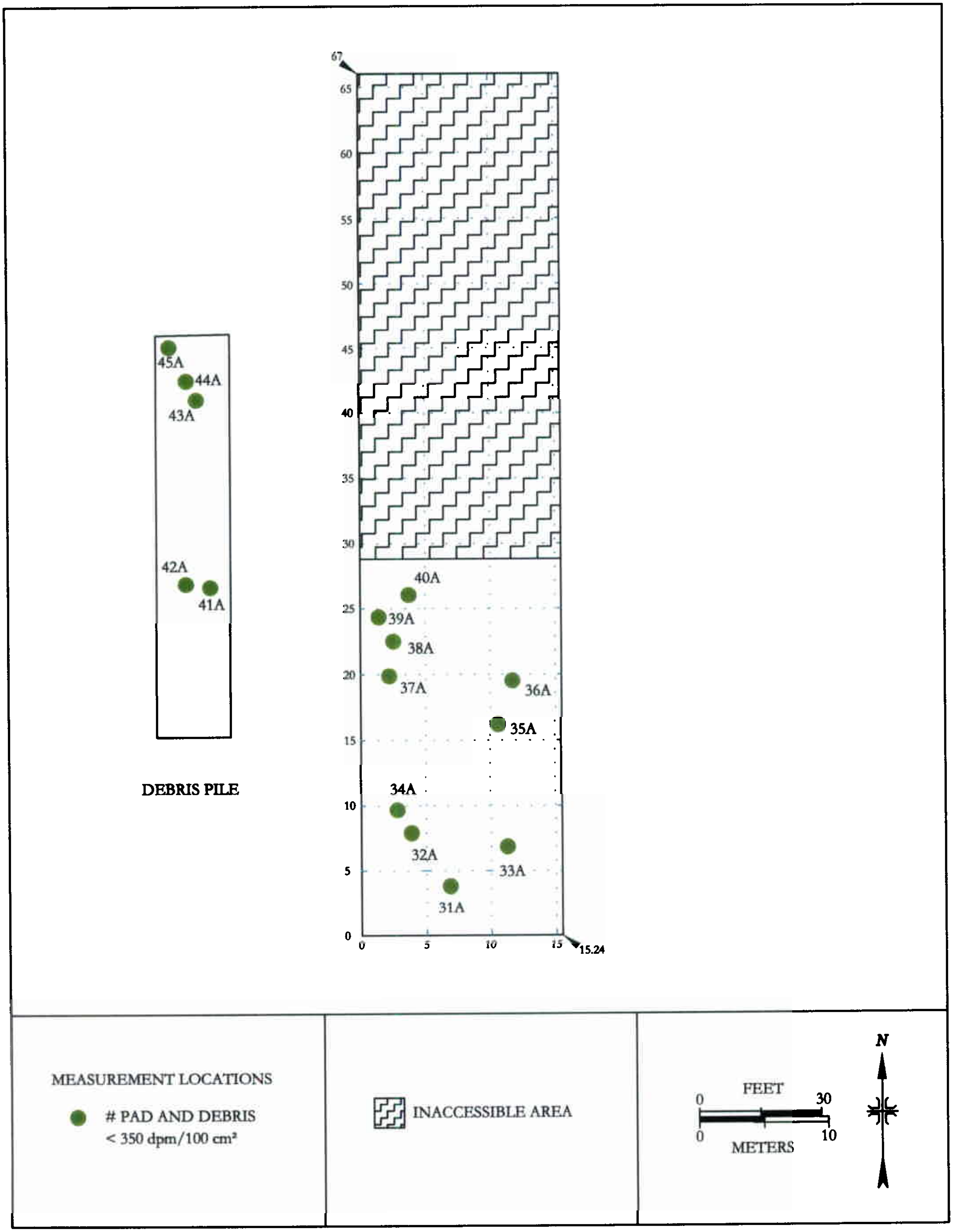


FIGURE 33: Building E-1115 - Measurement Locations

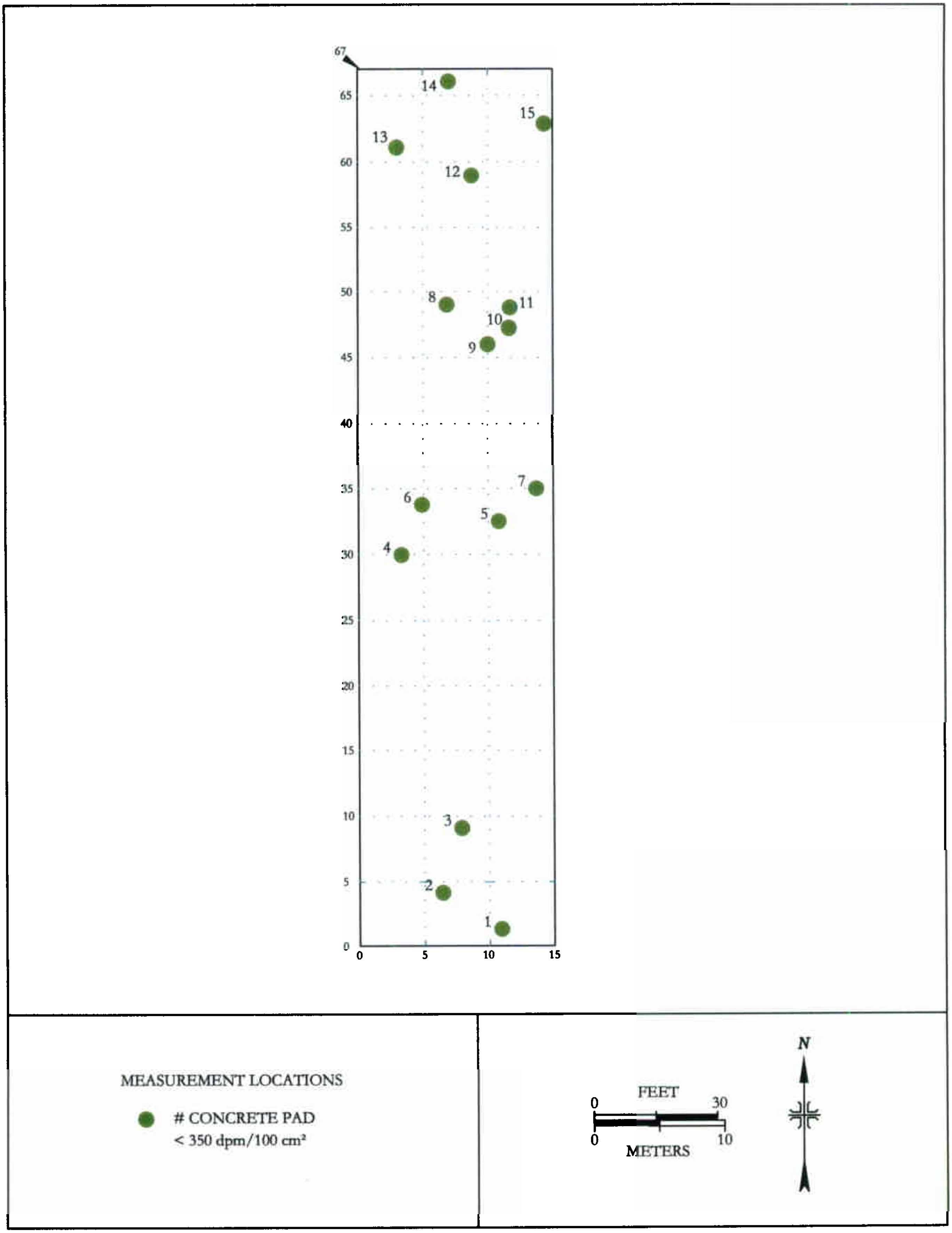


FIGURE 34: Building E-1116 - Measurement Locations

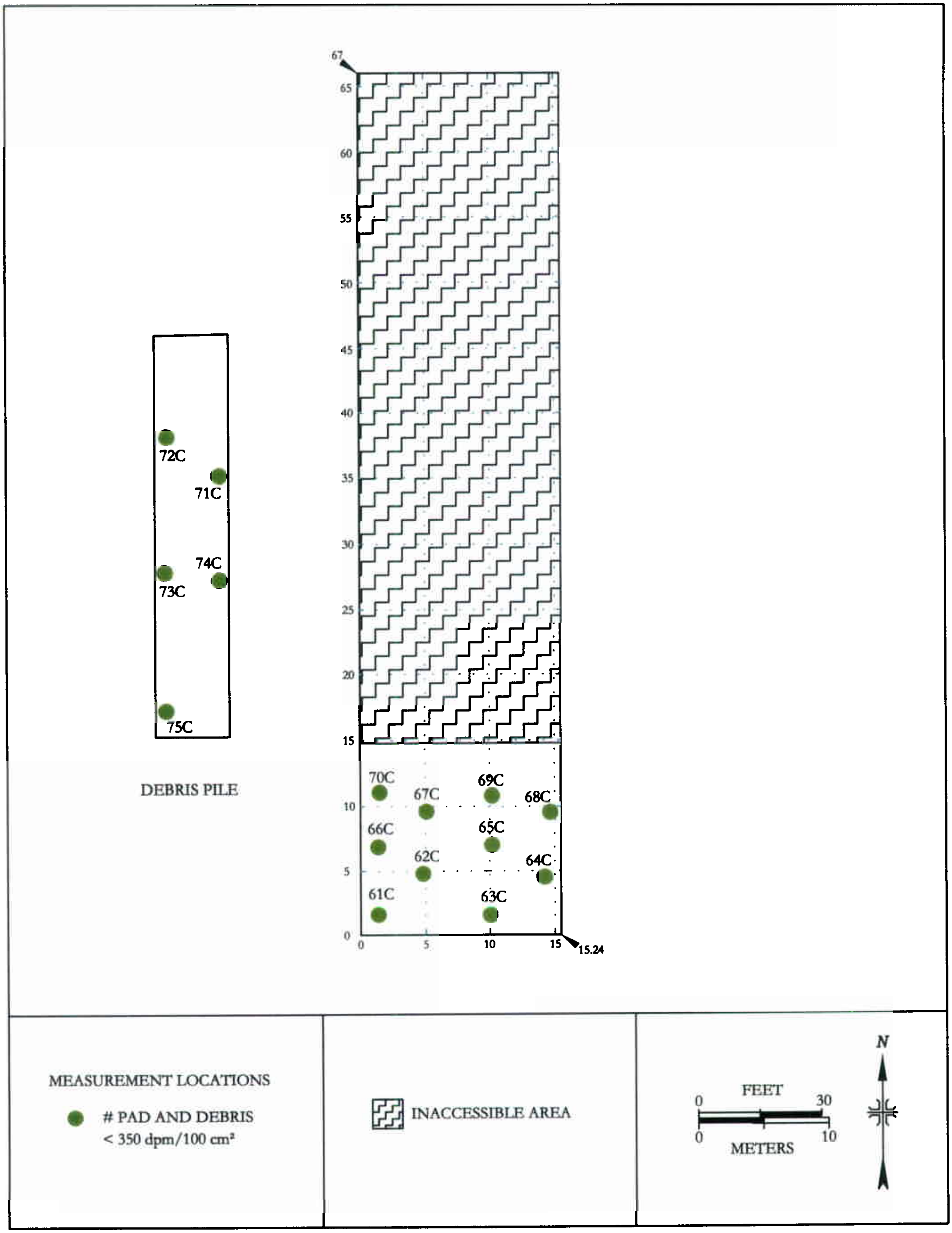


FIGURE 35: Building F-732 - Measurement Locations

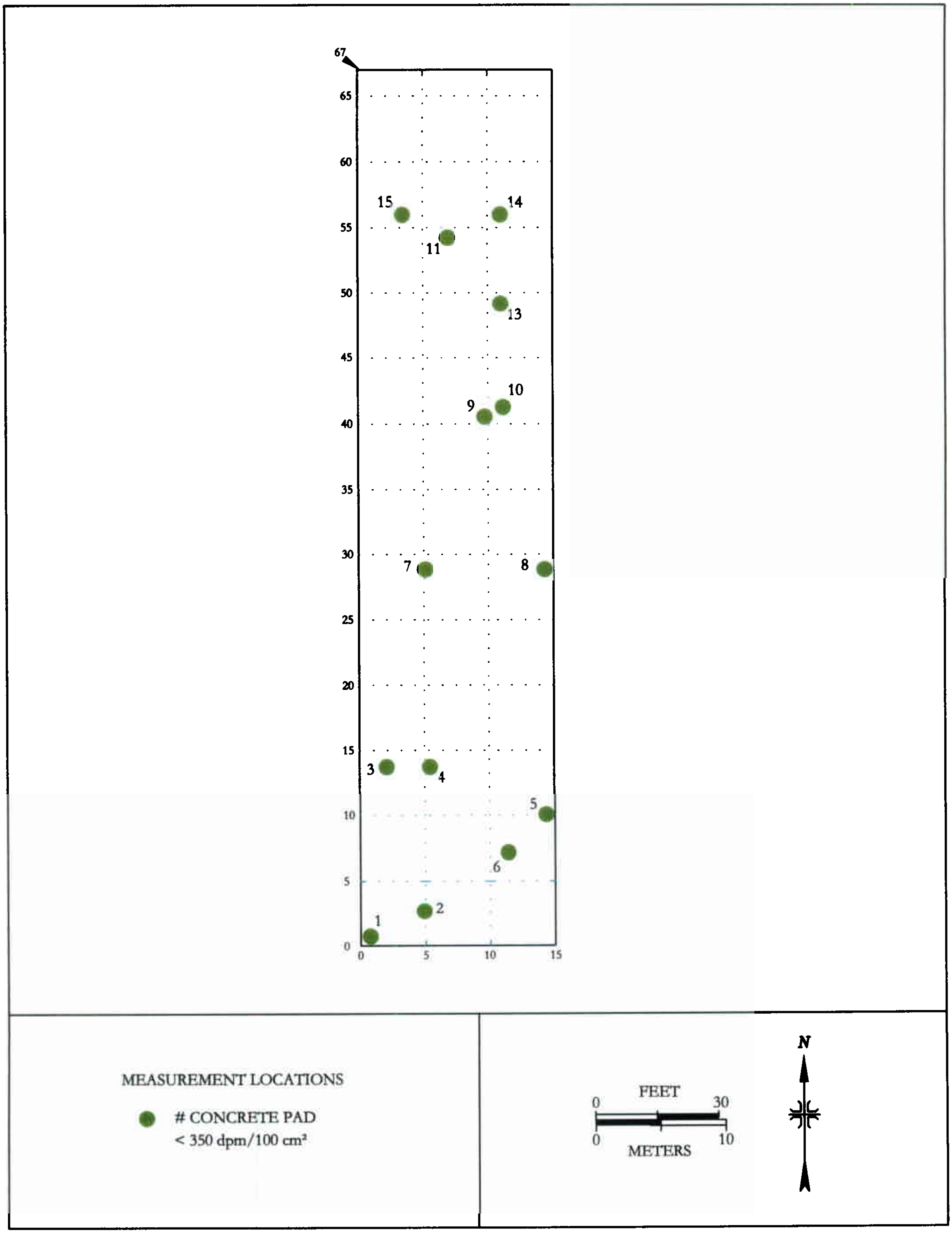


FIGURE 36: Building F-733 - Measurement Locations

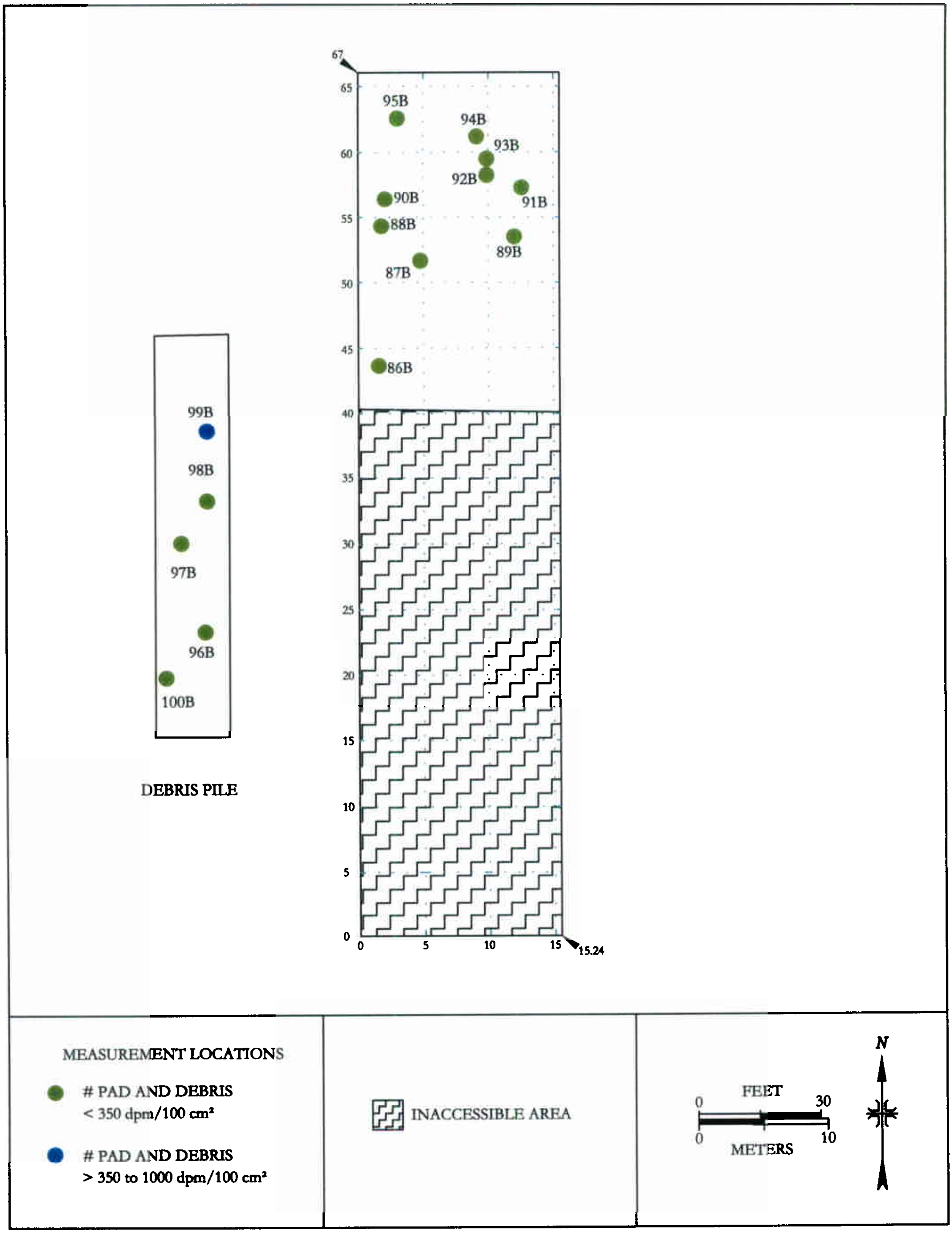


FIGURE 37: Building G-722 - Measurement Locations

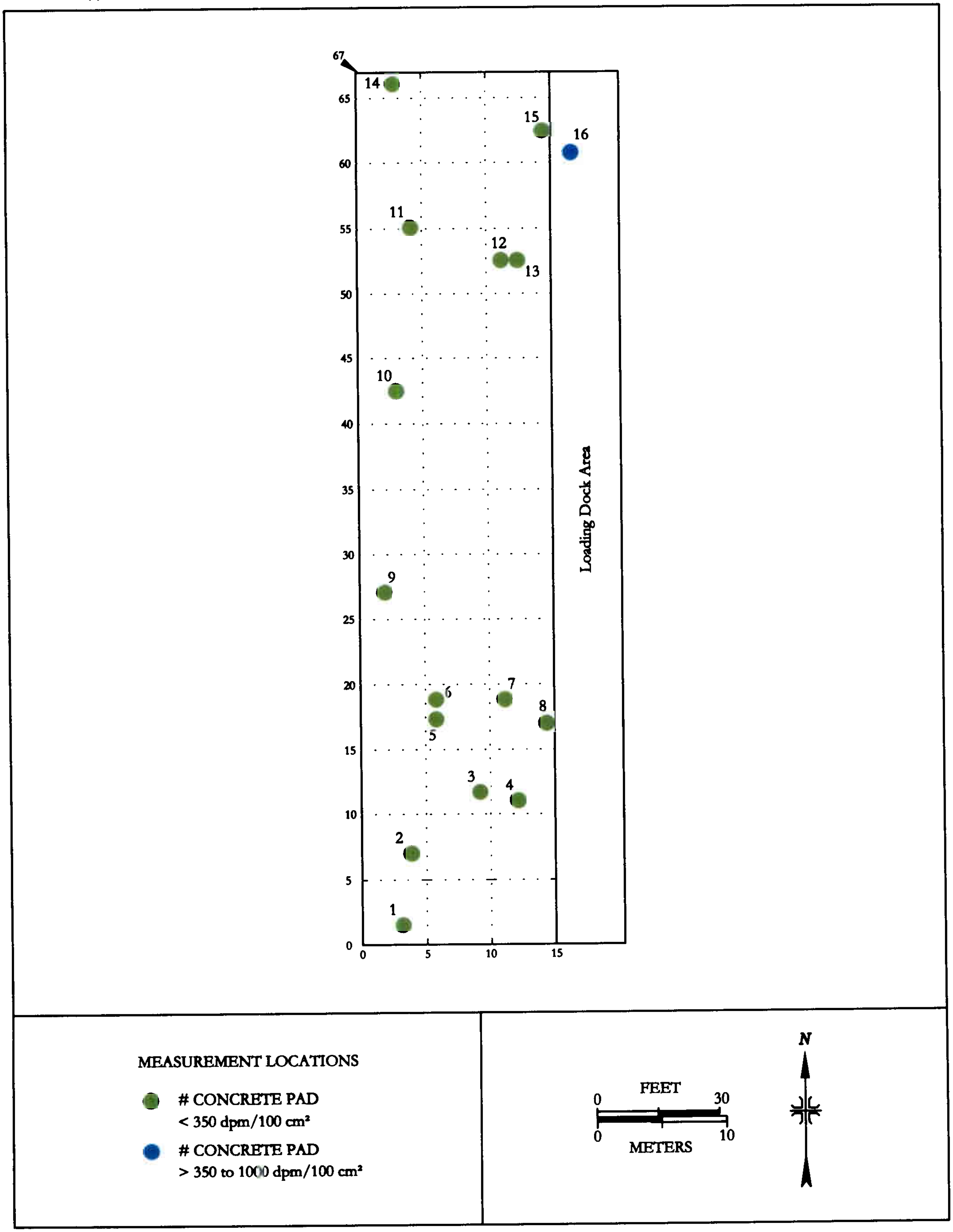


FIGURE 38: Building G-723 - Measurement Locations

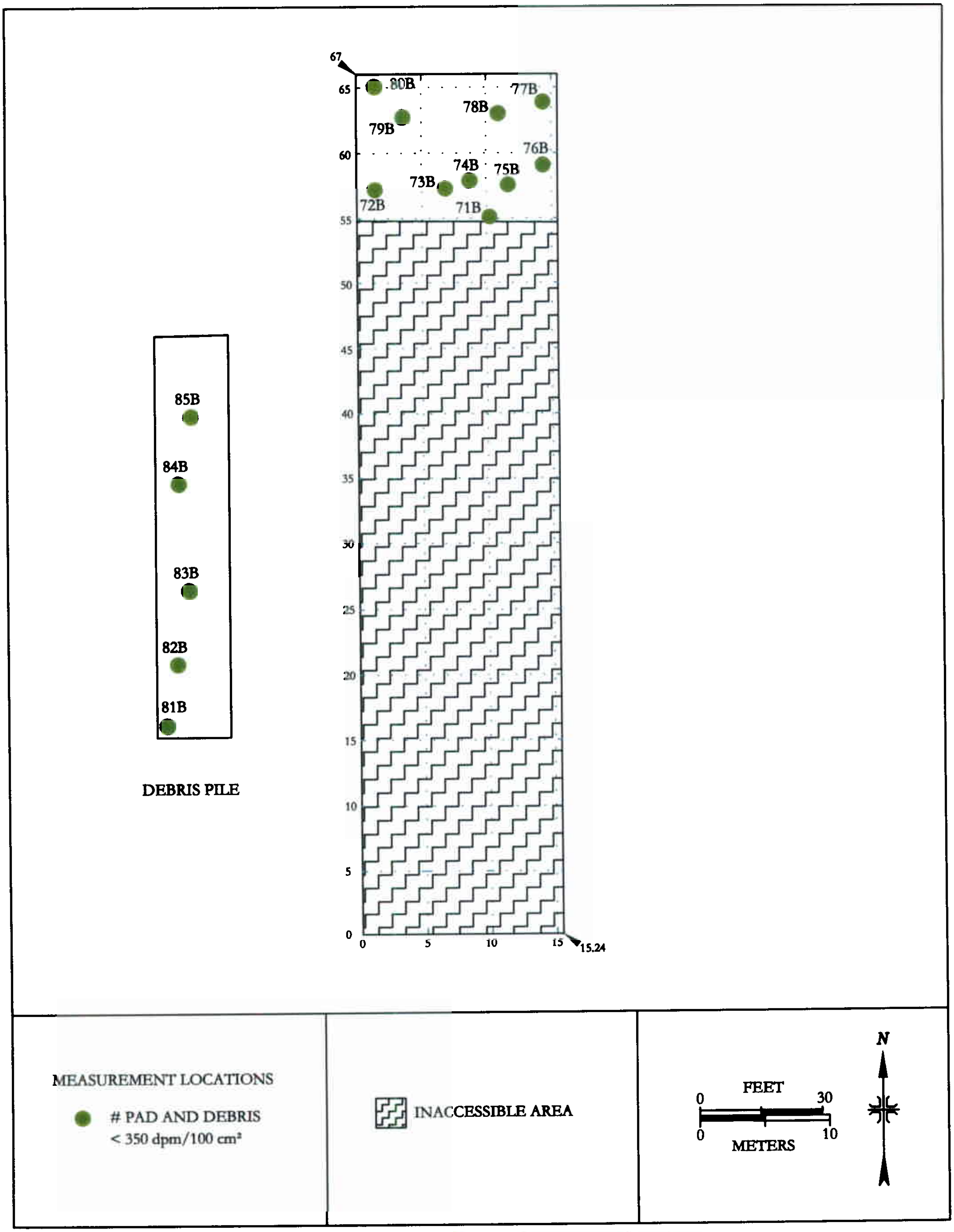


FIGURE 39: Building G-724 - Measurement Locations

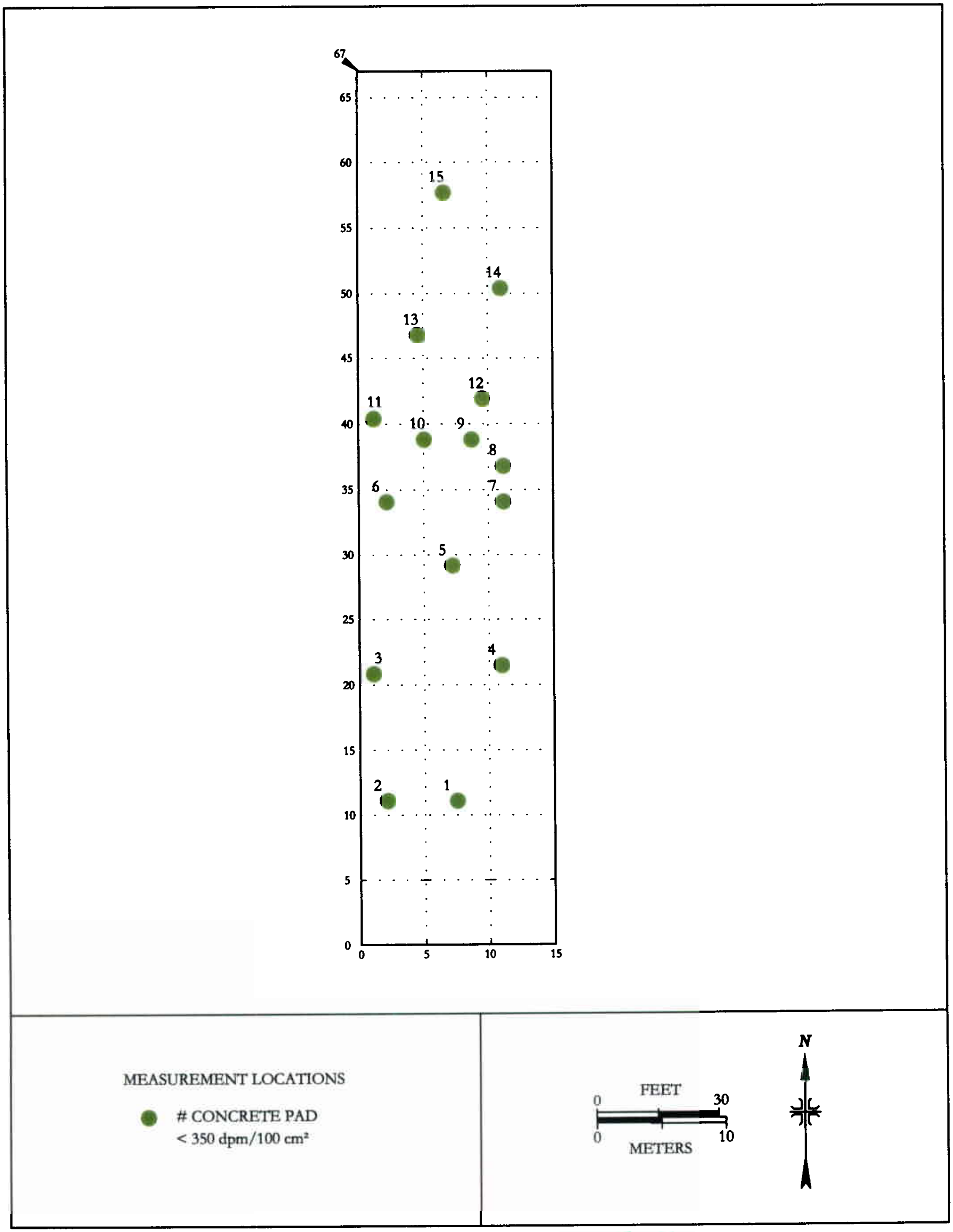


FIGURE 40: Building G-725 - Measurement Locations

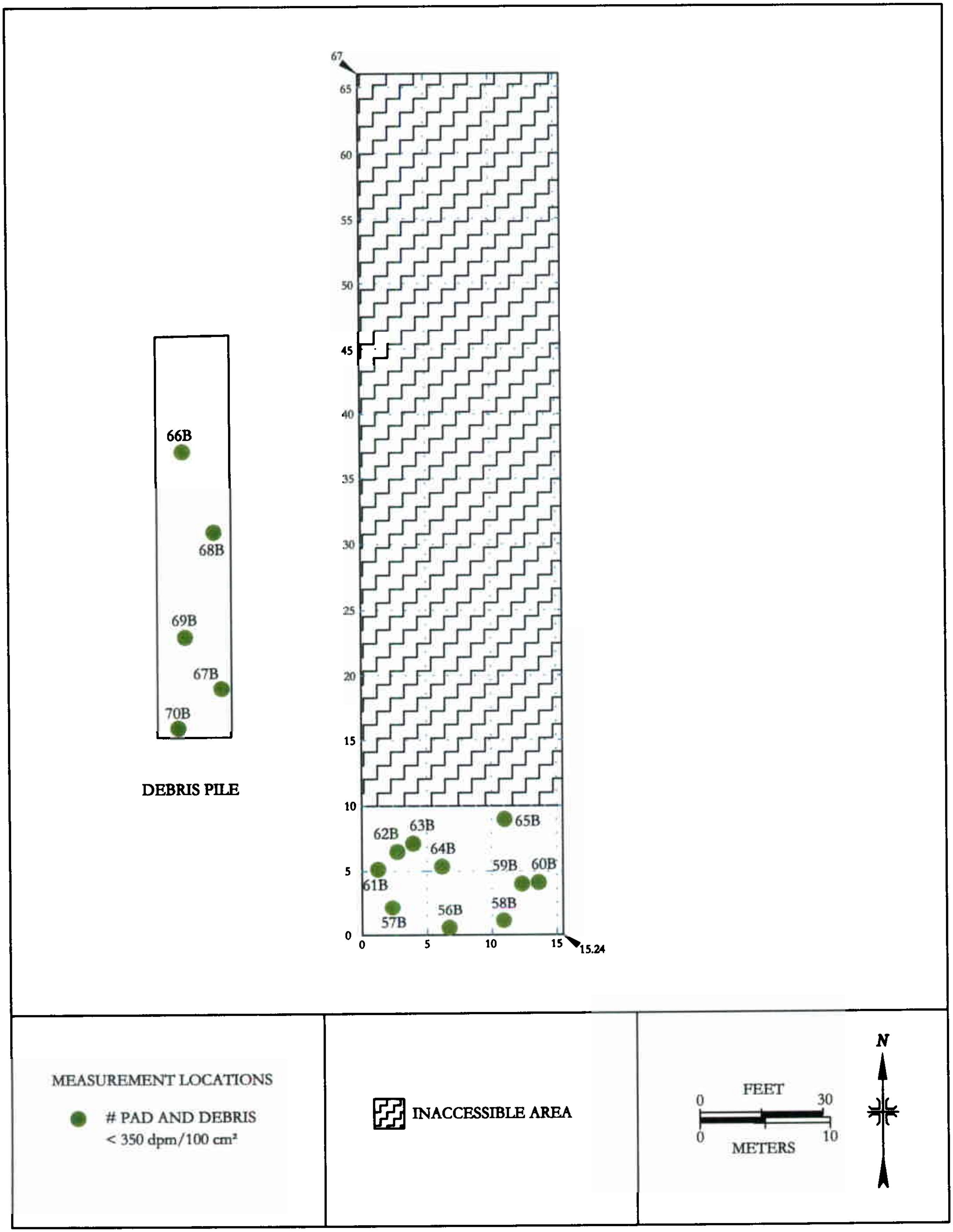


FIGURE 41: Building G-726 - Measurement Locations

FIGURE 42: Building I-531 - Measurement Locations

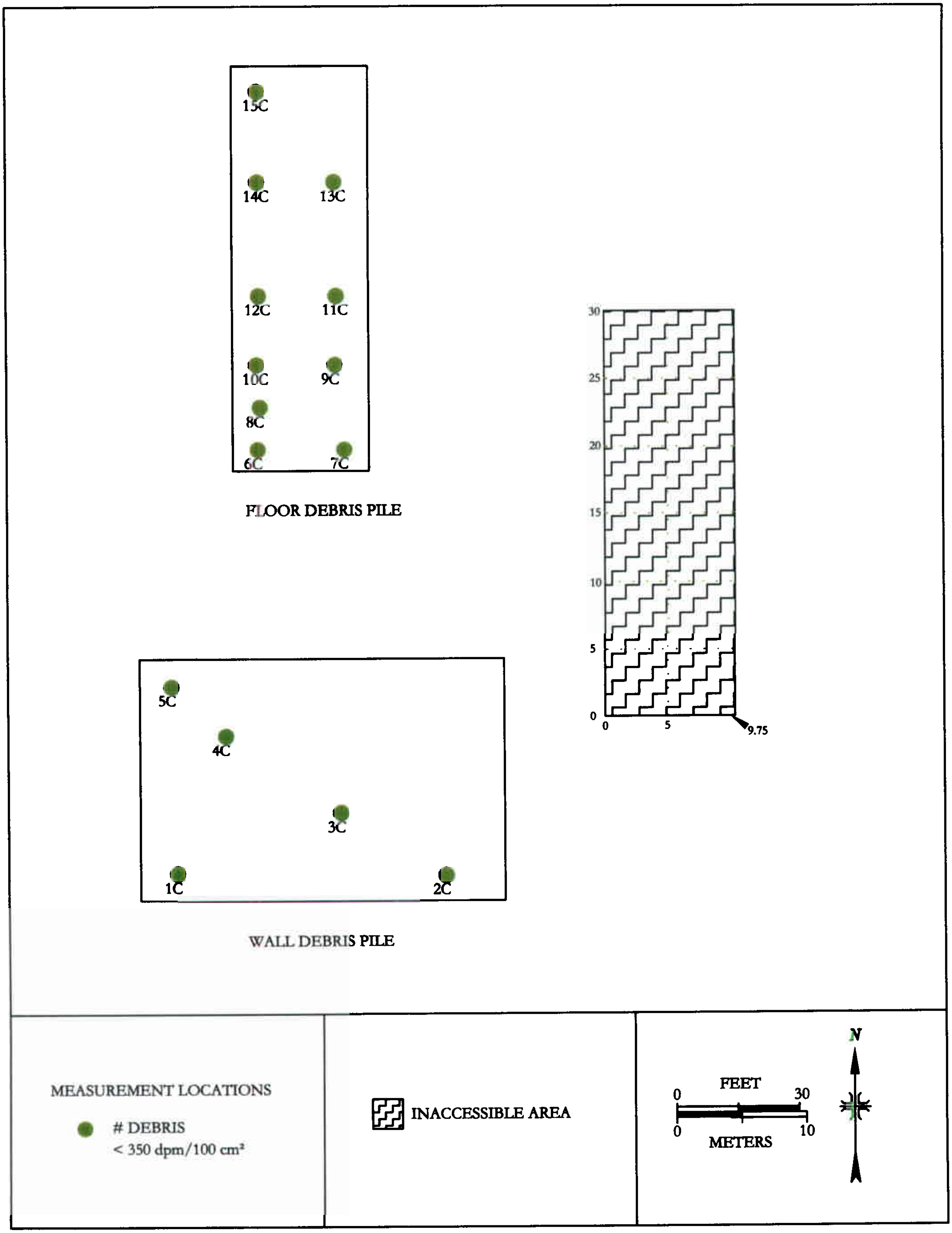


FIGURE 43: Building I-631 - Measurement Locations

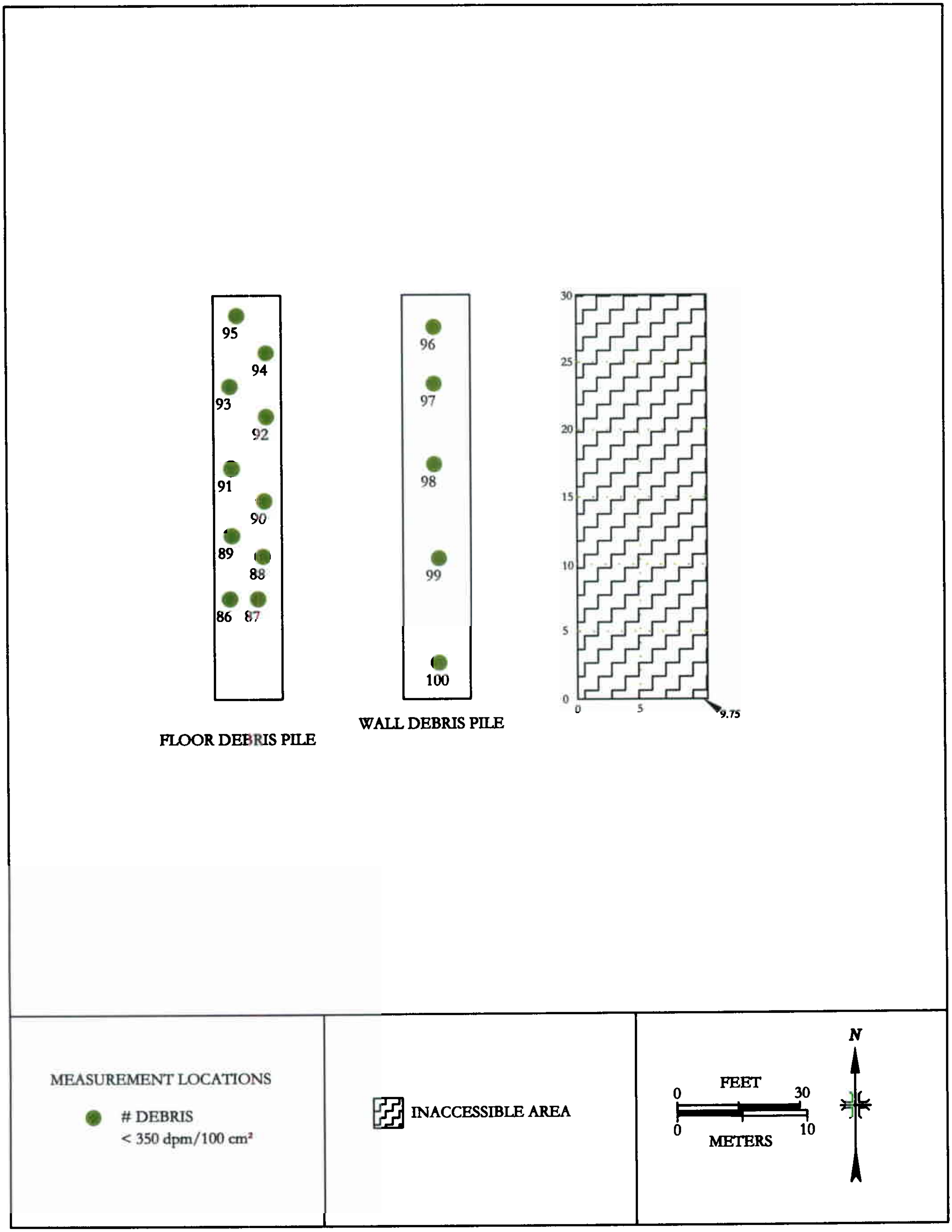


FIGURE 44: Building I-632 - Measurement Locations

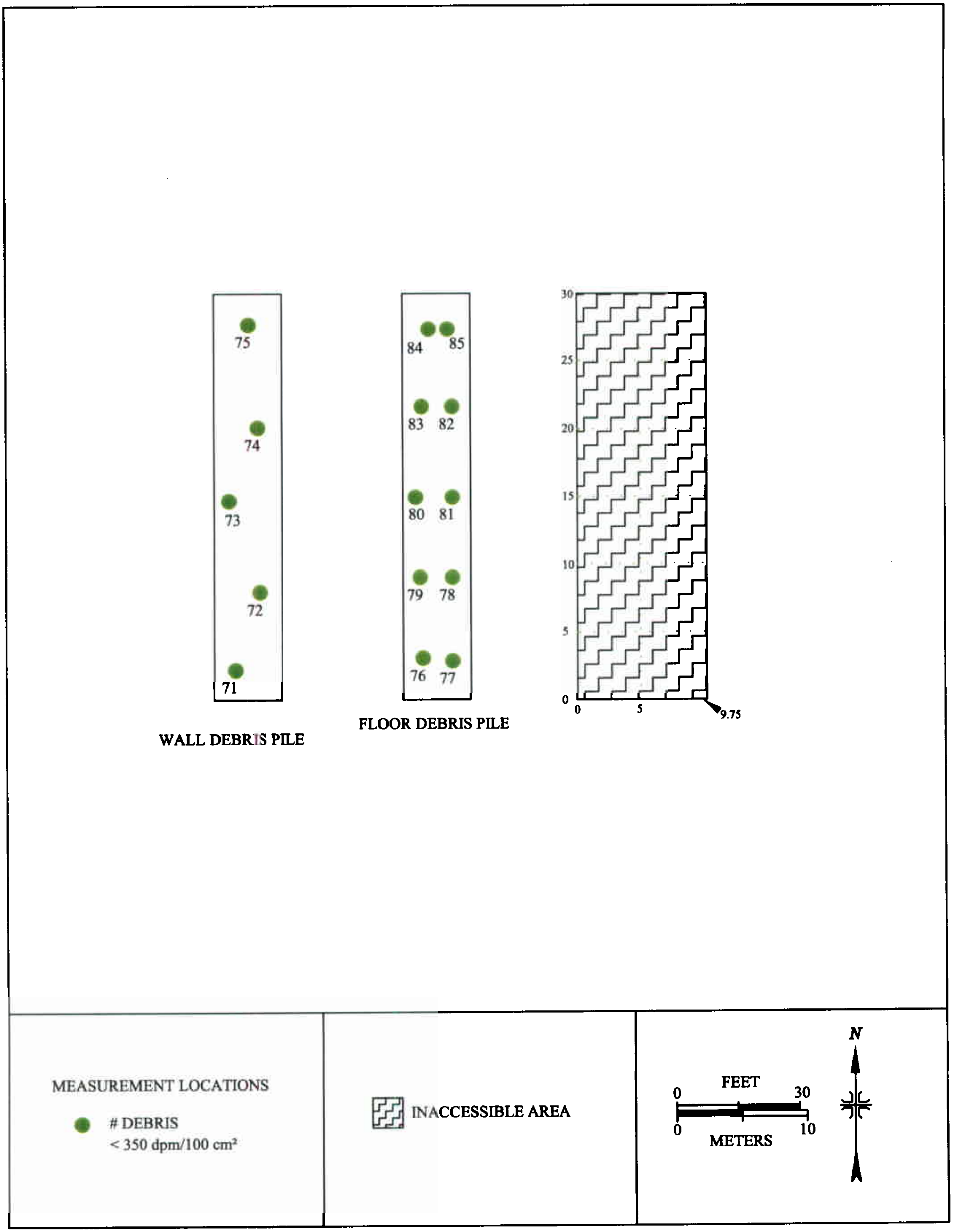


FIGURE 45: Building I-633 - Measurement Locations

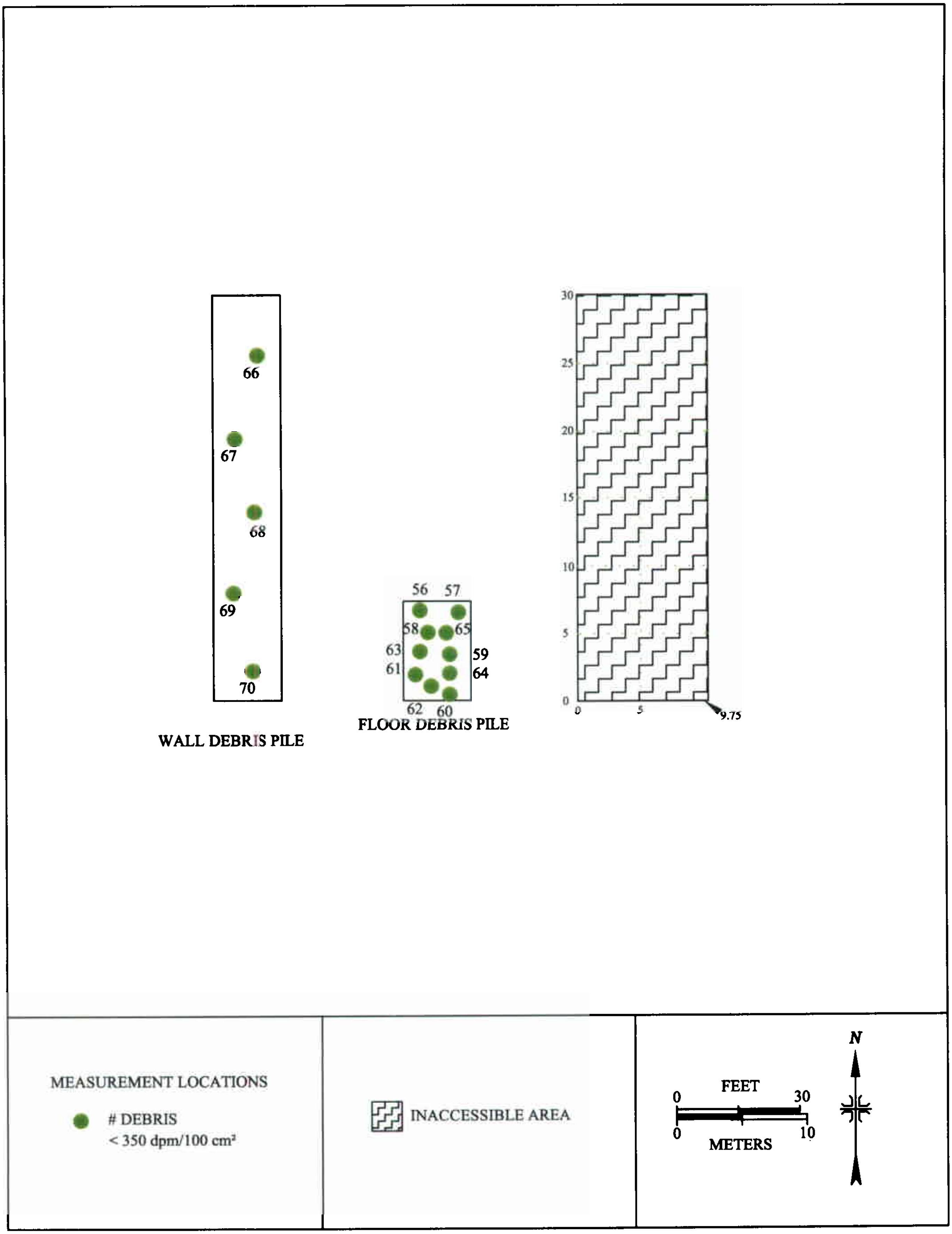


FIGURE 46: Building I-634 - Measurement Locations

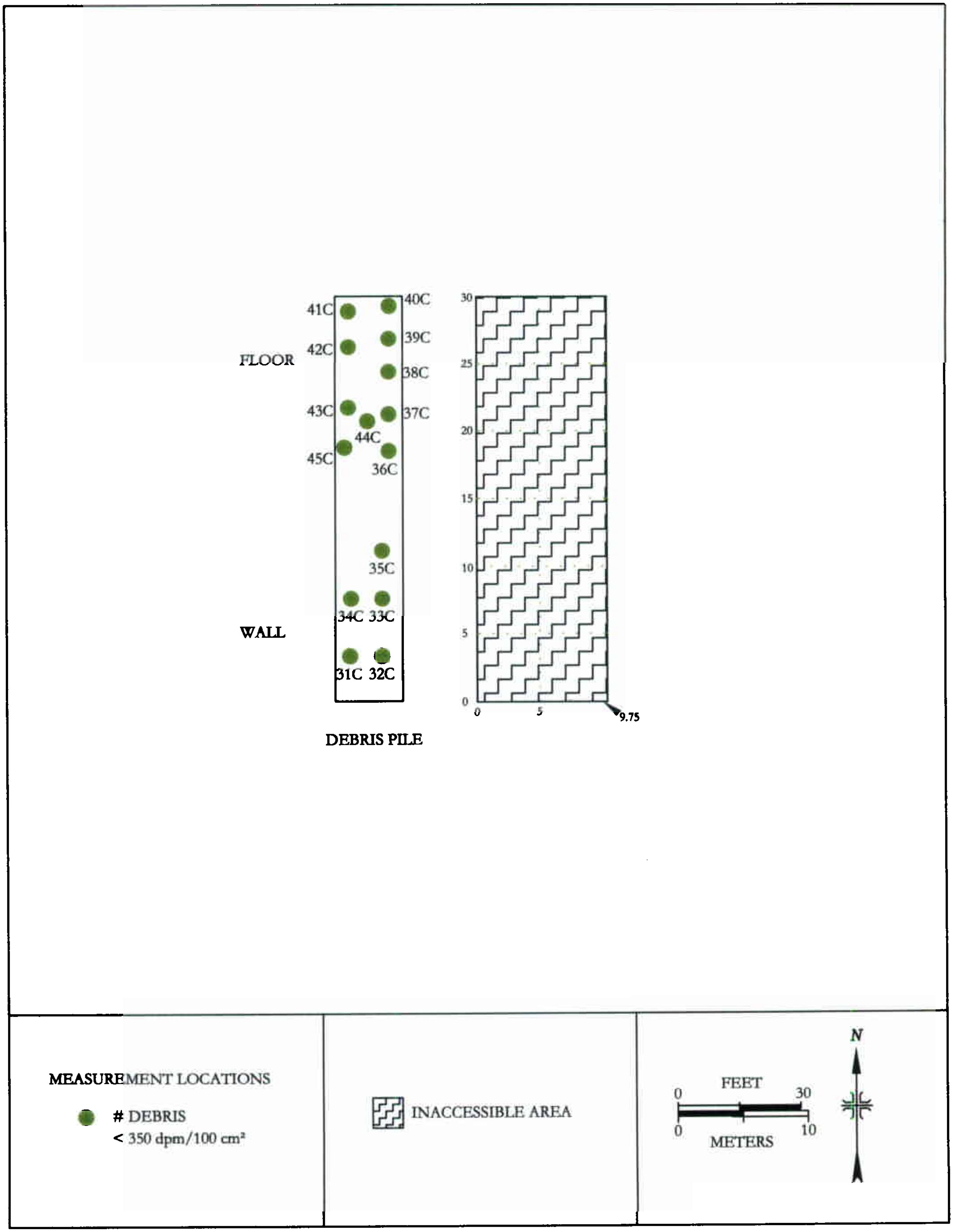


FIGURE 47: Building I-636 - Measurement Locations

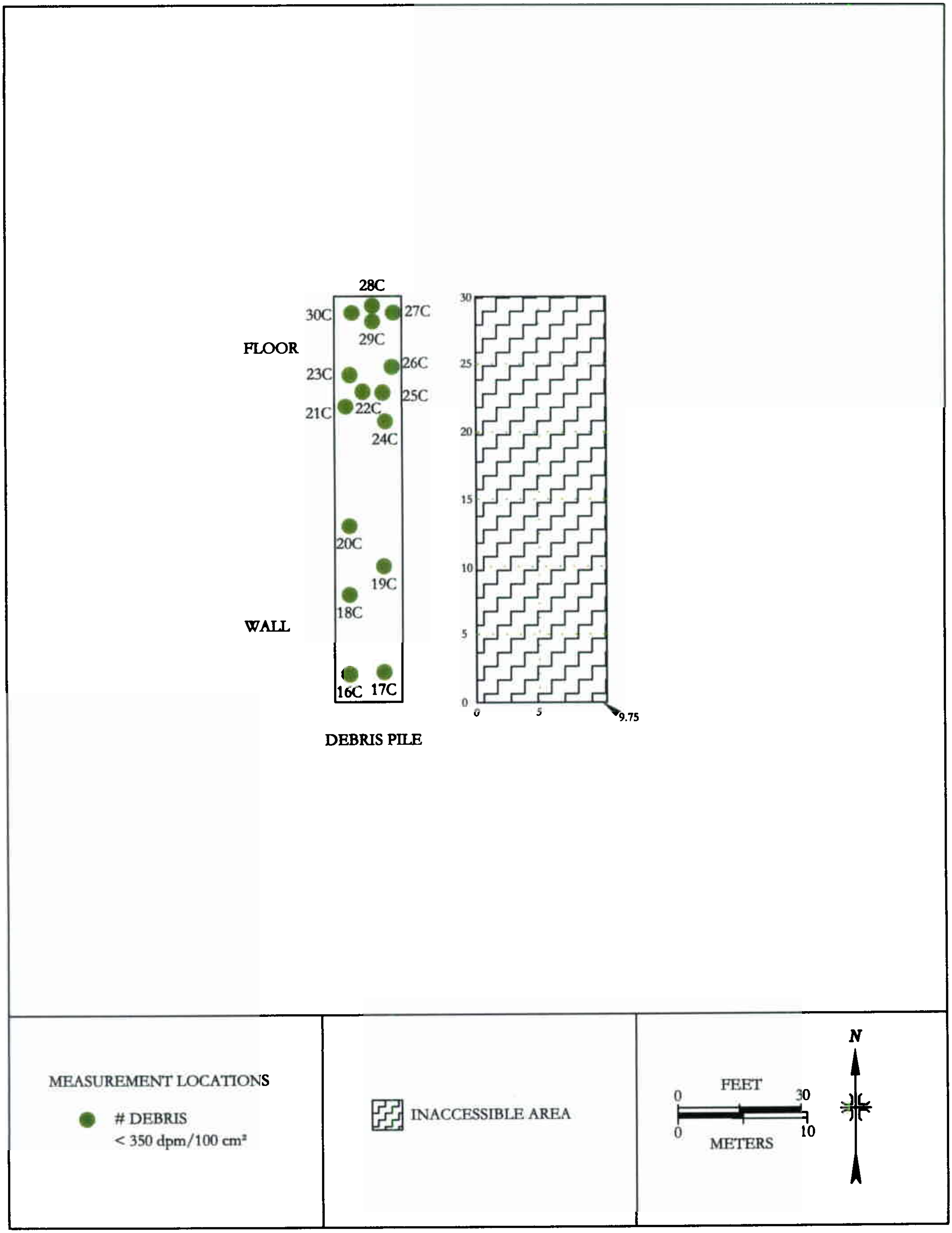


FIGURE 48: Building I-641 - Measurement Locations

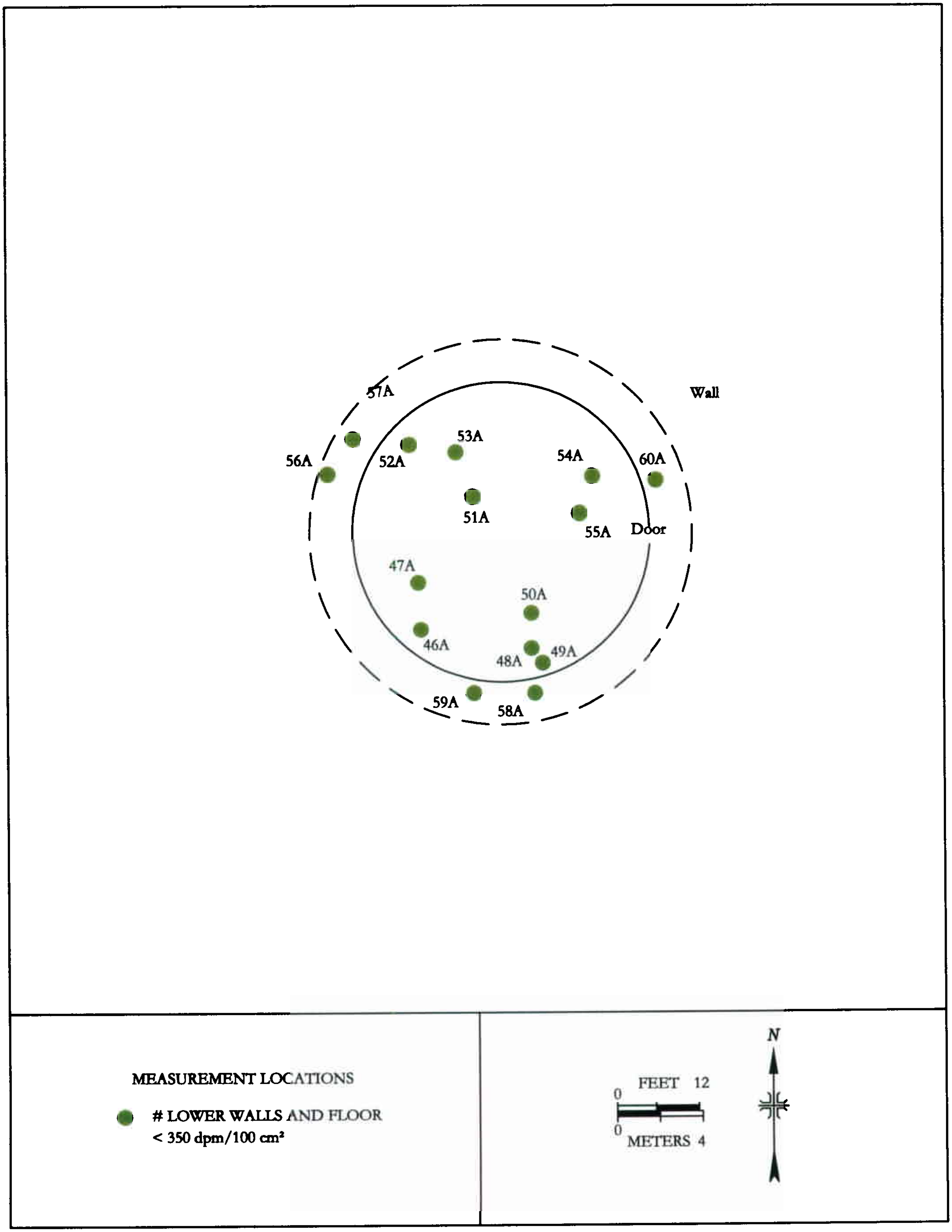
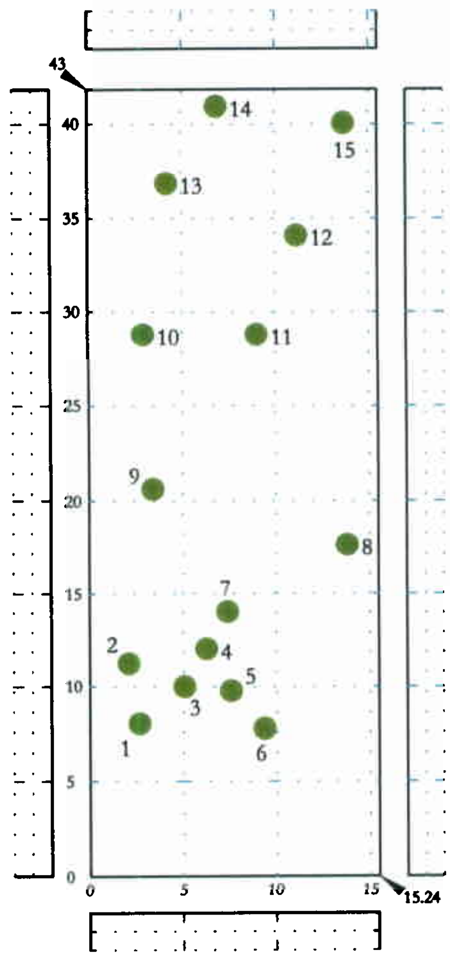


FIGURE 49: Building I-634 Igloo - Measurement Locations



MEASUREMENT LOCATIONS

● # LOWER WALLS AND FLOOR
< 350 dpm/100 cm²

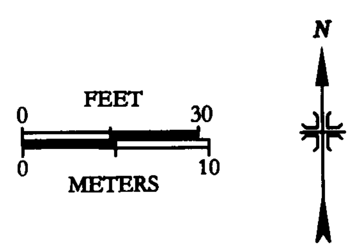


FIGURE 50: Building 821 - Measurement Locations

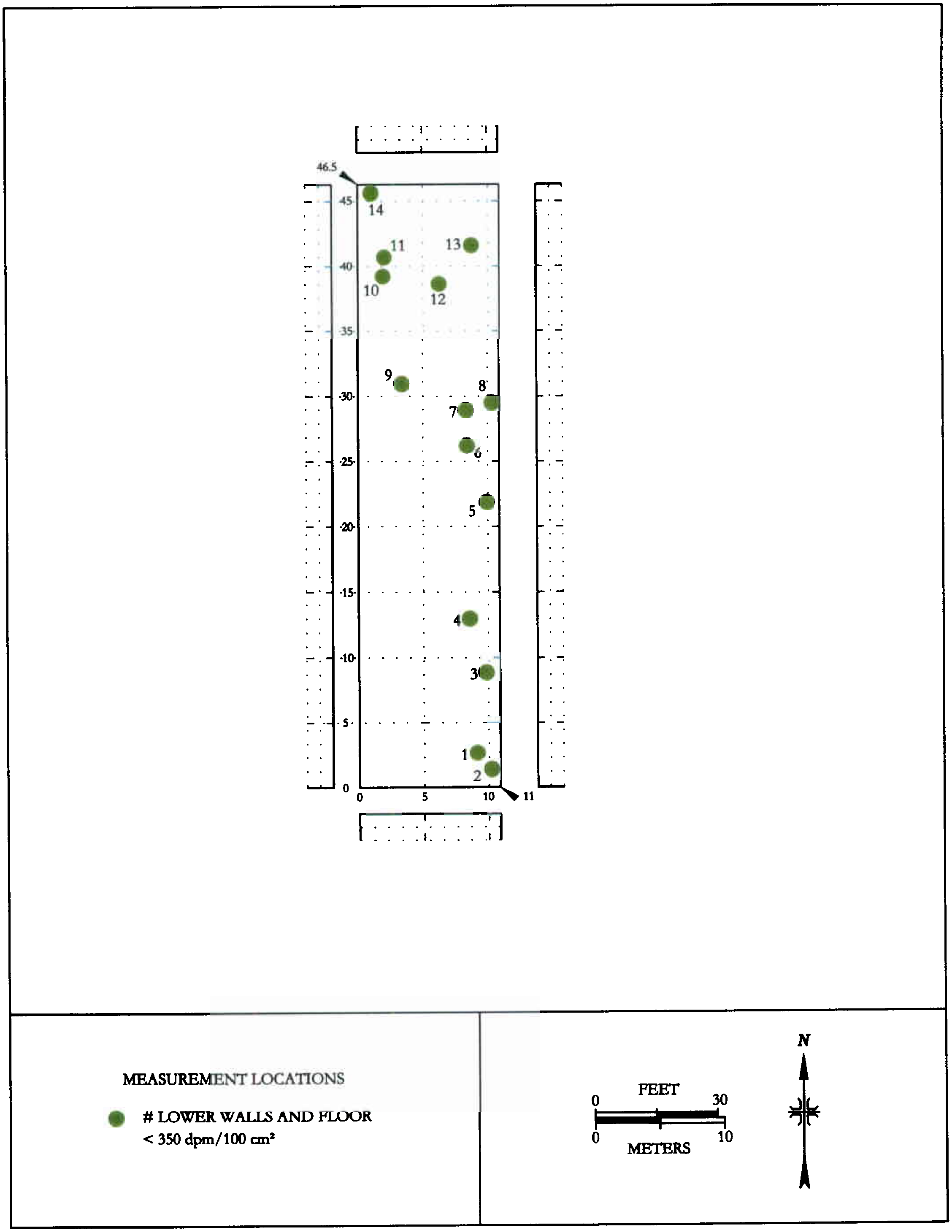


FIGURE 51: Building 825 - Measurement Locations

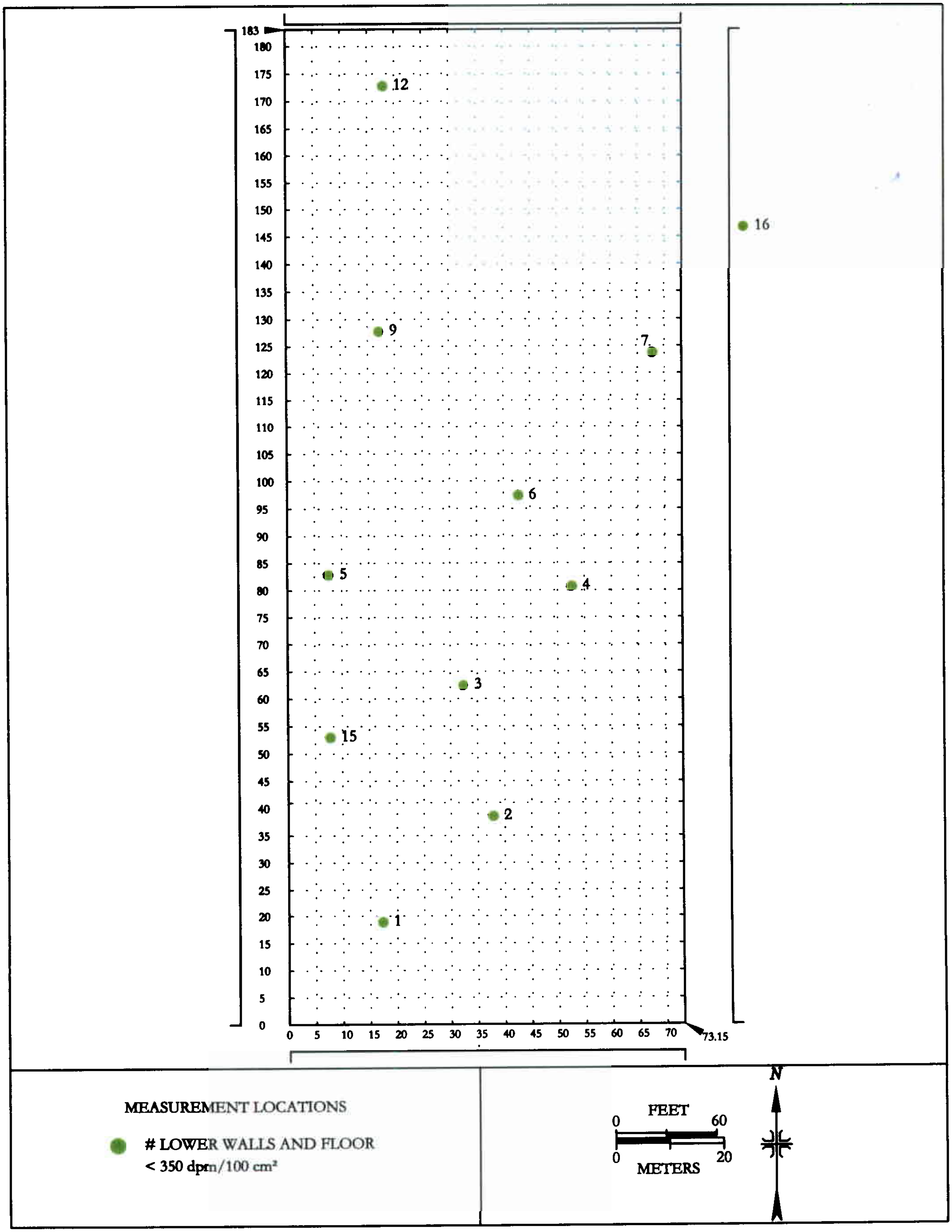


FIGURE 52: Building 1021 - Measurement Locations

431-063 (x)

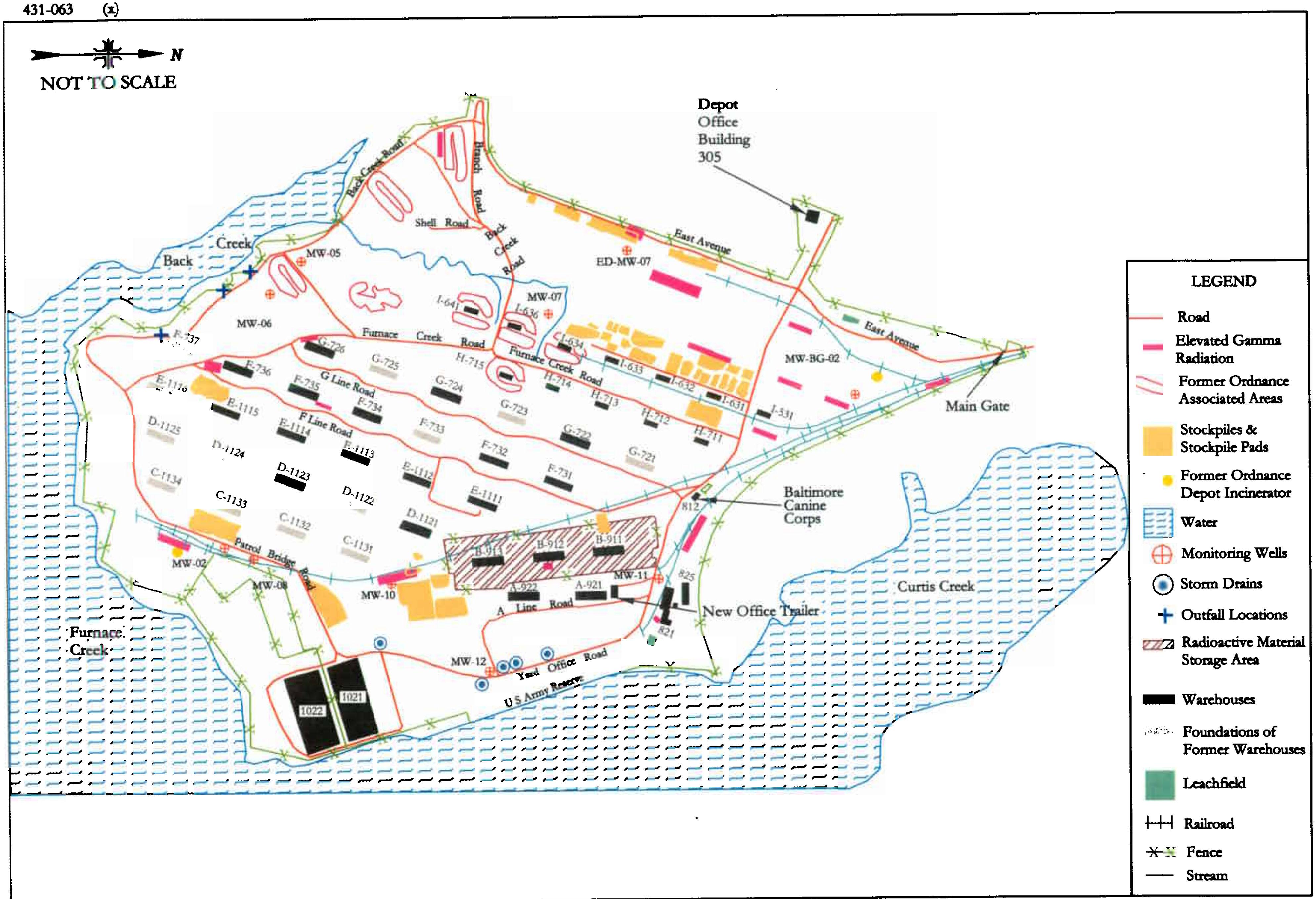


FIGURE 53: Curtis Bay Depot - Locations of Elevated Gamma Radiation

431-015 (2)

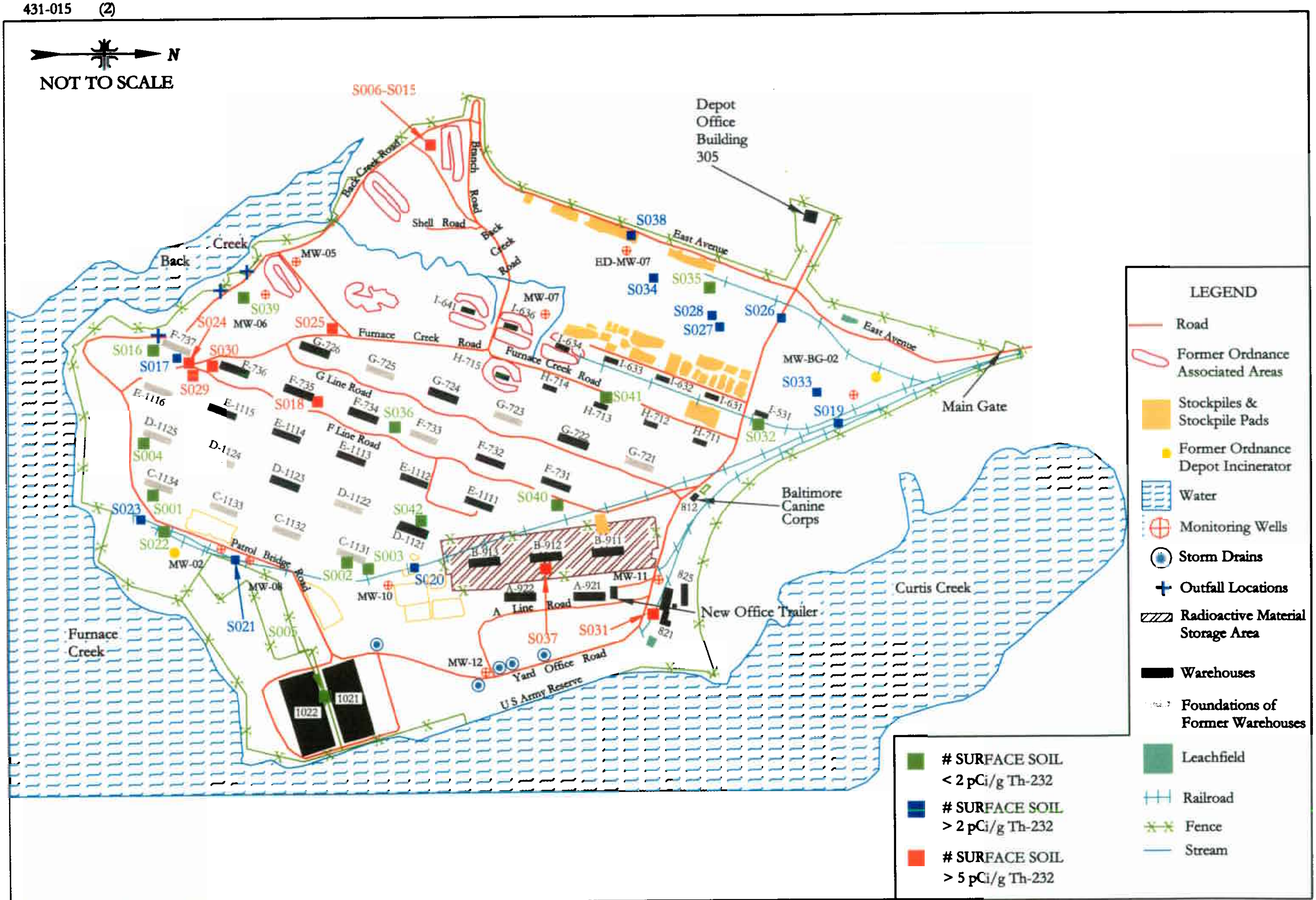


FIGURE 54: Curtis Bay Depot - Soil Sample Locations

TABLES

TABLE 1

BUILDING INFORMATION
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building Line Designation	Building ID	Condition/Survey Phase	History of Radioactive Material Use	Radioactive Material[a]	Building Classification
Warehouses	1021	Surveyed Phase 1	No	--[b]	3
73 m × 183 m	1022	Surveyed Phase 1	Yes	Th	2
A Line	A-921	Surveyed Phase 1	Yes	Th, MS	2
15 m × 67 m	A-922	Surveyed Phase 1	No		3
B Line	B-911	Surveyed Phase 1	Yes	Th, SS	1
15 m × 67 m	B-912	Surveyed Phase 1	Yes	Th	1
	B-913	Surveyed Phase 1	Yes	Th	2
C Line	C-1131	Surveyed Phase 1/Pad	No	--	3
15 m × 67 m	C-1132	Surveyed Phase 1/Pad	No	--	3
	C-1133	Surveyed Phase 1/Pad	No	--	3
	C-1134	Surveyed Phase 1/Pad	No	--	3
D Line	D-1121	Deconstructed	No	--	3
15 m × 67 m	D-1122	Surveyed Phase 1/Pad	No	--	3
	D-1123	Deconstructed	No	--	3
	D-1124	Surveyed Phase 1/Pad	No	--	3
	D-1125	Surveyed Phase 1/Pad	No	--	3
E Line	E-1111	Surveyed Phase 1	No	--	3
15 m × 67 m	E-1112	Surveyed Phase 1/Pad	No	--	3
	E-1113	Deconstructed	No	--	3
	E-1114	Deconstructed	No	--	3
	E-1115	Deconstructed	No	--	3
	E-1116	Surveyed Phase 1/Pad	No	--	3

TABLE 1 (Continued)

BUILDING INFORMATION
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building Line Designation	Building ID	Condition/Survey Phase	History of Radioactive Material Use	Radioactive Material[a]	Building Classification
F Line 15 m × 67 m	F-731	Surveyed Phase 1	Yes	Th	1
	F-732	Deconstructed	No	--	3
	F-733	Surveyed Phase 1/Pad	No	--	3
	F-734	Deconstructed	Yes	Th	2
	F-735	Deconstructed	Yes	MS	2
	F-736	Deconstructed	Yes	MS	2
	F-737	Surveyed Phase 1/Pad	Yes	MS	1
G Line 15 m × 67 m	G-721	Surveyed Phase 1/Pad	Yes	SS	2
	G-722	Deconstructed	No	--	3
	G-723	Surveyed Phase 1/Pad	No	--	3
	G-724	Deconstructed	No	--	3
	G-725	Surveyed Phase 1/Pad	No	--	3
	G-726	Deconstructed	No	--	3
H Line 10 m × 29 m	H-711	Deconstructed	Yes	SS	2
	H-712	Deconstructed	Yes	SS	2
	H-713	Deconstructed	Yes	SS	2
	H-714	Deconstructed	Yes	SS	2
	H-715	Deconstructed	Yes	SS	2

TABLE 1 (Continued)

BUILDING INFORMATION
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building Line Designation	Building ID	Condition/Survey Phase	History of Radioactive Material Use	Radioactive Material[a]	Building Classification
I Line 10 m × 29 m	I-531	Deconstructed	No	--	3
	I-631	Deconstructed	No	--	3
	I-632	Deconstructed	No	--	3
	I-633	Deconstructed	No	--	3
	I-634 Igloo	Surveyed Phase 2	No	--	3
	I-634	Deconstructed	No	--	3
	I-636	Deconstructed	No	--	3
	I-641	Deconstructed	No	--	3
800 series	821	Surveyed Phase 1	No	--	3
	825	Surveyed Phase 1	No	--	3

[a]Th = thorium nitrate, oxide, or hydroxide, MS = monazite sand, SS = sodium sulfate.
[b]-- = Not applicable.

TABLE 2

PHASE 1 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a, b]	Surface[c]	Total Activity[d] (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
		Alpha	Beta	Alpha	Beta
A-921 (2)					
1	F	--[e]	140	--	--
2	F	--	100	--	--
3	F	--	-8	--	--
4	F	--	150	--	--
5	F	--	160	--	--
6	F	--	95	--	--
7	F	--	130	--	--
8	F	--	160	--	--
9	F	--	230	--	--
10	F	--	150	--	--
11	LW	--	12	--	--
12	LW	--	-160	--	--
13	LW	--	-95	--	--
14	LW	--	-110	--	--
15	LW	--	-29	--	--
16	LW	--	-180	--	--
17	LW	--	-87	--	--
A-922 (3)					
1	F	--	230	1	-1
2	F	--	75	1	2
3	F	--	23	0	4
4	F	--	89	0	3
5	F	--	170	0	-4
6	F	--	75	0	3
7	F	--	45	0	1
8	F	--	29	0	-2
9	F	--	70	1	-4
10	F	--	-6	1	7
11	LW	--	-220	0	5
12	LW	--	-380	0	4
13	F	--	95	0	2
14	F	--	100	0	2
15	F	--	-12	0	8

TABLE 2 (Continued)

PHASE 1 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a, b]	Surface[c]	Total Activity[d] (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
		Alpha	Beta	Alpha	Beta
B-911 (1)					
1/12B	F	--	270	13	9
2/13B	F	--	380	5	1
3/14B	F	--	840	0	6
4/15B	F	--	1,400	3	8
5/16B	F	--	620	0	1
6/18B	F	--	1,200	5	-6
7/17B	F	--	6,200	9	9
8/19B	F	--	180,000	5	5
9/20B	F	--	7,200	0	3
10/21B	F	--	3,700	3	3
11/22B	F	--	1,200	9	9
12/23B	F	--	11,000	13	8
13/24B	F	--	5,200	13	9
14/25B	F	--	30,000	13	6
15/26B	F	--	87,000	1	-1
16/27B	F	--	8,800	11	14
17/28B	F	--	13,000	14	7
18/29B	F	--	130,000	100	52
19/30B	F	--	620,000	150	49
20/31B	F	--	5,900	3	2
21/32B	LW	--	110	1	-1
22/33B	LW	--	430	1	1
23/34B	LW	--	620	0	6
24/35B	LW	--	110	0	3
25/36B	LW	--	64,000	340	170
26/37B	LW	--	-160	0	2
27/38B	F	--	140,000	91	58
28/39B	US	--	590	3	3
29/40B	US	--	320	0	4
30/41B	US	--	580	0	3
31/42B	US	--	940	1	-3
32/43B	F	--	66,000	16	7
B-912 (1)					
1/48	F	9	170	1	11

TABLE 2 (Continued)

PHASE 1 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a, b]	Surface[c]	Total Activity[d] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
B-912 (1) (Continued)					
2/49	F	33	250	1	7
3/50	F	45	100	1	21
4/51	F	78	100,000	5	2
5/52	F	330	6,600	0	4
6/53	F	25	370	0	-3
7/54	F	39	480	9	14
8/55	F	18	37,000	1	11
9/56	F	39	390	3	-3
10/57	F	28	170	3	8
11/58	F	34	220	1	2
12/59	F	12,000	290,000	14	10
13/60	F	96	3,700	7	5
14/61	F	37	270	3	8
15/62	F	24	170	0	-1
16/63	F	10,000	97,000	3	17
17/64	F	6,500	110,000	5	4
18/65	F	27	240	0	3
19/66	F	5,800	43,000	18	7
20/67	F	96	85,000	0	6
21/68	F	120,000	66,000	22	15
22/69	F	21,000	28,000	0	4
23/70	F	950	15,000	9	2
24/71	LW	49	140	3	6
25/72	LW	58	-210	5	9
26/--	LW	33	420	--	--
27/73	LW	43	-110	3	3
28/74	US	--	660	5	18
29/75	US	--	350	11	5
30/76	US	--	330	3	6
31/77	US	--	470	3	4
32/78	US	--	250	9	1
B-913 (2)					
1/16	F	--	140	0	7
2/17	F	--	130	1	-1

TABLE 2 (Continued)

PHASE 1 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a, b]	Surface[c]	Total Activity[d] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
B-913 (2) (Continued)					
3/18	F	--	72	1	6
4/19	F	--	29	0	-2
5/20	F	--	-31	3	5
6/21	F	--	62	0	7
7/22	F	--	54	7	9
8/23	F	--	140	5	15
9/24	F	--	-17	11	10
10/25	F	--	-39	7	9
11/26	F	--	130	11	15
12/27	F	--	180	0	9
13/28	F	--	150	1	12
14/29	F	--	91	9	10
15/30	F	--	190	11	14
16/31	F	--	60	1	15
17/32	F	--	280	0	7
18/33	F	--	41	7	21
19/35	F	--	150	3	9
20/36	F	--	66	18	28
21/37	F	44,000	190,000	4,000	2,900
22/38	F	6,000	40,000	830	450
23/39	US	--	100	20	42
24/40	US	--	170	5	23
25/41	US	--	120	9	18
26/42	US	--	130	7	11
27/43	US	--	79	3	7
28/44	US	--	100	1	7
29/45	US	--	110	0	14
30/46	US	--	200	3	8
31/47	US	--	190	1	11
32/79	LW	87	23	1	-2
33/80	LW	94	19	0	3
34/81	LW	78	-91	1	-1
35/82	LW	76	68	1	4

TABLE 2 (Continued)

PHASE 1 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a, b]	Surface[c]	Total Activity[d] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
C-1131 (3)					
1	Pad	--	-75	--	--
2	Pad	--	35	--	--
3	Pad	--	41	--	--
4	Pad	--	33	--	--
5	Pad	--	43	--	--
6	Pad	--	6	--	--
7	Pad	--	79	--	--
8	Pad	--	-35	--	--
9	Pad	--	33	--	--
10	Pad	--	85	--	--
11	Pad	--	-60	--	--
12	Pad	--	-39	--	--
13	Pad	--	62	--	--
14	Pad	--	170	--	--
15	Pad	--	-41	--	--
C-1132 (3)					
1	Pad	--	-95	--	--
2	Pad	--	58	--	--
3	Pad	--	-14	--	--
4	Pad	--	60	--	--
5	Pad	--	60	--	--
6	Pad	--	-81	--	--
7	Pad	--	-27	--	--
8	Pad	--	-31	--	--
9	Pad	--	-35	--	--
10	Pad	--	-50	--	--
11	Pad	--	-52	--	--
12	Pad	--	50	--	--
13	Pad	--	10	--	--
14	Pad	--	-41	--	--
15	Pad	--	23	--	--
C-1133 (3)					
1	Pad	--	21	--	--
2	Pad	--	75	--	--

TABLE 2 (Continued)

PHASE 1 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a, b]	Surface[c]	Total Activity[d] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
C-1133 (3) (Continued)					
3	Pad	--	150	--	--
4	Pad	--	46	--	--
5	Pad	--	-46	--	--
6	Pad	--	0	--	--
7	Pad	--	56	--	--
9	Pad	--	-110	--	--
10	Pad	--	39	--	--
11	Pad	--	-75	--	--
12	Pad	--	-83	--	--
13	Pad	--	-79	--	--
14	Pad	--	-39	--	--
15	Pad	--	-50	--	--
16	Pad	--	-54	--	--
17	Pad	--	-100	--	--
C-1134 (3)					
1	Pad	--	56	--	--
2	Pad	--	-10	--	--
3	Pad	--	-4	--	--
4	Pad	--	-12	--	--
5	Pad	--	-56	--	--
6	Pad	--	66	--	--
7	Pad	--	-56	--	--
8	Pad	--	-74	--	--
9	Pad	--	99	--	--
10	Pad	--	-35	--	--
11	Pad	--	37	--	--
12	Pad	--	72	--	--
13	Pad	--	17	--	--
14	Pad	--	60	--	--
15	Pad	--	2	--	--
16	Pad	--	-21	--	--
D-1122 (3)					
1	Pad	--	17	--	--

TABLE 2 (Continued)

PHASE 1 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a, b]	Surface[c]	Total Activity[d] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
D-1122 (3) (Continued)					
2	Pad	--	52	--	--
3	Pad	--	31	--	--
4	Pad	--	2	--	--
5	Pad	--	6	--	--
6	Pad	--	41	--	--
7	Pad	--	2	--	--
8	Pad	--	-2	--	--
9	Pad	--	21	--	--
10	Pad	--	-10	--	--
11	Pad	--	-31	--	--
12	Pad	--	60	--	--
13	Pad	--	21	--	--
14	Pad	--	6	--	--
15	Pad	--	-10	--	--
D-1124 (3)					
1	Pad	--	-6	--	--
2	Pad	--	66	--	--
3	Pad	--	23	--	--
4	Pad	--	95	--	--
5	Pad	--	29	--	--
6	Pad	--	25	--	--
7	Pad	--	140	--	--
8	Pad	--	95	--	--
9	Pad	--	100	--	--
10	Pad	--	-50	--	--
11	Pad	--	-35	--	--
12	Pad	--	81	--	--
13	Pad	--	31	--	--
14	Pad	--	72	--	--
15	Pad	--	62	--	--
D-1125 (3)					
1	Pad	--	45	--	--
2	Pad	--	-50	--	--
3	Pad	--	-89	--	--

TABLE 2 (Continued)

PHASE 1 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a, b]	Surface[c]	Total Activity[d] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
D-1125 (3) (Continued)					
4	Pad	--	-160	--	--
5	Pad	--	-200	--	--
6	Pad	--	-240	--	--
7	Pad	--	370	--	--
8	Pad	--	-48	--	--
9	Pad	--	56	--	--
10	Pad	--	-77	--	--
11	Pad	--	-45	--	--
12	Pad	--	33	--	--
13	Pad	--	-27	--	--
14	Pad	--	19	--	--
15	Pad	--	95	--	--
E-1111 (3)					
1/32A	F	--	120	1	2
2/33A	F	--	140	0	2
3/34A	F	--	91	1	1
4/35A	F	--	-6	0	1
5/36A	F	--	35	0	-2
6/37A	F	--	43	1	-1
7/38A	F	--	-17	3	20
8/39A	F	--	-14	1	-1
9/40A	F	--	19	0	2
10/41A	F	--	130	0	1
11/42A	F	--	120	0	1
12/43A	F	--	120	1	2
13/44A	F	--	140	0	5
14/45A	F	--	150	0	-1
15/46A	F	--	200	0	3
16/47A	LW	--	72	0	1
17/48A	LW	--	-12	3	1
18/49A	LW	--	-130	0	1
E-1112 (3)					
1	Pad	--	29	--	--
2	Pad	--	-48	--	--

TABLE 2 (Continued)

PHASE 1 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a, b]	Surface[c]	Total Activity[d] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
E-1112 (3) (Continued)					
3	Pad	--	-2	--	--
4	Pad	--	-15	--	--
5	Pad	--	19	--	--
6	Pad	--	4	--	--
7	Pad	--	50	--	--
8	Pad	--	-21	--	--
9	Pad	--	85	--	--
10	Pad	--	72	--	--
11	Pad	--	14	--	--
12	Pad	--	29	--	--
13	Pad	--	74	--	--
14	Pad	--	0	--	--
15	Pad	--	33	--	--
16	Pad	--	250	--	--
E-1116 (3)					
1	Pad	--	48	--	--
2	Pad	--	25	--	--
3	Pad	--	-2	--	--
4	Pad	--	14	--	--
5	Pad	--	85	--	--
6	Pad	--	-35	--	--
7	Pad	--	130	--	--
8	Pad	--	56	--	--
9	Pad	--	99	--	--
10	Pad	--	200	--	--
11	Pad	--	200	--	--
12	Pad	--	27	--	--
13	Pad	--	-14	--	--
14	Pad	--	21	--	--
15	Pad	--	140	--	--
F-731 (1)					
1/50A	F	--	160	0	24
2/51A	F	--	150	0	4
3/52A	F	--	310	1	-1

TABLE 2 (Continued)

PHASE 1 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a, b]	Surface[c]	Total Activity[d] (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
		Alpha	Beta	Alpha	Beta
F-731 (1) (Continued)					
4/53A	F	--	160	3	-2
5/54A	F	--	320	3	22
6/55A	F	--	120	0	2
7/56A	F	--	240	0	1
8/57A	F	--	300	0	9
9/58A	F	--	-25	0	6
10/59A	F	--	160	0	11
11/60A	F	--	110	0	1
12/61A	F	--	100	0	2
13/62A	F	--	95	0	3
14/63A	F	--	120	0	20
15/64A	F	--	1,200	1	6
16/65A	F	--	1,400	0	-1
17/66A	F	--	1,400	3	3
18/67A	F	--	1,300	0	6
19/68A	US	--	-58	0	6
20/69A	US	--	-99	1	-2
21/70A	US	--	-97	0	2
22/71A	LW	--	-130	0	4
23/72A	LW	--	-200	1	6
24/73A	LW	--	-60	0	5
25/74A	LW	--	72	3	9
F-733 (3)					
1	Pad	--	290	--	--
2	Pad	--	120	--	--
3	Pad	--	150	--	--
4	Pad	--	-25	--	--
5	Pad	--	170	--	--
6	Pad	--	130	--	--
7	Pad	--	120	--	--
8	Pad	--	160	--	--
9	Pad	--	4	--	--
10	Pad	--	85	--	--
11	Pad	--	-33	--	--

TABLE 2 (Continued)

PHASE 1 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a, b]	Surface[c]	Total Activity[d] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
F-733 (3) (Continued)					
13	Pad	--	-37	--	--
14	Pad	--	35	--	--
15	Pad	--	130	--	--
F-737 (1)					
1	Pad	--	140	--	--
2	Pad	--	-64	--	--
3	Pad	--	410	--	--
4	Pad	--	0	--	--
5	Pad	--	95	--	--
6	Pad	--	630	--	--
7	Pad	--	81	--	--
8	Pad	--	350	--	--
9	Pad	--	64	--	--
10	Pad	--	150	--	--
11	Pad	--	100	--	--
12	Pad	--	95	--	--
13	Pad	--	72	--	--
14	Pad	--	74	--	--
15	Pad	--	99	--	--
17	Pad	--	690	--	--
G-721 (2)					
1	Pad	--	-8	--	--
2	Pad	--	-2	--	--
3	Pad	--	110	--	--
4	Pad	--	72	--	--
5	Pad	--	52	--	--
6	Pad	--	150	--	--
7	Pad	--	72	--	--
8	Pad	--	170	--	--
9	Pad	--	140	--	--
10	Pad	--	160	--	--
11	Pad	--	120	--	--

TABLE 2 (Continued)

PHASE 1 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a, b]	Surface[c]	Total Activity[d] (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
		Alpha	Beta	Alpha	Beta
G-721 (2) (Continued)					
12	Pad	--	130	--	--
13	Pad	--	99	--	--
14	Pad	--	17	--	--
15	Pad	--	95	--	--
16	Pad	--	89	--	--
17	Pad	--	66	--	--
18	Pad	--	140	--	--
19	Pad	--	190	--	--
20	Pad	--	220	--	--
G-723 (3)					
1	Pad	--	68	--	--
2	Pad	--	-2	--	--
3	Pad	--	-54	--	--
4	Pad	--	31	--	--
5	Pad	--	-140	--	--
6	Pad	--	4	--	--
7	Pad	--	-8	--	--
8	Pad	--	8	--	--
9	Pad	--	-31	--	--
10	Pad	--	14	--	--
11	Pad	--	-41	--	--
12	Pad	--	6	--	--
13	Pad	--	25	--	--
14	Pad	--	160	--	--
15	Pad	--	75	--	--
16	Pad	--	420	--	--
G-725 (3)					
1	Pad	--	-33	--	--
2	Pad	--	-29	--	--
3	Pad	--	33	--	--
4	Pad	--	6	--	--
5	Pad	--	14	--	--
6	Pad	--	-19	--	--
7	Pad	--	8	--	--

TABLE 2 (Continued)

PHASE 1 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a, b]	Surface[c]	Total Activity[d] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
G-725 (3) (Continued)					
8	Pad	--	-19	--	--
9	Pad	--	25	--	--
10	Pad	--	-6	--	--
11	Pad	--	21	--	--
12	Pad	--	-14	--	--
13	Pad	--	0	--	--
14	Pad	--	81	--	--
15	Pad	--	-29	--	--
Bldg. 821 (3)					
1/75A	F	--	150	5	4
2/76A	F	--	95	0	5
3/77A	F	--	110	1	6
4/78A	F	--	-46	1	3
5/79A	F	--	68	0	1
6/80A	F	--	-31	0	11
7/81A	F	--	95	0	5
8/82A	F	--	110	0	1
9/83A	F	--	10	1	-1
10/84A	F	--	-8	0	3
11/85A	F	--	-58	1	1
12/86A	F	--	-31	0	3
13/87A	F	--	52	0	3
14/88A	F	--	8	1	7
15/89A	F	--	95	0	-2
Bldg. 825 (3)					
1/91A	F	--	140	0	7
2/92A	F	--	200	0	5
3/93A	F	--	200	0	5
4/94A	F	--	79	1	2
5/95A	F	--	25	1	14
6/96A	F	--	39	1	-4
7/97A	F	--	29	1	-1
8/98A	F	--	110	1	8
9/99A	F	--	83	1	1

TABLE 2 (Continued)

PHASE 1 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a, b]	Surface[c]	Total Activity[d] (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
		Alpha	Beta	Alpha	Beta
Bldg. 825 (3) (Continued)					
10/100A	F	--	-39	0	3
11/8B	F	--	52	1	4
12/9B	F	--	29	0	-3
13/10B	F	--	62	0	-2
14/11B	F	--	100	5	-1
Bldg. 1021 (3)					
1	F	--	-33	--	--
2	F	--	64	--	--
3	F	--	-140	--	--
4	F	--	-15	--	--
5	F	--	-140	--	--
6	F	--	-120	--	--
7	F	--	-2	--	--
9	F	--	2	--	--
12	F	--	39	--	--
15	F	--	270	--	--
16	LW	--	-56	--	--
Bldg. 1022 (2)					
1/1A	F	--	87	1	-1
2/2A	F	--	41	0	-2
3/3A	F	--	2	0	4
4/4A	F	--	110	0	3
5/5A	F	--	15	1	-5
6/6A	F	--	41	0	-4
7/7A	F	--	-39	3	-1
8/8A	F	--	50	1	3
9/9A	F	--	35	1	-3
10/10A	F	--	37	3	2
11/11A	F	--	77	0	-3
12/12A	F	--	-19	0	-2
13/13A	F	--	19	0	-1
14/14A	F	--	33	0	-2
15/15A	F	--	31	0	3
16/16A	F	--	68	1	8

TABLE 2 (Continued)

PHASE 1 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a, b]	Surface[c]	Total Activity[d] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
Bldg. 1022 (2) (Continued)					
17/17A	F	--	31	1	-3
18/18A	F	--	46	1	-3
19/19A	F	--	27	1	-1
20/20A	F	--	29	0	1
21/21A	F	--	120	1	-1
22/22A	F	--	140	0	5
23/23A	F	--	160	0	1
24/24A	F	--	46	1	4
25/25A	F	--	130	0	-1
26/26A	F	--	140	0	6
27/27A	F	--	180	0	10
28/28A	F	--	62	0	-2
29/29A	LW	--	120	3	2
30/30A	LW	--	20	5	4
32/1B	US	--	-85	0	5
33/2B	US	--	-210	0	-1
34/3B	US	--	-58	1	5
35/4B	US	--	-87	0	3
36/5B	US	--	190	0	-2
37/6B	US	--	-100	0	-3
38/7B	US	--	660	3	-1

[a]Refer to Figures 3 through 52 .
[b]Where two numbers are indicated, the first value is the measurement location identifier and the second number is the smear sample designation.
[c]F=floor, LW=lower wall, US=upper surface.
[d]Data represent net surface activity levels that have been corrected for background contributions.
[e]-- = Measurement or sampling not performed.

TABLE 3

PHASE 2 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a]	Surface	Total Activity[b] (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
		Alpha	Beta	Alpha	Beta
D-1121 (3)					
1A	Pad	--[c]	-17	0	2
2A	Pad	--	-72	0	2
3A	Pad	--	-74	0	-3
4A	Pad	--	32	1	2
5A	Pad	--	-34	0	2
6A	Pad	--	-11	0	3
7A	Pad	--	74	1	8
8A	Pad	--	8	0	4
9A	Pad	--	120	0	-1
10A	Pad	--	28	1	-3
11A	Wall Debris	--	-66	3	-2
12A	Wall Debris	--	6	1	-2
13A	Wall Debris	--	19	0	15
14A	Wall Debris	--	170	0	2
15A	Wall Debris	--	8	0	9
D-1123 (3)					
1	Pad	--	0	1	1
2	Pad	--	130	0	-1
3	Pad	--	210	0	1
4	Pad	--	150	1	7
5	Pad	--	68	0	-3
6	Pad	--	200	1	-2
7	Pad	--	140	0	4
8	Pad	--	85	0	-2
9	Pad	--	70	3	-2
10	Pad	--	25	0	1
11	Wall Debris	--	130	0	3
12	Wall Debris	--	150	7	1
13	Wall Debris	--	98	5	10
14	Wall Debris	--	-180	1	7
15	Wall Debris	--	-800	1	9
E-1113 (3)					
16	Pad	--	83	1	3
17	Pad	--	-30	0	8
18	Pad	--	30	1	-4

TABLE 3 (Continued)

PHASE 2 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a]	Surface	Total Activity[b] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
E-1113 (3) (Continued)					
19	Pad	--	-11	1	-3
20	Pad	--	-43	0	3
21	Pad	--	-70	1	2
22	Pad	--	-130	0	11
23	Pad	--	-34	0	1
24	Pad	--	-38	3	6
25	Pad	--	2	0	-2
26	Wall Debris	--	85	1	7
27	Wall Debris	--	45	3	-3
28	Wall Debris	--	190	0	6
29	Wall Debris	--	-49	1	4
30	Wall Debris	--	45	0	8
E-1114 (3)					
16A	Pad	--	38	0	8
17A	Pad	--	0	0	1
18A	Pad	--	87	1	-2
19A	Pad	--	79	0	-3
20A	Pad	--	-4	0	6
21A	Pad	--	110	1	-1
22A	Pad	--	34	1	16
23A	Pad	--	89	1	2
24A	Pad	--	49	1	3
25A	Pad	--	38	0	1
26A	Wall Debris	--	53	0	7
27A	Wall Debris	--	-250	0	4
28A	Wall Debris	--	34	1	1
29A	Wall Debris	--	-51	1	3
30A	Wall Debris	--	-140	0	2
E-1115 (3)					
31A	Pad	--	-43	0	2
32A	Pad	--	-26	0	2
33A	Pad	--	25	0	-1
34A	Pad	--	38	1	4
35A	Pad	--	-38	1	6

TABLE 3 (Continued)

PHASE 2 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a]	Surface	Total Activity[b] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
E-1115 (3) (Continued)					
36A	Pad	--	-28	1	-3
37A	Pad	--	43	9	7
38A	Pad	--	11	0	1
39A	Pad	--	34	3	5
40A	Pad	--	28	0	-3
41A	Wall Debris	--	-120	3	-1
42A	Wall Debris	--	74	0	-2
43A	Wall Debris	--	-130	0	7
44A	Wall Debris	--	17	7	20
45A	Wall Debris	--	-170	0	6
F-732 (3)					
61C	Pad	--	-64	0	2
62C	Pad	--	-23	0	1
63C	Pad	--	9	0	10
64C	Pad	--	4	0	4
65C	Pad	--	36	0	-2
66C	Pad	--	34	0	1
67C	Pad	--	76	1	-3
68C	Pad	--	47	0	1
69C	Pad	--	13	1	1
70C	Pad	--	47	1	-2
71C	Wall Debris	--	-240	0	4
72C	Wall Debris	--	-15	0	1
73C	Wall Debris	--	72	1	16
74C	Wall Debris	--	170	0	9
75C	Wall Debris	--	140	0	6
F-734 (2)					
31B	Pad	--	26	0	2
32B	Pad	--	38	0	-1
33B	Pad	--	9	0	-3
34B	Pad	--	17	0	-3
35B	Pad	--	25	1	2
36B	Pad	--	13	1	2
37B	Pad	--	0	3	1

TABLE 3 (Continued)

PHASE 2 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a]	Surface	Total Activity[b] (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
		Alpha	Beta	Alpha	Beta
F-734 (2) (Continued)					
38B	Pad	--	8	0	5
39B	Pad	--	110	0	7
40B	Pad	--	68	0	2
41B	Pad	--	62	0	2
42B	Pad	--	40	0	2
43B	Pad	--	34	0	9
44B	Pad	--	-13	1	17
45B	Pad	--	91	0	7
46B	Pad	--	25	1	2
47B	Pad	--	81	3	8
48B	Pad	--	28	0	-2
49B	Pad	--	43	3	10
50B	Pad	--	91	0	4
51B	Wall Debris	--	-140	0	14
52B	Wall Debris	--	140	0	1
53B	Wall Debris	--	-57	1	4
54B	Wall Debris	--	-23	3	15
55B	Wall Debris	--	11	0	8
F-735 (2)					
76C	Pad	--	-85	1	7
77C	Pad	--	-91	0	8
78C	Pad	--	-100	0	15
79C	Pad	--	-120	1	3
80C	Pad	--	-53	5	2
81C	Pad	--	-79	0	5
82C	Pad	--	-100	0	-1
83C	Pad	--	-110	1	-1
84C	Pad	--	-93	1	-1
85C	Pad	--	-94	0	3
86C	Wall Debris	--	43	0	-1
87C	Wall Debris	--	-77	0	-1
88C	Wall Debris	--	25	1	5
89C	Wall Debris	--	0	0	-1
90C	Wall Debris	--	-53	0	-4

TABLE 3 (Continued)

PHASE 2 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a]	Surface	Total Activity[b] (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
		Alpha	Beta	Alpha	Beta
F-736 (2)					
31	Pad	--	-4	0	-2
32	Pad	--	45	0	-3
33	Pad	--	55	1	3
34	Pad	--	49	0	1
35	Pad	--	-23	0	1
36	Pad	--	47	1	-2
37	Pad	--	42	5	7
38	Pad	--	74	0	4
39	Pad	--	70	1	5
40	Pad	--	-21	5	-1
41	Pad	--	85	3	3
42	Pad	--	62	0	2
43	Pad	--	34	0	4
44	Pad	--	25	1	8
45	Pad	--	40	0	6
46	Pad	--	47	1	-3
47	Pad	--	62	3	12
48	Pad	--	-62	0	-3
49	Pad	--	-40	1	5
50	Pad	--	25	1	4
51	Wall Debris	--	57	0	12
52	Wall Debris	--	120	0	2
53	Wall Debris	--	34	1	7
54	Wall Debris	--	-150	3	18
55	Wall Debris	--	130	0	3
G-722 (3)					
86B	Pad	--	-13	1	5
87B	Pad	--	21	0	5
88B	Pad	--	-8	1	2
89B	Pad	--	36	0	8
90B	Pad	--	-40	0	1
91B	Pad	--	23	0	-1
92B	Pad	--	-49	1	8
93B	Pad	--	11	3	-1
94B	Pad	--	-51	0	10

TABLE 3 (Continued)

PHASE 2 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a]	Surface	Total Activity[b] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
G-722 (3) (Continued)					
95B	Pad	--	-15	0	14
96B	Wall Debris	--	42	0	3
97B	Wall Debris	--	89	0	2
98B	Wall Debris	--	96	0	-3
99B	Wall Debris	--	510	3	-2
100B	Wall Debris	--	190	1	4
G-724 (3)					
71B	Pad	--	120	1	7
72B	Pad	--	81	0	3
73B	Pad	--	180	0	17
74B	Pad	--	110	3	4
75B	Pad	--	170	0	1
76B	Pad	--	19	0	12
77B	Pad	--	59	0	2
78B	Pad	--	130	0	8
79B	Pad	--	130	0	7
80B	Pad	--	60	0	1
81B	Wall Debris	--	-190	0	-1
82B	Wall Debris	--	81	0	-1
83B	Wall Debris	--	140	0	3
84B	Wall Debris	--	-38	0	2
85B	Wall Debris	--	230	0	-1
G-726 (3)					
56B	Pad	--	140	1	1
57B	Pad	--	8	0	7
58B	Pad	--	53	0	5
59B	Pad	--	-2	0	8
60B	Pad	--	70	0	6
61B	Pad	--	-100	0	1
62B	Pad	--	21	1	3
63B	Pad	--	-89	0	25
64B	Pad	--	-72	1	1
65B	Pad	--	43	0	4
66B	Wall Debris	--	-150	0	-4

TABLE 3 (Continued)

PHASE 2 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a]	Surface	Total Activity[b] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
G-726 (3) (Continued)					
67B	Wall Debris	--	15	0	3
68B	Wall Debris	--	-43	0	-3
69B	Wall Debris	--	100	0	-2
70B	Wall Debris	--	110	0	-1
H-711 (2)					
61A	Floor	--	-32	3	3
62A	Floor	--	-76	1	3
63A	Floor	--	-23	1	15
64A	Floor	--	-79	5	5
65A	Floor	--	-89	3	-4
66A	Floor	--	-47	1	3
67A	Floor	--	-93	0	-1
68A	Floor	--	-51	0	4
69A	Floor	--	-36	1	7
70A	Floor	--	-91	1	3
71A	Wall Debris	--	-250	0	3
72A	Wall Debris	--	-250	1	1
73A	Wall Debris	--	11	0	7
74A	Wall Debris	--	36	1	3
75A	Wall Debris	--	-260	3	-1
H-712 (2)					
76A	Floor Debris	--	53	0	12
77A	Floor Debris	--	25	1	1
78A	Floor Debris	--	45	0	18
79A	Floor Debris	--	-30	0	-3
80A	Floor Debris	--	42	0	3
81A	Floor Debris	--	4	1	2
82A	Floor Debris	--	-13	0	4
83A	Floor Debris	--	-38	0	-2
84A	Floor Debris	--	15	3	5
85A	Floor Debris	--	62	0	3
86A	Wall Debris	--	-350	0	5
87A	Wall Debris	--	66	1	6
88A	Wall Debris	--	-93	0	2

TABLE 3 (Continued)

PHASE 2 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a]	Surface	Total Activity[b] (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
		Alpha	Beta	Alpha	Beta
H-712 (2) (Continued)					
89A	Wall Debris	--	-230	3	2
90A	Wall Debris	--	68	0	4
H-713 (2)					
91A	Floor Debris	--	13	1	2
92A	Floor Debris	--	30	0	-2
93A	Floor Debris	--	2	0	1
94A	Floor Debris	--	-40	1	3
95A	Floor Debris	--	8	0	14
96A	Floor Debris	--	-25	1	-1
97A	Floor Debris	--	-23	0	2
98A	Floor Debris	--	-42	3	5
99A	Floor Debris	--	-60	0	-2
100A	Floor Debris	--	-13	0	7
1B	Wall Debris	--	9	1	3
2B	Wall Debris	--	93	1	-1
3B	Wall Debris	--	110	0	2
4B	Wall Debris	--	-150	0	7
5B	Wall Debris	--	-220	1	2
H-714 (2)					
6B	Wall Debris	--	-120	0	2
7B	Wall Debris	--	-87	0	1
8B	Wall Debris	--	93	0	-2
9B	Wall Debris	--	72	0	1
10B	Wall Debris	--	-140	1	-1
11B	Floor Debris	--	-21	5	3
12B	Floor Debris	--	53	3	-3
13B	Floor Debris	--	38	0	10
14B	Floor Debris	--	-13	0	-2
15B	Floor Debris	--	-79	1	1
16B	Floor Debris	--	-15	0	-1
17B	Floor Debris	--	36	1	-3
18B	Floor Debris	--	13	0	-4
19B	Floor Debris	--	-19	0	-1
20B	Floor Debris	--	-6	0	5

TABLE 3(Continued)

PHASE 2 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a]	Surface	Total Activity[b] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
H-715 (2)					
21B	Floor Debris	--	-120	0	3
22B	Wall Debris	--	-9	0	5
23B	Wall Debris	--	-45	0	-3
24B	Wall Debris	--	-210	1	12
25B	Wall Debris	--	-120	0	-2
26B	Wall Debris	--	-220	0	3
27B	Wall Debris	--	57	1	5
28B	Wall Debris	--	-440	1	2
29B	Wall Debris	--	-140	3	9
30B	Wall Debris	--	4	3	11
I-531 (3)					
46C	Floor Debris	--	-23	0	1
47C	Floor Debris	--	-42	1	17
48C	Floor Debris	--	-13	0	-1
49C	Floor Debris	--	15	0	11
50C	Floor Debris	--	-21	0	11
51C	Floor Debris	--	-77	1	8
52C	Floor Debris	--	-11	1	2
53C	Floor Debris	--	-34	0	1
54C	Floor Debris	--	-55	3	14
55C	Floor Debris	--	4	0	-3
56C	Wall Debris	--	91	1	-1
57C	Wall Debris	--	17	1	9
58C	Wall Debris	--	-59	1	4
59C	Wall Debris	--	-81	1	8
60C	Wall Debris	--	-30	0	4
I-631 (3)					
1C	Wall Debris	--	220	0	3
2C	Wall Debris	--	-220	0	-3
3C	Wall Debris	--	23	1	1
4C	Wall Debris	--	210	1	-1
5C	Wall Debris	--	-4	1	-2
6C	Floor Debris	--	8	1	-5

TABLE 3 (Continued)

PHASE 2 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a]	Surface	Total Activity[b] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
I-631 (3) (Continued)					
7C	Floor Debris	--	-26	3	-1
8C	Floor Debris	--	-38	3	-1
9C	Floor Debris	--	-140	0	1
10C	Floor Debris	--	-130	0	5
11C	Floor Debris	--	-6	7	2
12C	Floor Debris	--	-77	1	1
13C	Floor Debris	--	-38	3	10
14C	Floor Debris	--	-47	1	-1
15C	Floor Debris	--	-8	0	6
I-632 (3)					
86	Floor Debris	--	-6	0	1
87	Floor Debris	--	-110	0	2
88	Floor Debris	--	-51	1	4
89	Floor Debris	--	-4	0	-1
90	Floor Debris	--	-38	1	4
91	Floor Debris	--	160	1	-1
92	Floor Debris	--	-170	0	5
93	Floor Debris	--	-49	0	3
94	Floor Debris	--	-260	0	2
95	Floor Debris	--	60	1	7
96	Wall Debris	--	-270	0	-4
97	Wall Debris	--	93	0	5
98	Wall Debris	--	81	0	3
99	Wall Debris	--	60	0	1
100	Wall Debris	--	-32	0	6
I-633 (3)					
71	Wall Debris	--	-74	1	-1
72	Wall Debris	--	-130	1	1
73	Wall Debris	--	130	0	15
74	Wall Debris	--	-51	0	6
75	Wall Debris	--	120	3	1
76	Floor Debris	--	-26	0	16
77	Floor Debris	--	-47	0	7
78	Floor Debris	--	-40	1	22
79	Floor Debris	--	-13	0	1

TABLE 3 (Continued)

PHASE 2 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a]	Surface	Total Activity[b] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
I-633 (3) (Continued)					
80	Floor Debris	--	-96	0	3
81	Floor Debris	--	-38	0	-2
82	Floor Debris	--	32	0	-2
83	Floor Debris	--	-45	0	2
84	Floor Debris	--	-34	0	-2
85	Floor Debris	--	11	0	1
I-634 (3)					
56	Floor Debris	--	-62	0	1
57	Floor Debris	--	-120	0	5
58	Floor Debris	--	-15	3	2
59	Floor Debris	--	2	0	7
60	Floor Debris	--	-68	0	2
61	Floor Debris	--	-13	1	-2
62	Floor Debris	--	-200	1	4
63	Floor Debris	--	-36	3	20
64	Floor Debris	--	-36	0	6
65	Floor Debris	--	-94	0	5
66	Wall Debris	--	4	0	-1
67	Wall Debris	--	-2	3	6
68	Wall Debris	--	-64	3	-2
69	Wall Debris	--	-120	0	-1
70	Wall Debris	--	-11	3	4
I-636 (3)					
31C	Wall Debris	--	-53	0	4
32C	Wall Debris	--	-43	1	-1
33C	Wall Debris	--	-28	0	3
34C	Wall Debris	--	-62	1	-3
35C	Wall Debris	--	-87	0	2
36C	Floor Debris	--	-53	1	-2
37C	Floor Debris	--	2	1	8
38C	Floor Debris	--	-2	0	1
39C	Floor Debris	--	-40	0	5
40C	Floor Debris	--	9	1	-1
41C	Floor Debris	--	-23	0	-1
42C	Floor Debris	--	-32	0	1

TABLE 3 (Continued)

PHASE 2 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a]	Surface	Total Activity[b] (dpm/100 cm²)		Removable Activity (dpm/100 cm²)	
		Alpha	Beta	Alpha	Beta
I-636 (3) (Continued)					
43C	Floor Debris	--	-81	3	4
44C	Floor Debris	--	89	3	19
45C	Floor Debris	--	-4	5	5
I-641 (3)					
16C	Wall Debris	--	11	1	4
17C	Wall Debris	--	-77	0	-5
18C	Wall Debris	--	17	1	1
19C	Wall Debris	--	-34	0	2
20C	Wall Debris	--	9	0	-3
21C	Floor Debris	--	-23	1	3
22C	Floor Debris	--	-51	0	3
23C	Floor Debris	--	-62	1	5
24C	Floor Debris	--	-96	1	6
25C	Floor Debris	--	-15	0	-1
26C	Floor Debris	--	-62	0	8
27C	Floor Debris	--	-57	1	2
28C	Floor Debris	--	-85	3	-1
29C	Floor Debris	--	-76	0	11
30C	Floor Debris	--	-160	0	1
I-634 Igloo (3)					
46A	Floor	--	-66	3	-3
47A	Floor	--	-100	1	10
48A	Floor	--	-120	0	-3
49A	Floor	--	-120	0	6
50A	Floor	--	-110	0	1
51A	Floor	--	-110	0	10
52A	Floor	--	-150	1	6
53A	Floor	--	-72	1	5
54A	Floor	--	-180	1	16
55A	Floor	--	-110	1	4
56A	Wall	--	-160	5	5
57A	Wall	--	-120	0	12

TABLE 3 (Continued)

PHASE 2 SURFACE ACTIVITY LEVELS
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

Building (Class) Measurement Location[a]	Surface	Total Activity[b] (dpm/100 cm^2)		Removable Activity (dpm/100 cm^2)	
		Alpha	Beta	Alpha	Beta
I-634 Igloo (3) (Continued)					
58A	Wall	--	-320	1	1
59A	Wall	--	-270	0	4
60A	Wall	--	-290	3	6

[a]Refer to Figures 3 through 52.
[b]Data represent net surface activity levels that have been corrected for background contributions.
[c]-- = Measurement or sampling not performed.

TABLE 4

RADIONUCLIDE CONCENTRATIONS IN MISCELLANEOUS SAMPLES
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

ESSAP Sample ID/Sample Type	Radionuclide Concentration (pCi/g)		
	K-40	Th-232	U-238
M0006/Terra Cotta Block	16.3 ± 1.1[a]	2.72 ± 0.30	2.53 ± 0.89
M0007/Terra Cotta Block	28.6 ± 1.7	1.64 ± 0.21	2.04 ± 0.87
	Pb-210 (pCi/sample)[b]		
M0008/Metal From G-722	710 ± 100		

[a]Uncertainties represent the 95% confidence interval based on total propagated uncertainties.
[b]Qualitative data.

TABLE 5
RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

ESSAP Sample ID/ Location (Depth)/Class[a]	Radionuclide Concentration (pCi/g)[b]			
	GPS Coordinate	Th-232	Th-228	U-238
1/C-Line (0 to 15 cm)/2	39°11.326N, 076°35.007W	1.81 ± 0.20[c]	1.77 ± 0.11	1.27 ± 0.52
2/C-Line (0 to 15 cm)/2	39°11.567N, 076°34.889W	1.72 ± 0.25	1.85 ± 0.13	2.38 ± 0.78
3/C-Line (residue top of pad)/2	--[d]	0.67 ± 0.19	0.54 ± 0.08	0.98 ± 0.74
4/D-Line (0 to 15 cm)/2	39°11.312N, 076°35.093W	1.70 ± 0.23	1.70 ± 0.12	1.49 ± 0.61
5/1021 Area (0 to 15 cm)/2	39°11.536N, 076°34.670W	0.77 ± 0.12	0.81 ± 0.07	1.07 ± 0.57
6/Disposal Area (150 cm)/1	--	1.71 ± 0.24	1.31 ± 0.12	1.39 ± 0.86
7/Disposal Area (60 cm)/1	--	0.45 ± 0.09	0.46 ± 0.04	0.30 ± 0.31
8/Disposal Area (135 cm)/1	--	0.42 ± 0.10	0.42 ± 0.04	0.37 ± 0.30
9/Disposal Area (90 cm)/1	--	0.40 ± 0.09	0.34 ± 0.04	0.32 ± 0.32
10/Disposal Area (135 cm)/1	--	1.57 ± 0.21	1.36 ± 0.10	0.43 ± 0.58
11/Disposal Area (90 cm)/1	--	0.54 ± 0.09	0.54 ± 0.04	0.53 ± 0.36
12/Disposal Area (120 cm)/1	--	7.05 ± 0.63	6.53 ± 0.38	1.38 ± 0.94
13/Disposal Area (90 cm)/1	--	0.67 ± 0.11	0.55 ± 0.05	0.50 ± 0.39

TABLE 5 (Continued)
RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

ESSAP Sample ID/ Location (Depth)/Class[a]	Radionuclide Concentration (pCi/g)[b]			
	GPS Coordinate	Th-232	Th-228	U-238
14/Disposal Area (135 cm)/1	--	0.76 ± 0.15	0.61 ± 0.06	0.80 ± 0.66
15/Disposal Area (105 cm)/1	--	3.96 ± 0.37	3.48 ± 0.20	1.00 ± 0.60
16/F-Line (0 to 15 cm)/2	39°11.322N, 076°35.244W	1.21 ± 0.17	1.21 ± 0.09	0.58 ± 0.51
17/F-Line (0 to 15 cm)/2	39°11.357N, 076°35.228W	3.27 ± 0.35	3.06 ± 0.20	0.75 ± 0.80
18/F-Line (0 to 15 cm)/1	39°11.520N, 076°35.150W	46.7 ± 3.8	38.5 ± 2.2	2.90 ± 2.30
19/Railroad North (0 to 15 cm)/2	39°12.181N, 076°35.102W	2.33 ± 0.26	2.08 ± 0.14	2.18 ± 0.67
20/Railroad Southeast (0 to 15 cm)/2	39°11.644N, 076°34.879W	4.12 ± 0.40	3.97 ± 0.24	2.14 ± 0.94
21/Railroad South (0 to 15 cm)/2	39°11.436N, 076°34.887W	3.85 ± 0.42	3.80 ± 0.24	3.62 ± 0.80
22/Railroad South (0 to 15 cm)/2	39°11.337N, 076°34.942W	1.90 ± 0.26	1.82 ± 0.13	1.80 ± 0.81
23/Railroad South (0 to 15 cm)/2	39°11.321N, 076°34.951W	2.83 ± 0.29	2.64 ± 0.16	1.76 ± 0.57
24/F-Line (0 to 15 cm)/2	39°11.364N, 076°35.216W	453 ± 35	429 ± 24	29 ± 11
25/G-Line (0 to 15 cm)/2	39°11.545N, 076°35.261W	7.55 ± 0.67	7.55 ± 0.44	2.0 ± 1.0
26/Yard Office Rd-North/ (0 to 15 cm)/2	39°12.103N, 076°35.275W	4.49 ± 0.46	4.40 ± 0.28	1.07 ± 0.88
27/H-Line (0 to 15 cm)/3	39°12.023N, 076°35.218W	2.25 ± 0.25	2.13 ± 0.14	1.58 ± 0.71
28/H-Line (0 to 15 cm)/3	39°12.022N, 076°35.222W	3.38 ± 0.33	3.09 ± 0.19	2.09 ± 0.70

TABLE 5 (Continued)
RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES
CURTIS BAY DEPOT
CURTIS BAY, MARYLAND

ESSAP Sample ID/ Location (Depth)/Class[a]	Radionuclide Concentration (pCi/g)[b]			
	GPS Coordinate	Th-232	Th-228	U-238
29/F-Line (0 to 15 cm)	39°11.378N, 076°35.207W	6.31 ± 0.58	6.30 ± 0.37	0.85 ± 0.80
30/F-Line (0 to 15 cm)/2	39°11.385N, 076°35.211W	13.1 ± 1.2	13.26 ± 0.79	1.5 ± 2.0
31/Bldg. 821 (0 to 15 cm)/2	39°11.947N, 076°34.799W	19.6 ± 1.6	18.0 ± 1.0	0.2 ± 1.3
32/Railroad North (0 to 15 cm)/2	39°12.072N, 076°35.116W	1.87 ± 0.24	1.69 ± 0.12	1.28 ± 0.77
33/J-Line (0 to 15 cm)/3	39°12.154N, 076°35.156W	2.06 ± 0.24	1.96 ± 0.12	1.98 ± 0.46
34/K-Line (0 to 15 cm)/3	39°11.950N, 076°35.335W	3.30 ± 0.35	3.10 ± 0.19	2.13 ± 0.72
35/K-Line (0 to 15 cm)/3	39°12.002N, 076°35.306W	1.68 ± 0.22	1.78 ± 0.12	1.67 ± 0.55
36/F-Line (0 to 15 cm)/2	39°11.610N, 076°35.100W	1.78 ± 0.22	1.78 ± 0.12	0.02 ± 0.92
37/B-Line (0 to 15 cm)/2	39°11.815N, 076°34.876W	17.6 ± 1.5	16.80 ± 0.95	1.2 ± 1.3
38/East Ave. – East (0 to 15 cm)/3	39°11.918N, 076°35.423W	2.16 ± 0.23	1.95 ± 0.13	1.93 ± 0.60
39/Patrol Road-Southwest (0 to 15 cm)/3	39°11.450N, 076°35.318W	1.49 ± 0.19	1.34 ± 0.09	1.58 ± 0.53
40/F-Line (0 to 15 cm)/2	39°11.831N, 076°34.987W	0.72 ± 0.13	0.65 ± 0.06	1.12 ± 0.65
41/H-Line (0 to 15 cm)/2	39°11.880N, 076°35.142W	1.92 ± 0.26	1.84 ± 0.13	2.04 ± 0.83
42/D-Line (0 to 15 cm)/3	39°11.640N, 076°34.946W	0.77 ± 0.18	0.81 ± 0.07	1.14 ± 0.54

[a]Refer to Figure 53.
[b]Radionuclide concentrations are gross values that include background contributions.
[c]Uncertainties represent the 95% confidence interval based on total propagated uncertainties.
[d]--=Coordinate not collected.

REFERENCES

Oak Ridge Institute for Science and Education (ORISE). Survey Procedures Manual for the Environmental Survey and Site Assessment Program. Oak Ridge, TN; September 2, 2004.

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Oak Ridge Institute for Science and Education. Laboratory Procedures Manual for the Environmental Survey and Site Assessment Program. Oak Ridge, TN; June 20, 2005e.

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APPENDIX A

MAJOR INSTRUMENTATION

APPENDIX A

MAJOR INSTRUMENTATION

The display of a specific product is not to be construed as an endorsement of the product or its manufacturer by the author or his employer.

SCANNING INSTRUMENT/DETECTOR COMBINATIONS

Alpha plus Beta

Ludlum Floor Monitor Model 239-1
combined with
Ludlum Ratemeter-Scaler Model 2221
coupled to
Ludlum Gas Proportional Detector Model 43-37, Physical Area: 550 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

Beta

Ludlum Ratemeter-Scaler Model 2221
coupled to
Ludlum Gas Proportional Detector Model 43-68, Physical Area: 126 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

Gamma

Ludlum Pulse Ratemeter Model 12
(Ludlum Measurements, Inc., Sweetwater, TX)
coupled to
Victoreen NaI Scintillation Detector Model 489-55, Crystal: 3.2 cm x 3.8 cm
(Victoreen, Cleveland, OH)

DIRECT MEASUREMENT INSTRUMENT/DETECTOR COMBINATIONS

Alpha and Beta

Ludlum Ratemeter-Scaler Model 2221
coupled to
Ludlum Gas Proportional Detector Model 43-68, Physical Area: 126 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

LABORATORY ANALYTICAL INSTRUMENTATION

Low Background Gas Proportional Counter
Model LB-5100-W
(Tennelec/Canberra, Meriden, CT)

LABORATORY ANALYTICAL INSTRUMENTATION (CONTNUED)

High Purity Extended Range Intrinsic Detector
CANBERRA/Tennelec Model No: ERVDS30-25195
(Canberra, Meriden, CT)
Used in conjunction with:
Lead Shield Model G-11
(Nuclear Lead, Oak Ridge, TN) and
Multichannel Analyzer
DEC ALPHA Workstation
(Canberra, Meriden, CT)

High Purity Extended Range Intrinsic Detector
Model No. GMX-45200-5
(AMETEK/ORTEC, Oak Ridge, TN)
used in conjunction with:
Lead Shield Model SPG-16-K8
(Nuclear Data)
Multichannel Analyzer
DEC ALPHA Workstation
(Canberra, Meriden, CT)

High-Purity Germanium Detector
Model GMX-30-P4, 30% Eff.
(AMETEK/ORTEC, Oak Ridge, TN)
Used in conjunction with:
Lead Shield Model G-16
(Gamma Products, Palos Hills, IL) and
Multichannel Analyzer
DEC ALPHA Workstation
(Canberra, Meriden, CT)

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

PROJECT HEALTH AND SAFETY

The proposed survey and sampling procedures were evaluated to ensure that any hazards inherent to the procedures themselves were addressed in current job hazard analyses. Additionally, upon arrival on site, a walk-down of the site was performed to identify hazards present and a pre-job integrated safety management checklist was completed and discussed with field personnel and daily safety briefings were held. All survey and laboratory activities were conducted in accordance with ORISE health and safety and radiation protection procedures.

CALIBRATION AND QUALITY ASSURANCE

Calibration of all field and laboratory instrumentation was based on standards/sources, traceable to NIST.

Analytical and field survey activities were conducted in accordance with procedures from the following documents of the Oak Ridge Institute for Science and Education:

- Survey Procedures Manual (September 2004)
- Laboratory Procedures Manual (June 2005)
- Quality Assurance Manual (July 2005)

The procedures contained in these manuals were developed to meet the requirements of Department of Energy (DOE) Order 414.1C and the U.S. Nuclear Regulatory Commission *Quality Assurance Manual for the Office of Nuclear Material Safety and Safeguards* and contain measures to assess processes during their performance.

Quality control procedures include:

- Daily instrument background and check-source measurements to confirm that equipment operation is within acceptable statistical fluctuations.
- Participation in MAPEP, NRIP, and ITP Laboratory Quality Assurance Programs.
- Training and certification of all individuals performing procedures.

- Periodic internal and external audits.

Detectors used for assessing surface activity were calibrated in accordance with ISO-7503[1] recommendations. Total alpha and beta efficiencies (ε_{total}) were determined for each instrument/detector combination and consisted of the product of the 2π instrument efficiency (ε_i) and surface efficiency (ε_s): $\varepsilon_{total} = \varepsilon_i \times \varepsilon_s$. Beta total efficiencies were determined based on a beta energy multi-point calibration, development of instrument efficiency to beta energy calibration curves, and the calculation of the weighted efficiency representing the Th-232 decay series. Included in the weighted efficiency was an empirically determined correction for disequilibrium in the decay series that results from Rn-220 loss. A 3.8 mg/cm^2 density thickness mylar window was used on the beta detectors to block detector response contributions from alpha radiation.

Th-230 was selected as the alpha calibration source. The 2π alpha instrument efficiency (ε_i) factors were 0.41 and 0.42 for the gas proportional detectors. C-14, Tc-99, Tl-204, and Sr/Y-90 were selected as the beta calibration sources to represent the energy distribution of the detectable beta-emitters in the Th-232 decay series. The 2π interpolated ε_i factors for the detectable beta-emitters ranged from 0.19 to 0.60 for the gas proportional detectors. ISO-7503 recommends an ε_s of 0.25 for alpha emitters and also beta emitters with a maximum energy of less than 0.4 MeV and an ε_s of 0.5 for maximum beta energies greater than 0.4 MeV. The thorium series total weighted alpha efficiency ranged from 0.53 to 0.58. The total weighted beta efficiency for the beta detectors ranged from 0.41 to 0.42.

SURVEY PROCEDURES

Surface Scans

Structural surface scans were performed by passing the detectors slowly over the surface; the distance between the detector and the surface was maintained at a minimum—nominally about 1 cm. Pad/building/debris pile surfaces were scanned using either a floor monitor or small area (126 cm^2) hand-held gas proportional detectors. A NaI scintillation detector was used to scan for elevated gamma radiation throughout the pads/buildings/debris piles and the exterior grounds.

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[1]International Standard. ISO 7503-1, Evaluation of Surface Contamination - Part 1: Beta-emitters (maximum beta energy greater than 0.15 MeV) and alpha-emitters. August 1, 1988.

Identification of elevated radiation levels was based on increases in the audible signal from the recording and/or indicating instrument.

Beta surface scan minimum detectable concentrations (MDCs) were estimated using the calculational approach described in NUREG-1507.[2] The scan MDC is a function of many variables, including the background level. Additional parameters selected for the calculation of scan MDCs included a two-second observation interval, a specified level of performance at the first scanning stage of 95% true positive rate and 25% false positive rate, which yields a *d'* value of 2.32 (NUREG-1507, Table 6.1), and a surveyor efficiency of 0.5. The scanning instrument total efficiency (ε_{total}) for the hand-held gas proportional detectors was approximately 0.40.

The construction material-specific background levels ranged from 260 to 700 cpm for the gas proportional detectors. To illustrate an example for a hand-held gas proportional detector using a concrete background of 340 cpm, the minimum detectable count rate (MDCR) and scan MDC can be calculated as follows:

b_i = (340 cpm)(2 s)(1 min/60 s) = 11.3 counts,
MDCR = (2.32)(11.3 counts)$^{1/2}$ [(60 s/min)/(2 s)] = 234 cpm,
$MDCR_{surveyor}$ = 234/(0.5)$^{1/2}$ = 331 cpm

The scan MDC is calculated using the weighted total efficiency of 0.40.

$$ScanMDC = \frac{MDCR_{surveyor}}{(\varepsilon_s)(\varepsilon_i)} dpm/100\,cm^2$$

For the given background, the estimated scan MDC was 830 dpm/100 cm^2 for the hand-held gas proportional detector.

The scan MDC for the NaI scintillation detector for Th-232 in soil was 2.8 pCi/g as provided in NUREG-1507.

[2]NUREG-1507. Minimum Detectable Concentrations With Typical Radiation Survey Instruments for Various Contaminants and Field Conditions. US Nuclear Regulatory Commission. Washington, DC; June 1998.

Surface Activity Measurements

Measurements of total alpha and beta surface activity levels were performed using hand-held gas proportional detectors coupled to portable ratemeter-scalers. Count rates (cpm), which were integrated over one minute with the detector held in a static position, were converted to activity levels (dpm/100 cm^2) by dividing the count rate by the total static efficiency ($\varepsilon_i \times \varepsilon_s$) and correcting for the physical area of the detector. Construction material-specific background corrections were made for each surface type encountered for determining net count rates.

Surface activity measurements were performed on concrete, brick, terra cotta block, metal, and wood. The static beta MDC ranged from 150 to 250 dpm/100 cm^2 for the gas proportional detector. The physical surface area assessed by the gas proportional detector used was 126 cm^2.

Removable Activity Measurements

Smear samples for removable gross alpha and gross beta contamination were obtained from most measurement locations. Removable activity samples were collected using numbered filter paper disks, 47 mm in diameter. Moderate pressure was applied to the smear and approximately 100 cm^2 of the surface was wiped. Smears were placed in labeled envelopes with the location and other pertinent information recorded.

Radiological Analysis

Gross Alpha/Beta

Smears were counted on a low-background gas proportional system for gross alpha and beta activity. The MDCs of the procedure were 9 dpm/100 cm^2 and 15 dpm/100 cm^2 for a 2-minute count time for gross alpha and gross beta, respectively.

Gamma Spectroscopy

Samples of soil and terra cotta block were dried, mixed, crushed, and/or homogenized as necessary, and a portion sealed in a 0.5-liter Marinelli beaker or other appropriate container. The quantity placed in the beaker was chosen to reproduce the calibrated counting geometry. The metal coupon cut from the G-722 debris pile was placed directly in an air filter geometry for semi-quantitative analysis. Net material weights were determined and the samples counted using intrinsic germanium detectors coupled to a pulse height analyzer system. Background and Compton stripping, peak search, peak identification, and concentration calculations were performed using the computer capabilities inherent in the analyzer system. All total absorption peaks (TAP) associated with the radionuclides of concern were reviewed for consistency of activity. TAPs used for determining the activities of radionuclides of concern and the typical associated MDCs for a one-hour count time were:

Radionuclide	TAP (MeV)	MDC (pCi/g)
Th-232	0.911 from Ac-228*	0.11
U-238	0.063 from Th-234*	0.70
Pb-210	0.047	70 (pCi/sample)

*Secular equilibrium assumed.

Spectra were also reviewed for other identifiable TAPs.

DETECTION LIMITS

Detection limits, referred to as minimum detectable concentration (MDC), were based on 3 plus 4.65 times the standard deviation of the background count $[3 + (4.65 (BKG)^{1/2})]$. Because of variations in background levels, measurement efficiencies, and contributions from other radionuclides in samples, the detection limits differ from sample to sample and instrument to instrument.