CONFIRMATORY SURVEY RESULTS FOR THE SENECA ARMY DEPOT ACTIVITY (SEDA) ROMULUS, NEW YORK

W. C. Adams

Prepared for the
Office of Federal and State Materials and
Environmental Management Programs
U.S. Nuclear Regulatory Commission

ORISE

Oak Ridge Institute for Science and Education

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ABBREVIATIONS AND ACRONYMS

b_i	number of background counts in the interval
d′	index of sensitivity
ε_i	instrument efficiency
ε_s	surface efficiency
ε_{total}	total efficiency
ANL	Argonne National Laboratory
BKG	background
BRAC	Base Realignment and Closure
CFR	Code of Federal Regulations
cm	centimeter
cpm	counts per minute
DCGL	derived concentration guideline level
DOA	U.S. Department of the Army
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
dpm/100 cm^2	disintegrations per minute per 100 square centimeters
DU	depleted uranium
FSS	final status survey
FSSP	final status survey plan
FSSR	final status survey report
ha	hectare
HSA	historical site assessment
ISM	integrated safety management
km	kilometers
LRP	license release plan
LTP	license termination plan
LTR	license termination report
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	minimum detectable concentration
MDCR	minimum detectable count rate
MeV	million electron volts
min	minute
mg/cm^2	milligrams per square centimeter
mrem/y	millirem per year
NaI	sodium iodide
NIST	National Institute of Standards and Technology
NRC	U.S. Nuclear Regulatory Commission
NYSDEC	New York State Department of Environmental Conservation
ORISE	Oak Ridge Institute for Science and Education
ROC	radionuclides-of-concern
s	second
SEDA	Seneca Army Depot Activity
SU	survey unit
TEDE	total effective dose equivalent

CONFIRMATORY SURVEY RESULTS FOR THE SENECA ARMY DEPOT ACTIVITY (SEDA) ROMULUS, NEW YORK

INTRODUCTION AND SITE HISTORY

The Seneca Army Depot Activity (SEDA) facility was constructed in 1941, and until 1995, the facility's primary mission was the receipt, storage, maintenance, and supply of military items, including munitions and equipment. A portion of the supplies contained radioactive materials, such as depleted uranium (DU) munitions. The Depot's mission changed in 1995 when the Department of Defense (DOD) recommended closure of SEDA under its Base Realignment and Closure (BRAC) process. SEDA is currently completing the process to close the base and transfer the property to local authorities. The site conducted operations under U.S. Nuclear Regulatory Commission (NRC) license SUC-1275 (Docket No. 04-08526) held by the U.S. Department of the Army (DOA).

The license-related activities occurred in Buildings 5, 306, 612, 2073, 2084, Warehouse 356 and in 121 ammunition storage bunkers (igloos). In addition to the buildings covered directly under the license, the entire site was evaluated by DOA to determine if the facility met radiological criteria for license termination specified in the Code of Regulations (10 CFR 20.1402) and applicable New York State criteria. This evaluation included a review of each facility previously released for unrestricted use and any facilities or areas currently undergoing decommissioning. Historical records of previously released areas were also evaluated to determine whether those areas met current release criteria. A review of these records indicated that periodic radiological surveys conducted by the Army, in accordance with the license, did not show any areas of concern (ANL 2003).

DOA contracted with Argonne National Laboratory (ANL) to prepare the license termination plan (LTP) and license release plan (LRP) and with Parsons, SEDA's closure contractor, to implement the final status survey plan (FSSP) and to prepare the final status survey report (FSSR). Section 5 of the LTP describes the FSSP which follows the guidance in the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM, NRC 2000). On the basis of the historical site assessments, areas under the license were divided into impacted and non-impacted areas as specified in MARSSIM.

These impacted areas were further divided into Class 1, 2 or 3 areas based on the potential for residual radioactive material contamination. The NRC's Headquarters and Region I Offices have requested that the Oak Ridge Institute for Science and Education (ORISE) perform confirmatory surveys of several buildings and ammunition bunkers at the SEDA facility in Romulus, New York.

SITE DESCRIPTION

SEDA is located about 64 kilometers [km (40 miles)] south of Lake Ontario, near Romulus, Seneca County, New York. Seneca County is located in the Finger Lakes Region in the center of the state (Figure 1). The facility consists of approximately 4,300 hectares [ha (10,587 acres)] and is located at 5786 State Route 96, Romulus, New York. The site lies east of Cayuga Lake and west of Seneca Lake. New York Highways 96 and 96A are to the east and west (Figure 2). The surrounding area is sparsely populated farmland (Parsons 2004). Several office, warehouse, utility and maintenance buildings and 121 ammunition bunkers (henceforth referred to as igloos) remain at the site.

OBJECTIVES

The objectives of the confirmatory survey were to provide independent contractor field data reviews and to generate independent radiological data for use by the NRC in evaluating the adequacy and accuracy of the licensee's procedures and final status survey (FSS) data. Additionally, this review provided assurance that the licensee adequately designed the FSS and fulfilled the commitments contained in the LTP.

DOCUMENT REVIEW

ORISE has reviewed Parsons' final radiological survey data as presented in the license termination report (LTR) for adequacy and appropriateness, taking into account commitments contained in the LTP that were approved by the NRC in 2003 (Parsons 2004 and ANL 2003). The release criteria for the site, along with the documentation on the derivation of the release criteria, are outlined in the LTP. ORISE reviewed and evaluated the radiological data, in accordance with the ORISE survey plan and other referenced documents, to ensure that FSS procedures and results adequately met site LTP commitments (Parsons 2004).

PROCEDURES

ORISE visited the SEDA and performed visual inspections and surface activity measurements. The confirmatory survey activities, performed on October 31 through November 1, 2006, were conducted in accordance with a site-specific survey plan and with the ORISE Survey Procedures and Quality Assurance Manuals (ORISE 2006a, 2006b and 2005). With concurrence from the NRC site representative, construction material backgrounds and smears were not necessary unless elevated residual surface activity was detected during the surface scans. These deviations from the survey plan were documented in the site logbook.

The following radiological survey procedures were used by ORISE to conduct confirmatory survey activities on various building surfaces that had been evaluated by Parsons. Specific survey units (SU) were selected based on ANL's classification of the SUs and/or selected based on elevated measurements noted in Parsons LTR. Approximately 25% of the available SUs within each of the buildings and 10 of the 121 igloos were selected for confirmatory survey activities.

SURVEY UNIT CLASSIFICATION

ANL divided the SEDA evaluated areas into impacted and non-impacted areas as specified in MARSSIM. Impacted areas were further divided into Class 1, 2 or 3 areas based on the potential and the extent of residual radioactive material contamination and on historical process knowledge (ANL 2003). Building 612 was the only building or area classified as Class 1. The basis of this classification relied on activities such as the demilitarization of DU munitions rather than on licensed activities that actually took place (ANL 2003). Buildings 5, 306, 2073 and 2084 were classified as Class 2 SUs since residual contamination was expected to be present. However, no confirmed contamination was identified by ANL (ANL 2003). Warehouse 356 and the igloos subject to confirmatory surveys were all classified as Class 3 SUs (ANL 2003).

REFERENCE SYSTEM

Direct measurement locations were referenced to prominent building features and recorded on building/igloo plot plans prepared by Parsons.

SURFACE SCANS

ORISE performed alpha plus beta and gamma radiation surface scans within each of the SUs selected for confirmatory surveys. Particular attention was given to cracks and joints where material may have accumulated. Scans were performed using gas proportional and sodium iodide (NaI) scintillation detectors coupled to ratemeters or ratemeter-scalers with audible indicators. The percentage of scan coverage for each building and igloo selected for confirmatory surveys are presented in Table 1 below:

TABLE 1

SURVEY UNIT SCAN PERCENTAGES

Survey Unit Scan Percentages				
Building/ Igloo	Rooms	Gamma Scan Percentage (%)	Alpha plus Beta Scan Percentage (%)	
		Floor	Floor	Lower Walls
5	6, 7, 8, 12, 13	75	25	25
306	3, 7, 10, 11	100	50	50
356	Section D[a]	25	25	25
612	E, G, J, N, P, U, AA	75	25	25
2073	1, 3	80	25	25
2084	2, 3, 6	80	25	25
A0508	--[b]	50	50	25
A0707	--	50	25	25
B0109	--	50	50	25
B0701	--	75	50	25
C0803	--	75	50	25
C0807	--	75	50	25
D0105	--	75	50	25
D0712	--	75	50	25
E0105	--	75	50	25
E0609	--	75	50	25

[a]A portion of Section D was marked off as the area to be surveyed. The area was approximately 25% of the Section D warehouse area. ORISE surveyed 25% of the designated area.
[b]Igloos consisted of only one room/area.

SURFACE ACTIVITY MEASUREMENTS

Construction material-specific background measurements were not deemed necessary for correcting gross activity measurements performed on structural and/or system surface SUs. Surface activity measurements for alpha plus beta activity were performed at judgmentally selected locations within the selected SUs to determine if residual activity levels met the gross surface derived concentration guideline levels (DCGLs). A minimum of five direct measurements were collected in each building and igloo where confirmatory surveys were performed (Figures 3 through 18). Direct measurements were collected using gas proportional detectors coupled to ratemeter-scalers. Smear samples to determine removable gross alpha and gross beta activity levels were not necessary based on surface scan findings.

DATA INTERPRETATION

Data were returned to ORISE's facilities in Oak Ridge, Tennessee for interpretation. Direct measurement data were converted to units of disintegrations per minute per 100 square centimeters (dpm/100 cm^2). The data generated was compared with the approved LTP criteria established for the SEDA facility (ANL 2003).

FINDINGS AND RESULTS

DOCUMENT REVIEW

ORISE reviewed ANL's LTP and Parsons' LTR (ANL 2003 and Parsons 2004). The procedures, methods, and data submitted by Parsons accurately documented the radiological status of the SEDA facility per the LTP commitments.

SURFACE SCANS

The ORISE independent radiological surveys did not detect any elevated radiation levels above the established DCGLs within any of the selected areas that received confirmatory surveys. All surface scan results for alpha plus beta activity were at background levels.

SURFACE ACTIVITY LEVELS

Direct measurement activity level results ranged from 820 to 3,010 dpm/100 cm^2 for total alpha plus beta activity (construction material backgrounds were not subtracted). Surface activity level ranges, presented in Table 2, for the areas surveyed by ORISE are as follows:

TABLE 2

RANGE OF SURFACE ACTIVITY MEASUREMENTS

Survey Unit	Range of Total Surface Alpha plus Beta Activity (dpm/100 cm^2)
Building 5	1,400 to 2,570
Building 306	1,280 to 2,900
Warehouse 356	225 to 443
Building 612	920 to 1,990
Building 2073	1,180 to 2,100
Building 2084	1,680 to 2,220
Igloo A0508	1,470 to 3,320
Igloo A0707	1,510 to 2,200
Igloo B0109	1,920 to 2,620
Igloo B0701	1,620 to 2,470
Igloo C0803	2,010 to 2,310
Igloo C0807	1,540 to 3,360
Igloo D0105	1,600 to 1,990
Igloo D0712	1,640 to 2,230
Igloo E0105	1,440 to 2,200
Igloo E0609	1,520 to 2,350

A complete listing of the confirmatory surface activity results is presented in Table 4.

COMPARISON OF RESULTS WITH GUIDELINES

The radionuclides-of-concern (ROC) are depleted and natural uranium, thorium, plutonium and tritium. As stated in the LTP, the total effective dose equivalent (TEDE) selected for the development of DCGLs at SEDA was the New York State Department of Environmental Conservation (NYSDEC) TAGM-4003 of 10 millirem per year (mrem/y). DCGLs are residual levels of radioactive material that correspond to allowable radiation dose standards (NRC 2000). As such, the FSSR/LTR was reviewed to evaluate whether or not the site's radiological status met the NRC and NYSDEC release criterion (Parsons 2004).

Two types of DCGLs were used in the license termination evaluation:

1. The $DCGL_W$ is defined as the concentration of residual radioactivity distinguishable from background that, if uniformly distributed throughout a survey unit, would result in a defined annual TEDE to an average member of the critical group.

2. The $DCGL_{EMC}$ (DCGL, elevated measurement comparison) is the concentration of residual radioactivity limited to a small, localized area that is equivalent to the TEDE.

For building structural surfaces, ANL used the building occupancy scenario since it was the most conservative of all the potential reasonable scenarios. The applicable surface activity guidelines from the LTP and LTR for the structural surfaces, as presented in Table 3, are as follows (ANL 2003 and Parsons 2004):

TABLE 3

DERIVED CONCENTRATION GUIDELINE LEVELS FROM SEDA LTP

Radionuclides	Surface $DCGL_W$ (dpm/100 cm^2)[a]	
	Gross Surface $DCGL_W$	Gross Surface $DCGL_{EMC}$
Depleted Uranium[b]	31,800	378,420
Tritium (H-3)[b]	2.07 E8	NA[c]
Th-232[d]	3,090	NA
Pu-239[e]	4,240	NA

[a]DCGL values taken from the LTP and LTR (ANL 2003 and Parsons 2004).
[b]DCGL values from LTR Table 2-1.
[c]NA = Not Applicable.
[d]Warehouse 356 was the only area where Th-232 was considered an ROC and the Th-232 $DCGL_w$ was used since it was more conservative.
[e]The DCGL value is from LTR Table 3-2. Pu-239 and H-3 are also listed as ROCs for Igloo A0508. The DCGL for Pu-239 is used because it is more conservative than the DCGL for H-3 and DU (Parsons 2004).

With the exception of Warehouse 356 and Igloo A0508, all direct measurement results, presented in Table 4, were less than the applicable gross surface $DCGL_W$ for DU. Warehouse Building 356 was identified as potentially having possessed uranium and thorium ores; therefore, direct measurements for Warehouse 356 were compared with the more conservative $DCGL_w$ for Th-232 and were less than the applicable gross $DCGL_w$ for Th-232. Amongst the igloos that were identified as having potentially been used to store special weapons containing H-3 and Pu-239 (Igloos A0201, A0316, A0317 and A0508), only Igloo A0508 was randomly selected for a confirmatory survey. Direct measurements for Igloo A0508 were compared with the more conservative $DCGL_w$ for Pu-239 and were determined to be less than the applicable $DCGL_W$. ORISE did not collect tritium smears from Igloo A0508.

SUMMARY

At the request of the Division of Decommissioning/Waste Management, U.S. Nuclear Regulatory Commission, the Oak Ridge Institute for Science and Education conducted confirmatory surveys of the Seneca Army Depot Activity (SEDA) facility during the period of October 31 through November 1, 2006. The survey activities consisted of visual inspections and radiological surveys that included surface scans and surface activity measurements.

The results of the confirmatory surveys indicated that gamma radiation levels and alpha and beta surface activity levels were comparable to background radiation levels within the buildings and igloos where confirmatory surveys were performed. All confirmatory surface activity level results were less than the respective derived concentration guideline levels (DCGLs) for the radionuclides-of-concern as specified in the License Termination Report [LTR (Parsons 2004)]. The ORISE results are also consistent with the radiological survey results in SEDA's LTR.

FIGURES

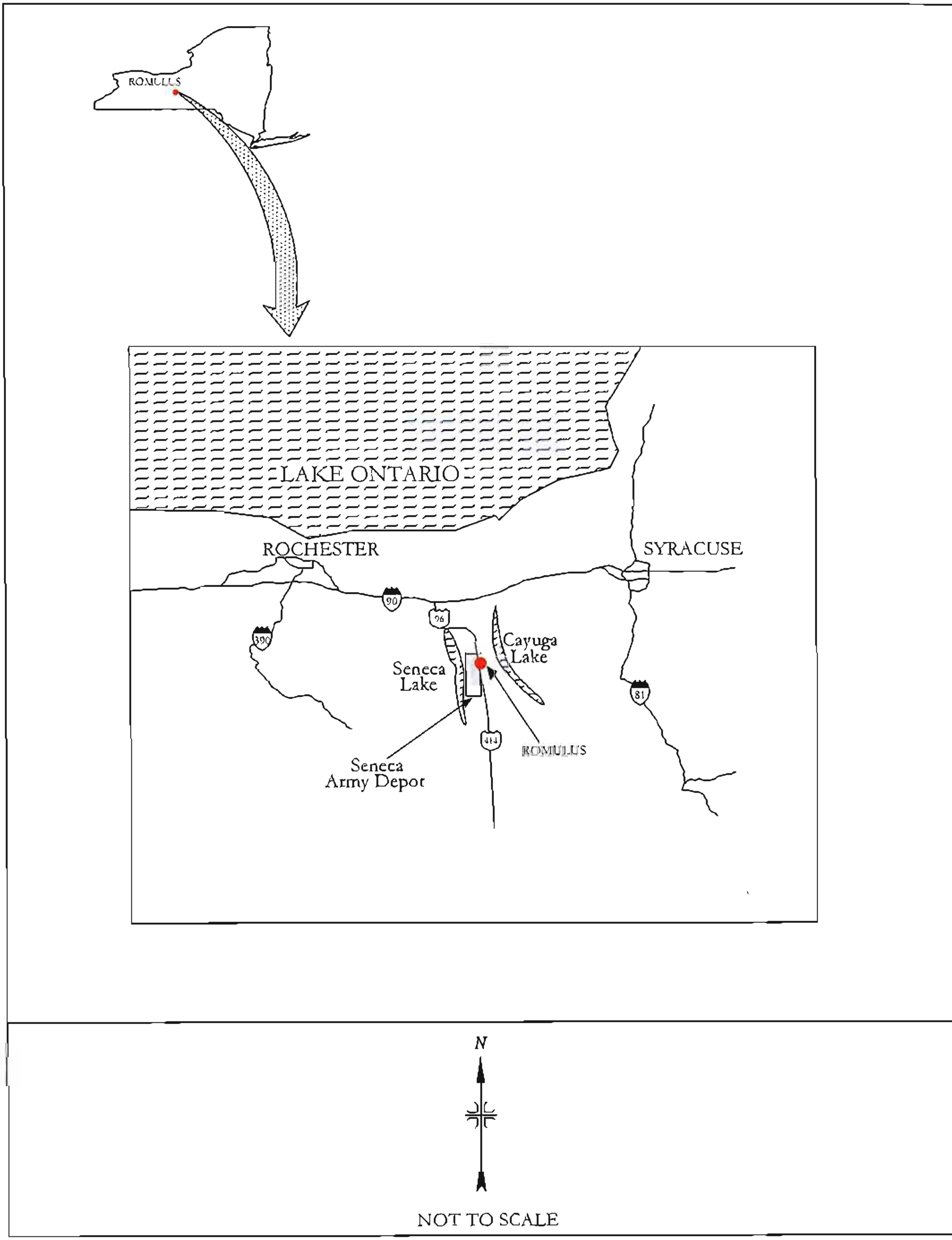

FIGURE 1: Location of the Seneca Army Depot Activity, Romulus, New York

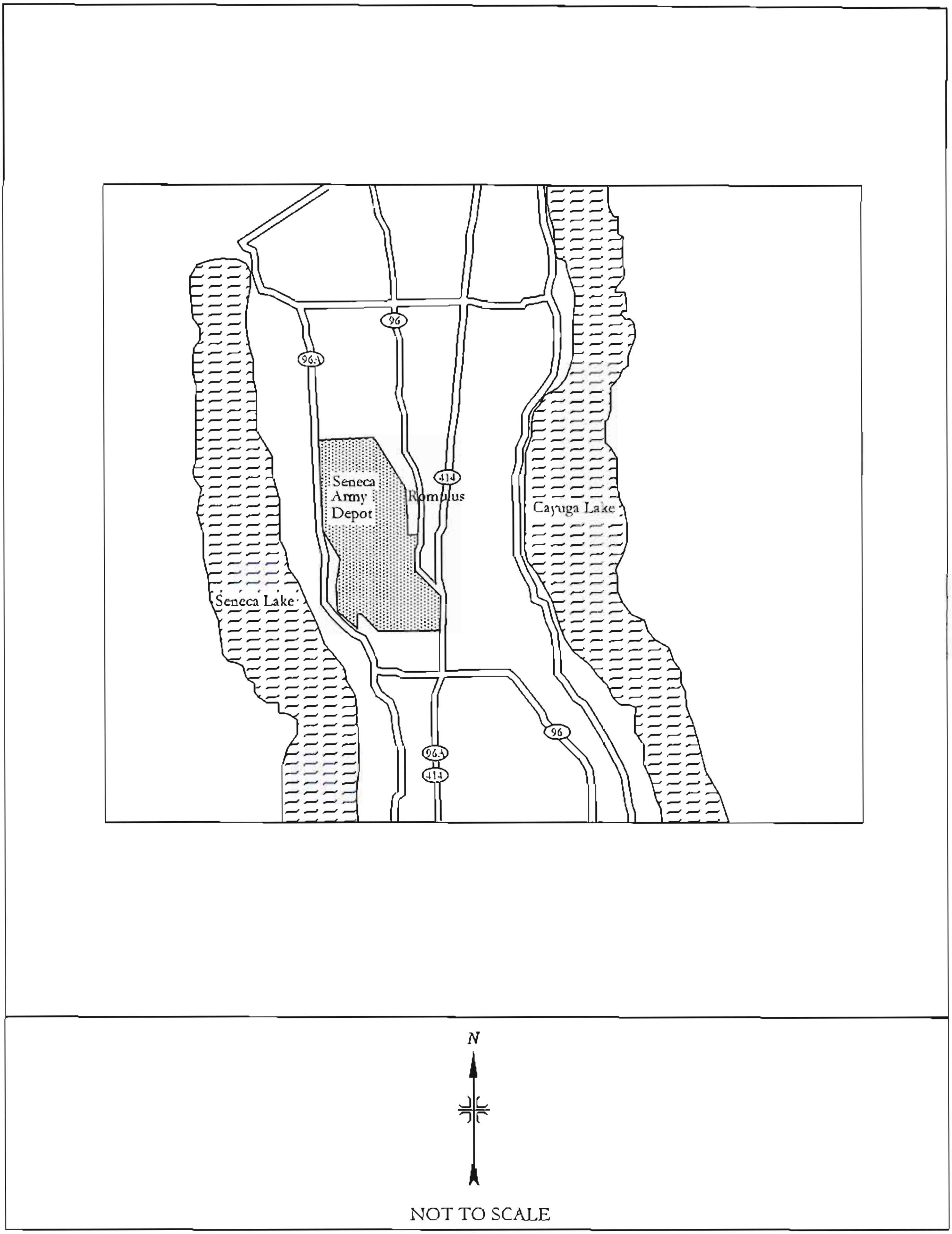

FIGURE 2: Seneca Army Depot Activity - Plot Plan

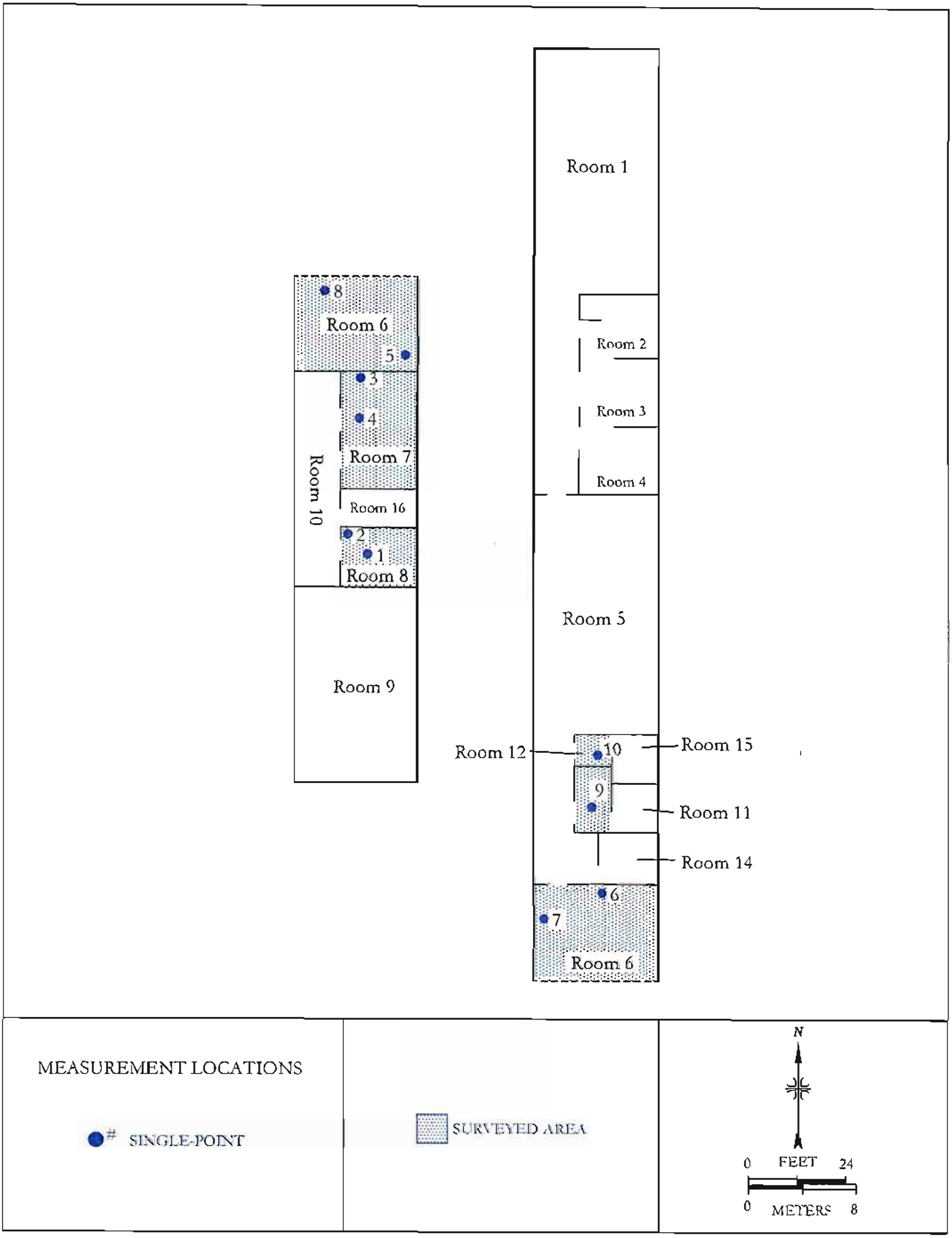

FIGURE 3: Building 5 - Direct Measurement Locations

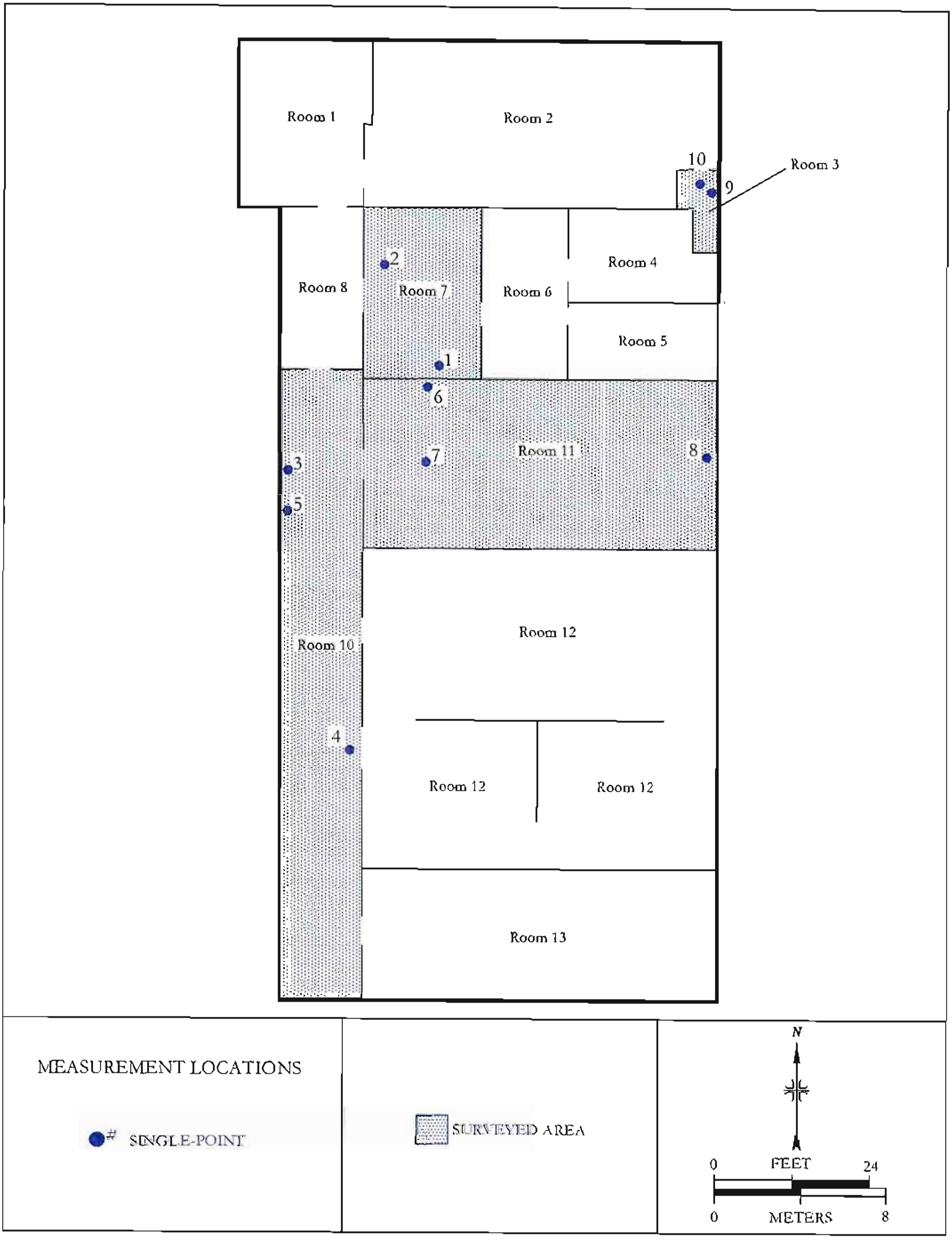

FIGURE 4: Building 306 - Direct Measurement Locations

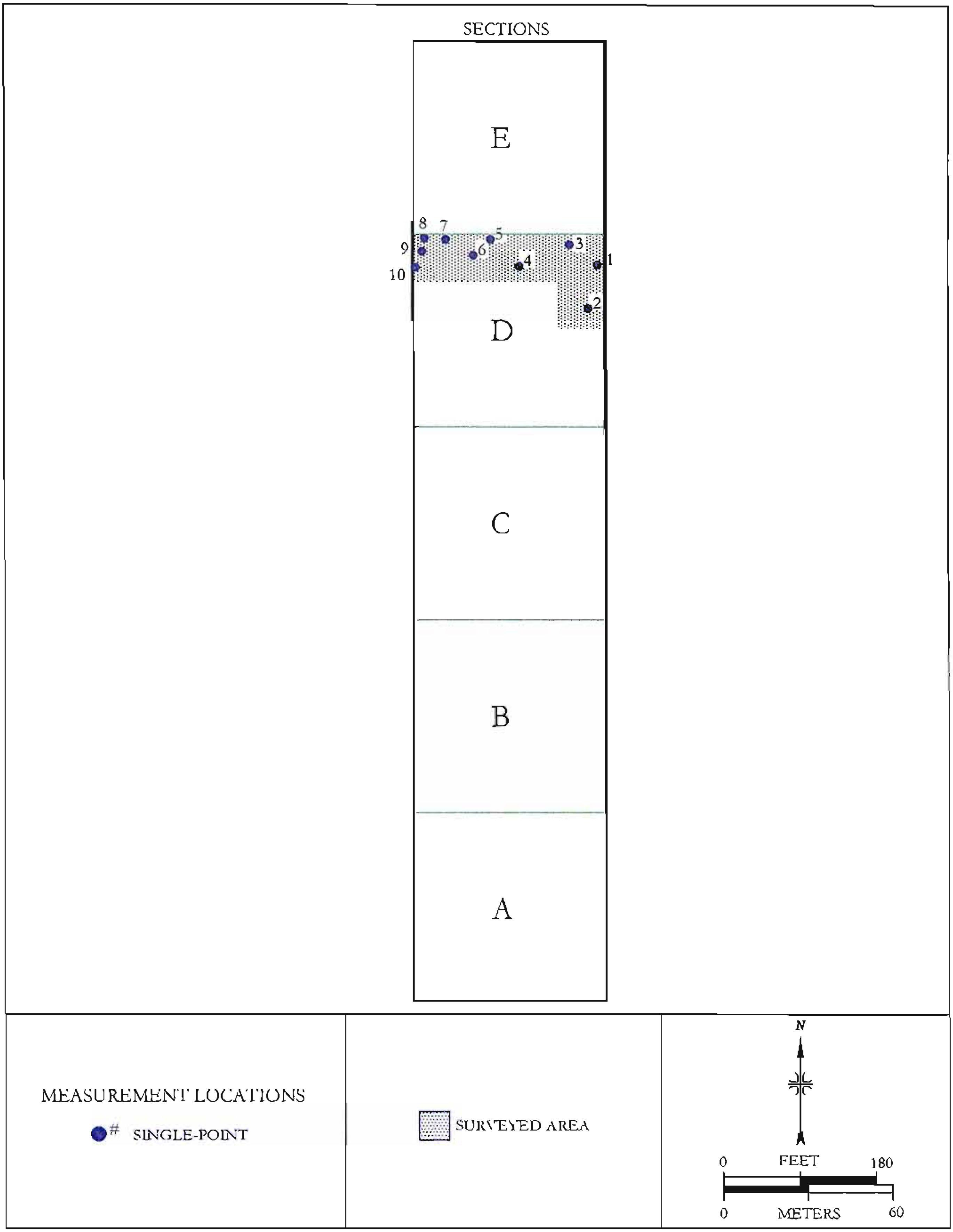

FIGURE 5: Building 356 - Direct Measurement Locations

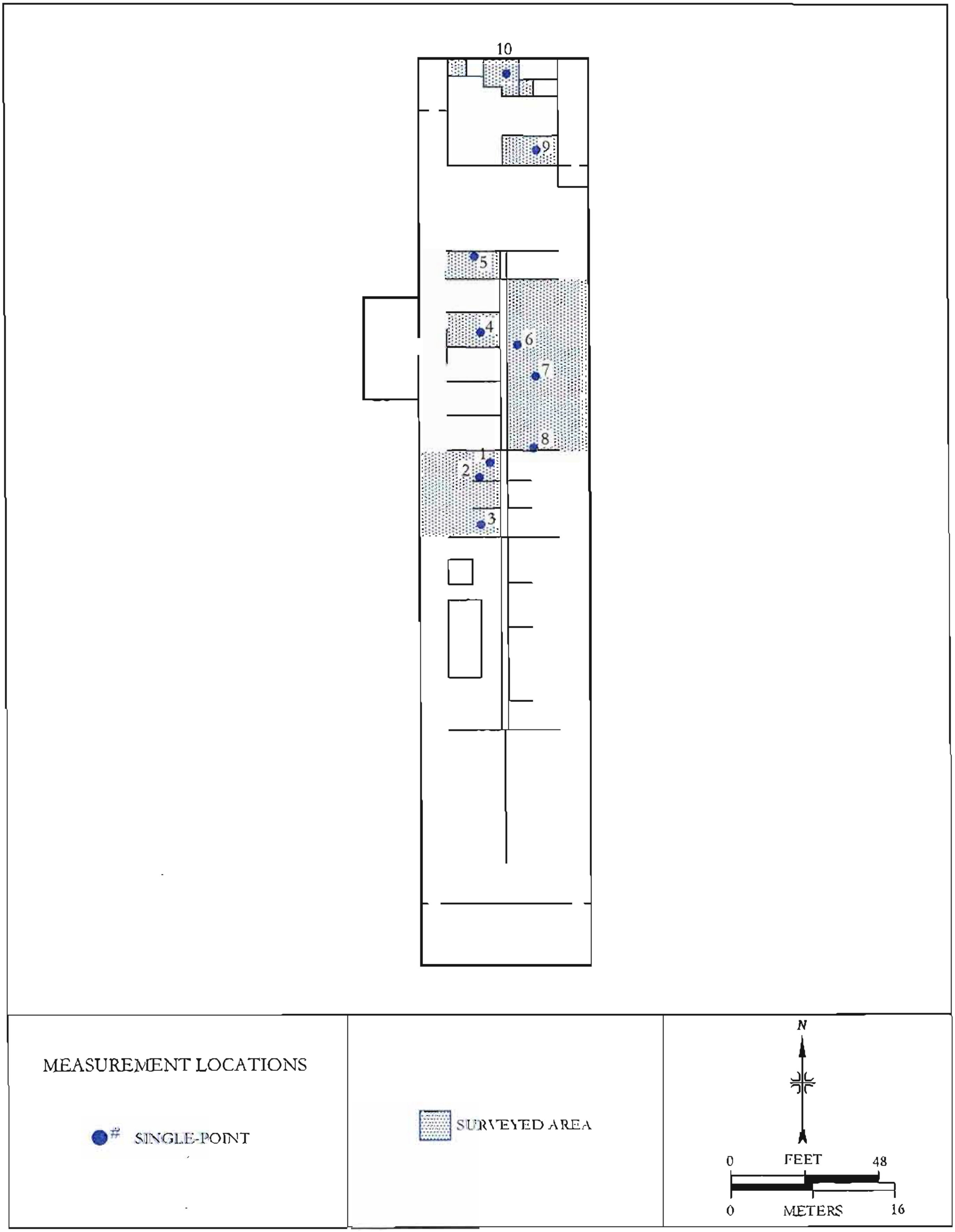

FIGURE 6: Building 612 - Direct Measurement Locations

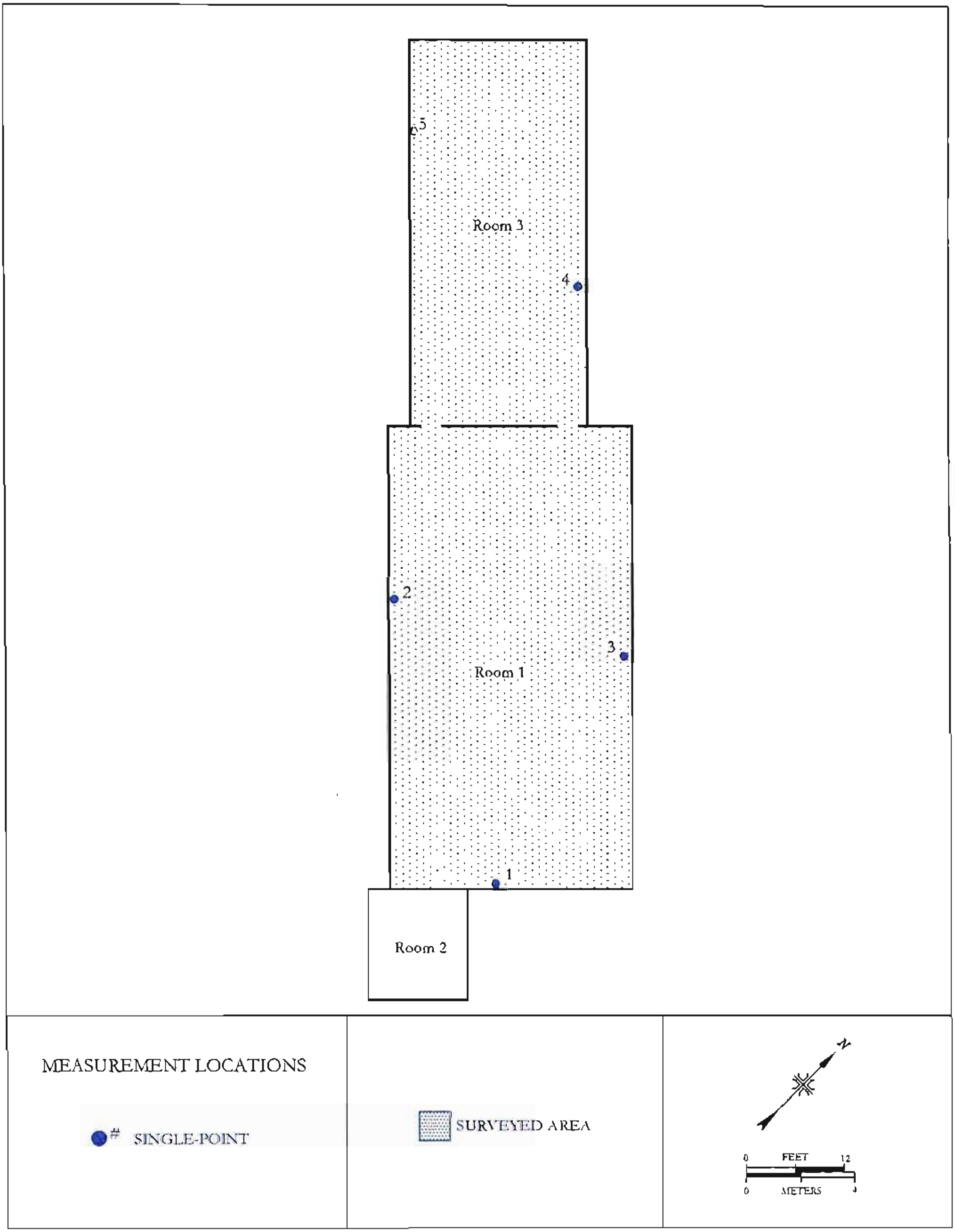

FIGURE 7: Building 2073 - Direct Measurement Locations

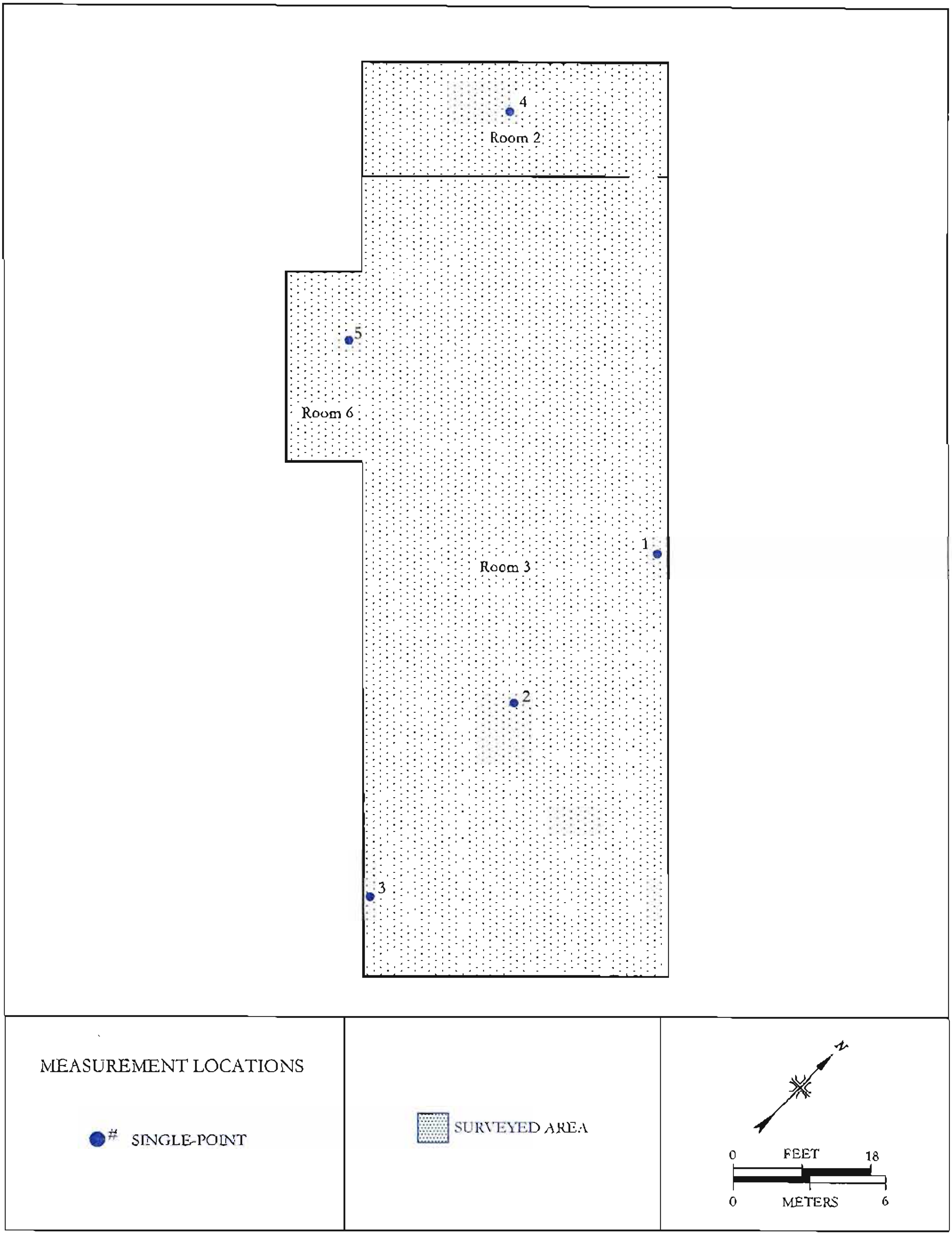

FIGURE 8: Building 2084 - Direct Measurement Locations

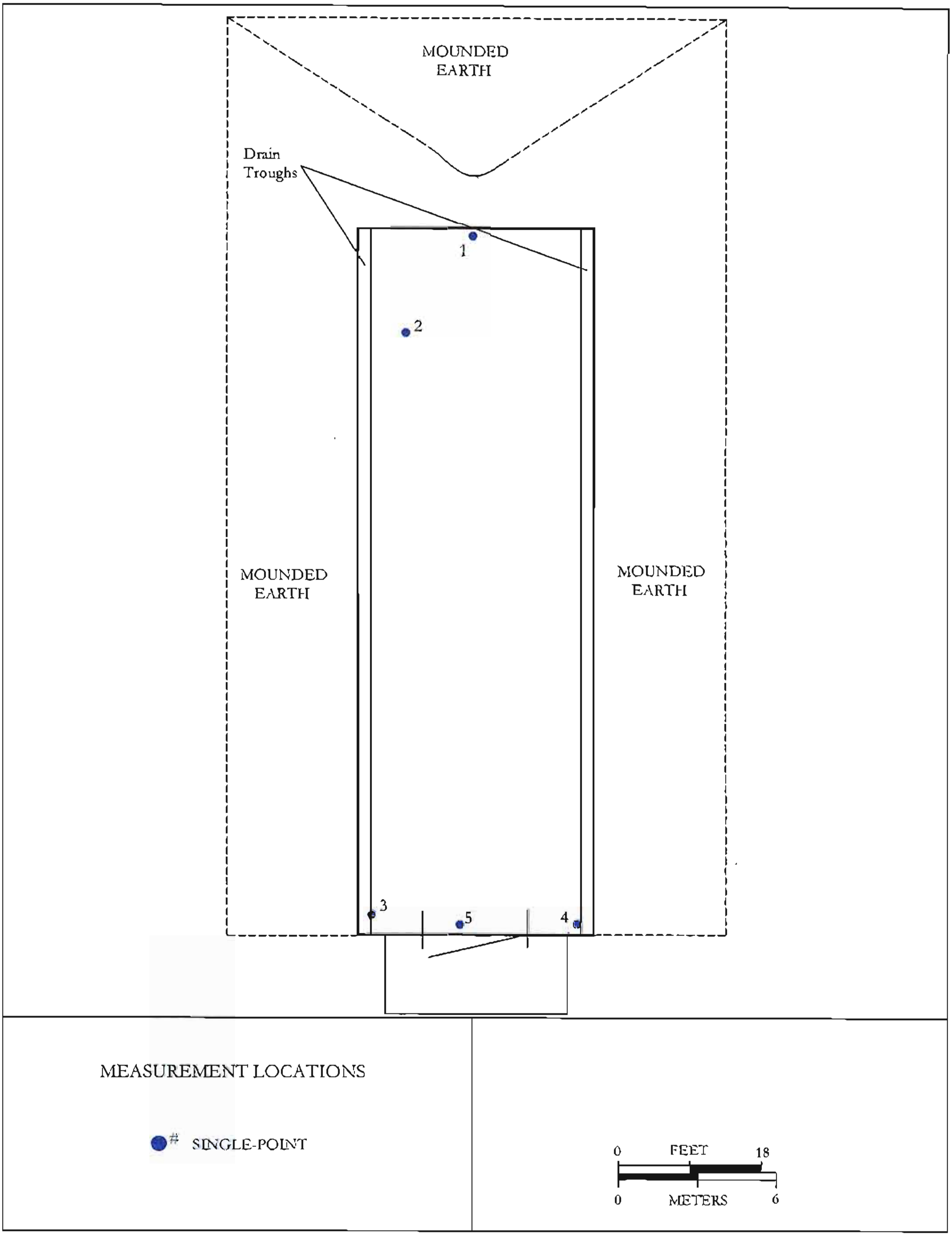

FIGURE 9: Igloo A0508 - Direct Measurement Locations

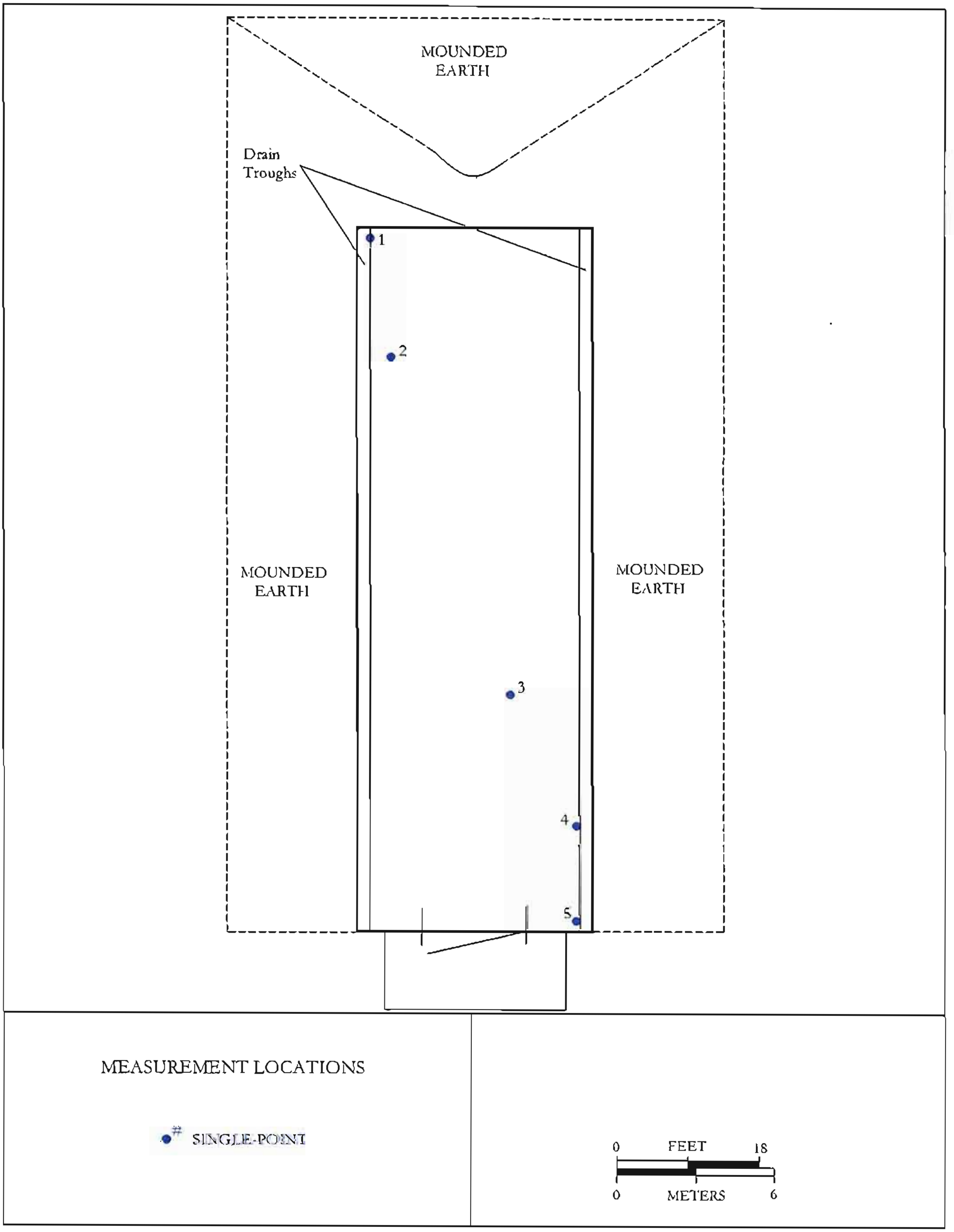

FIGURE 10: Igloo A0707 - Direct Measurement Locations

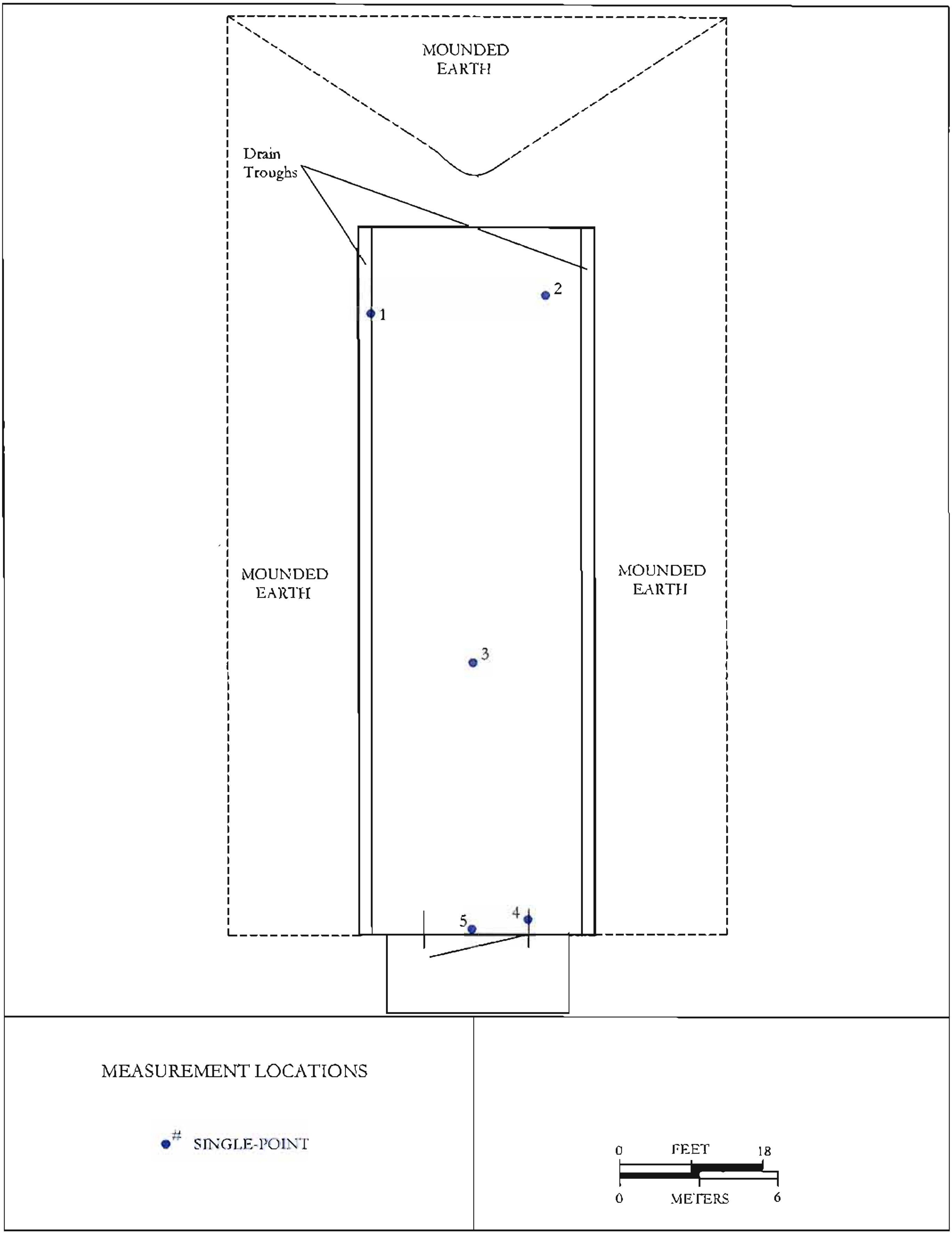

FIGURE 11: Igloo B0109 - Direct Measurement Locations

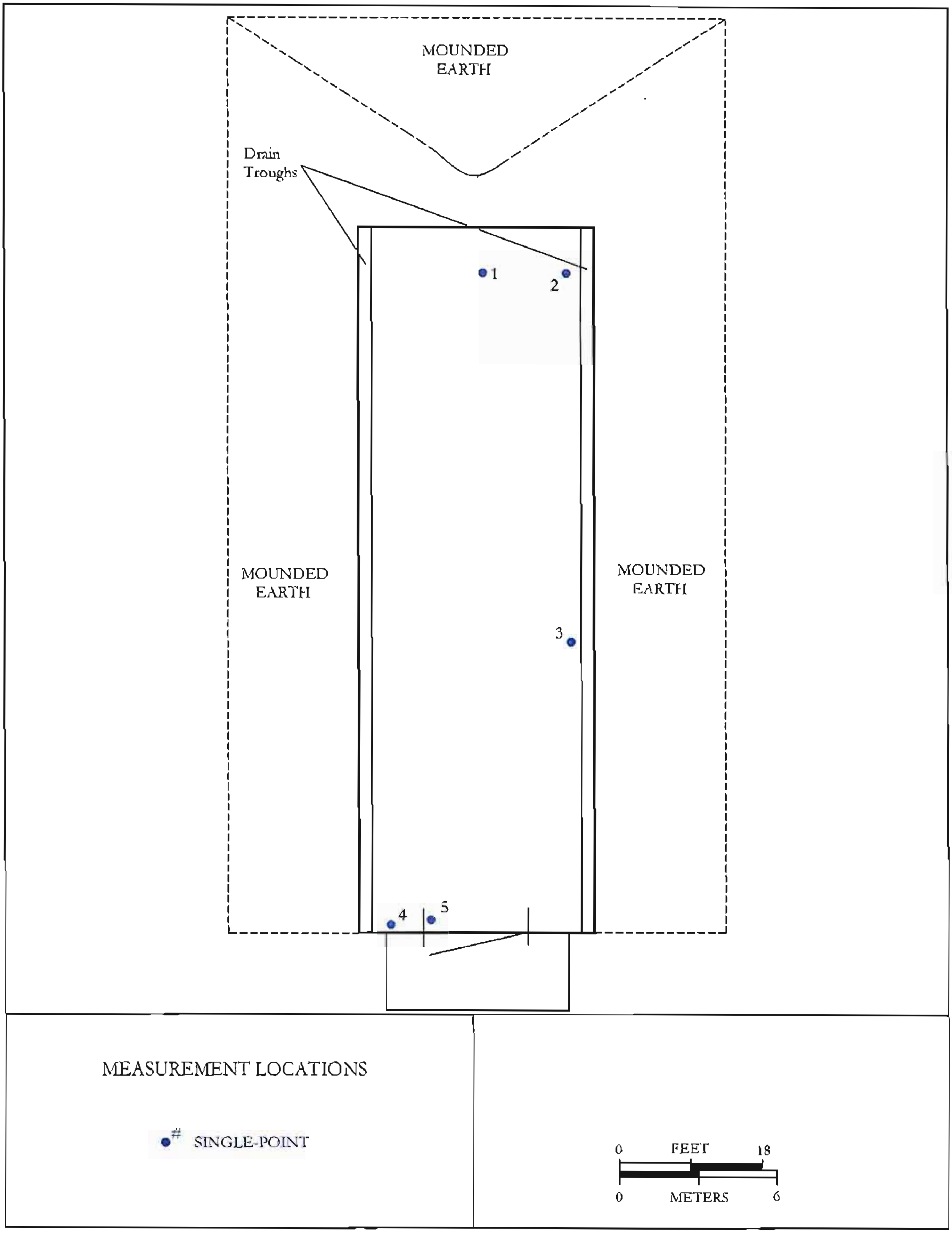

FIGURE 12: Igloo B0701 - Direct Measurement Locations

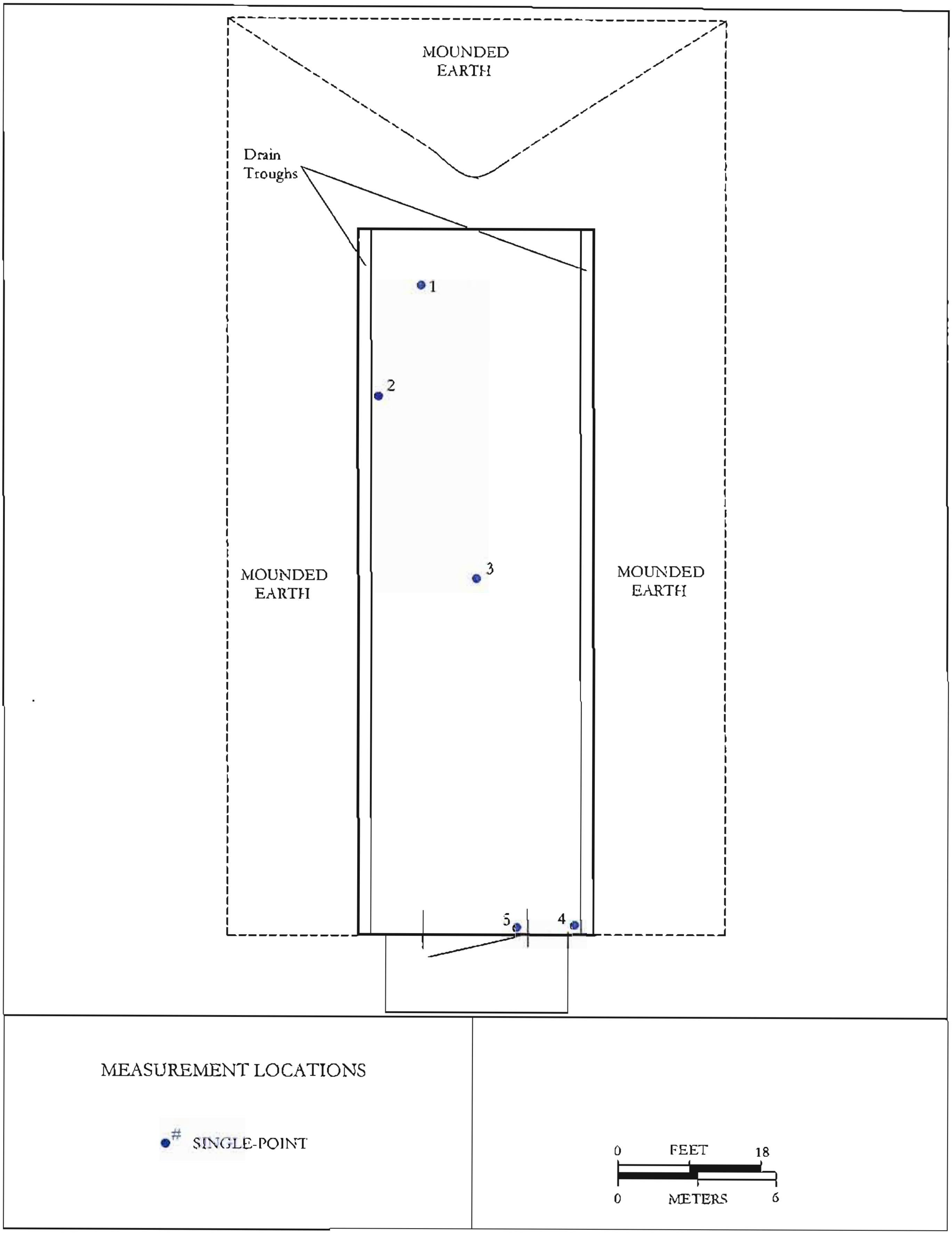

FIGURE 13: Igloo C0803 - Direct Measurement Locations

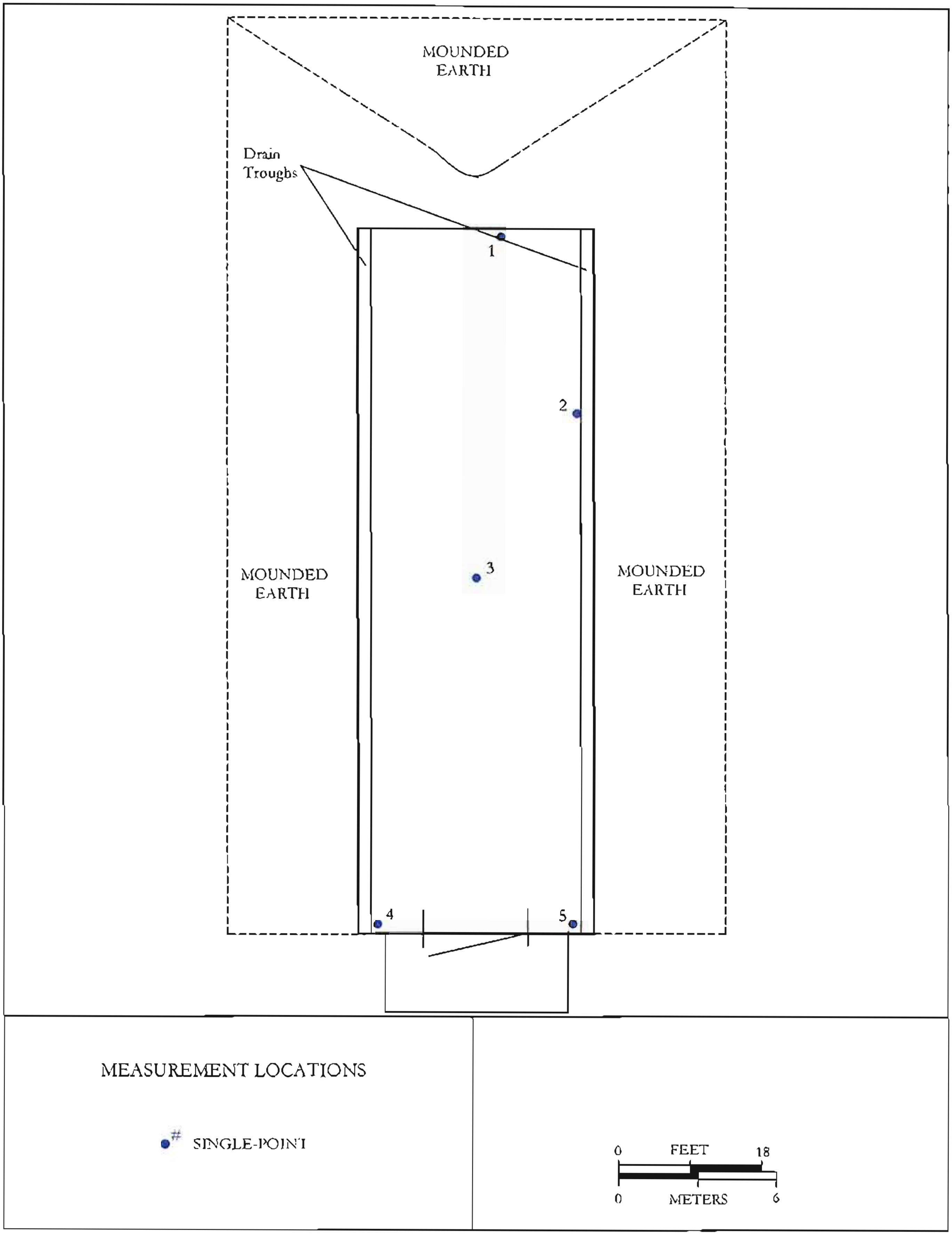

FIGURE 14: Igloo C0807 - Direct Measurement Locations

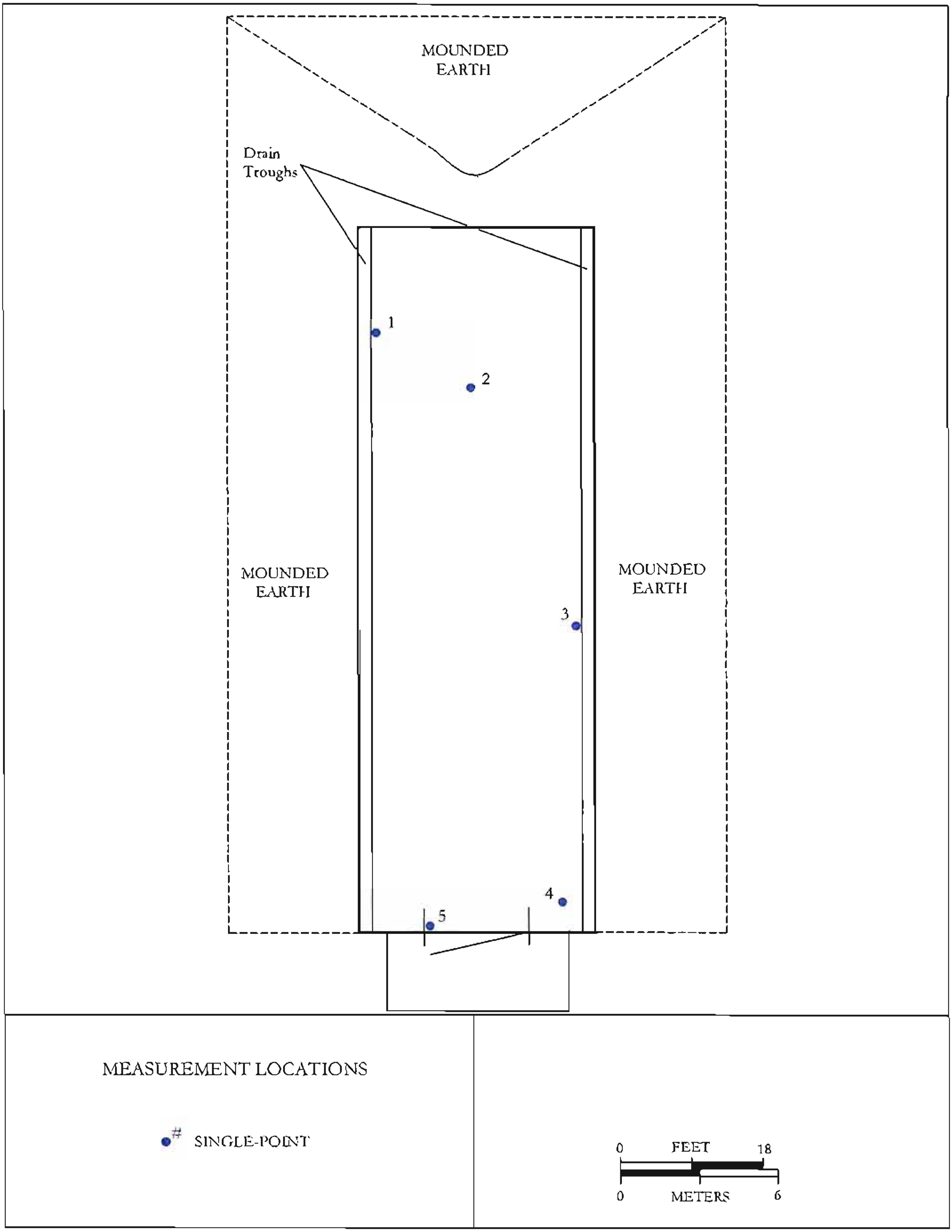

FIGURE 15: Igloo D0105 - Direct Measurement Locations

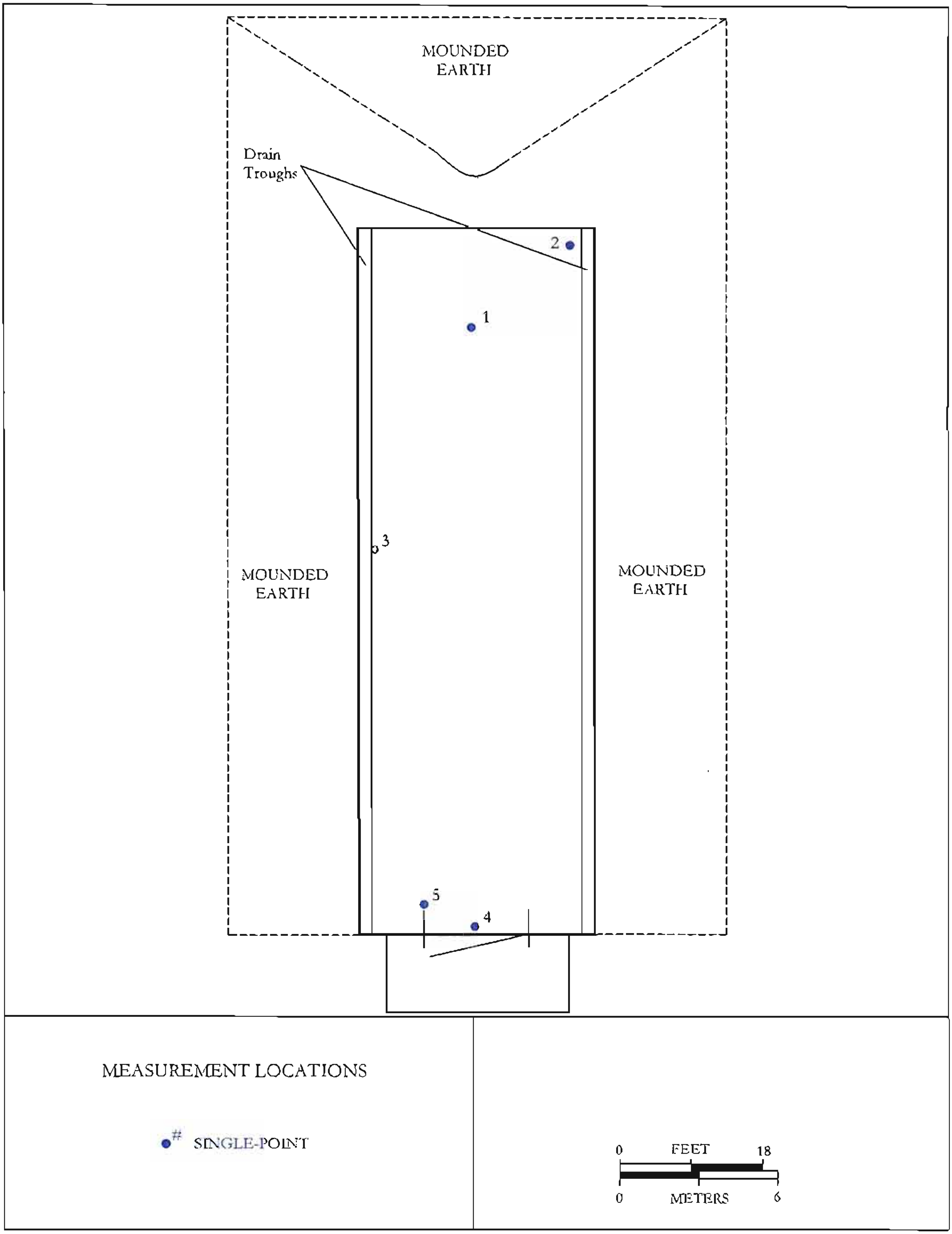

FIGURE 16: Igloo D0712 - Direct Measurement Locations

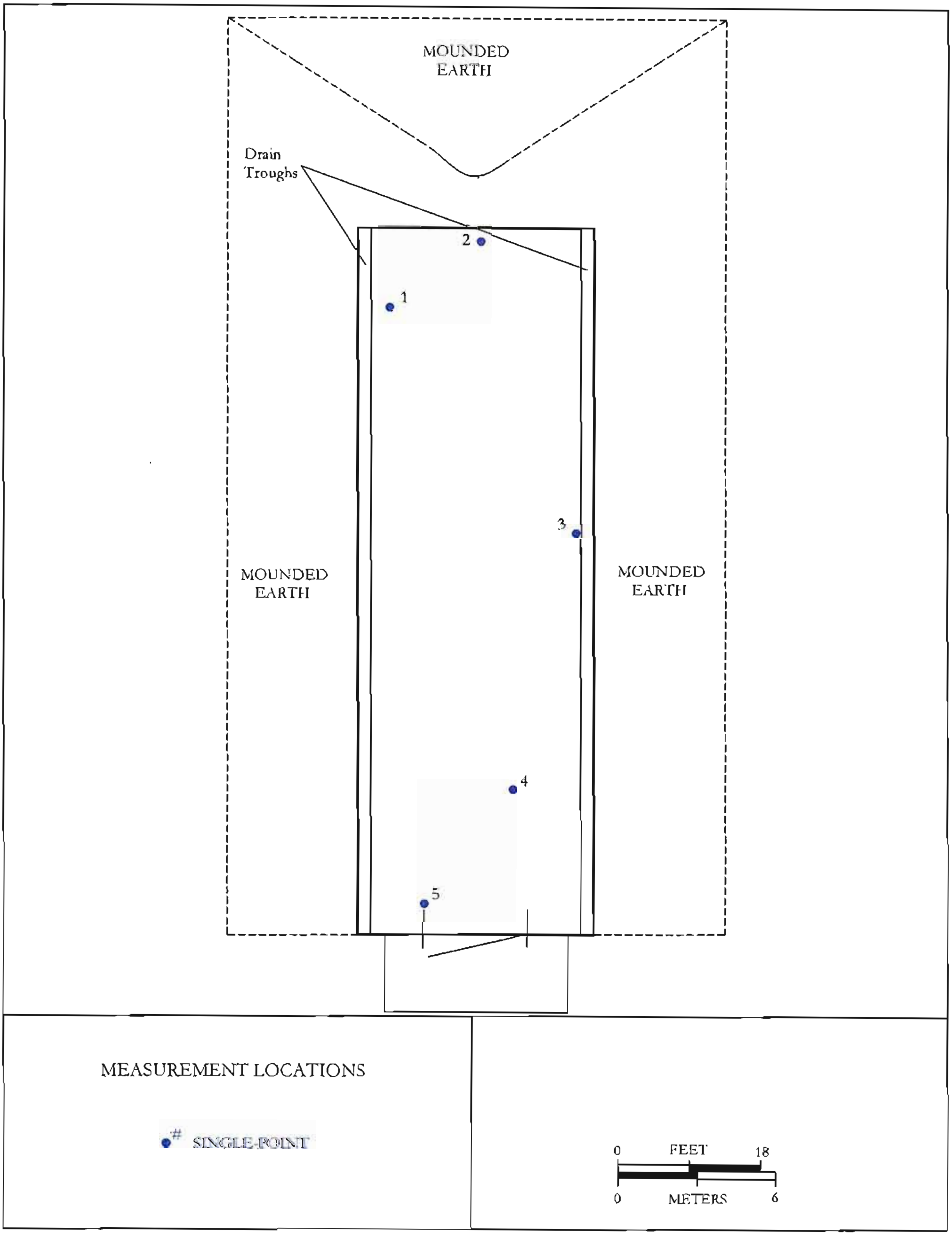

FIGURE 17: Igloo E0105 - Direct Measurement Locations

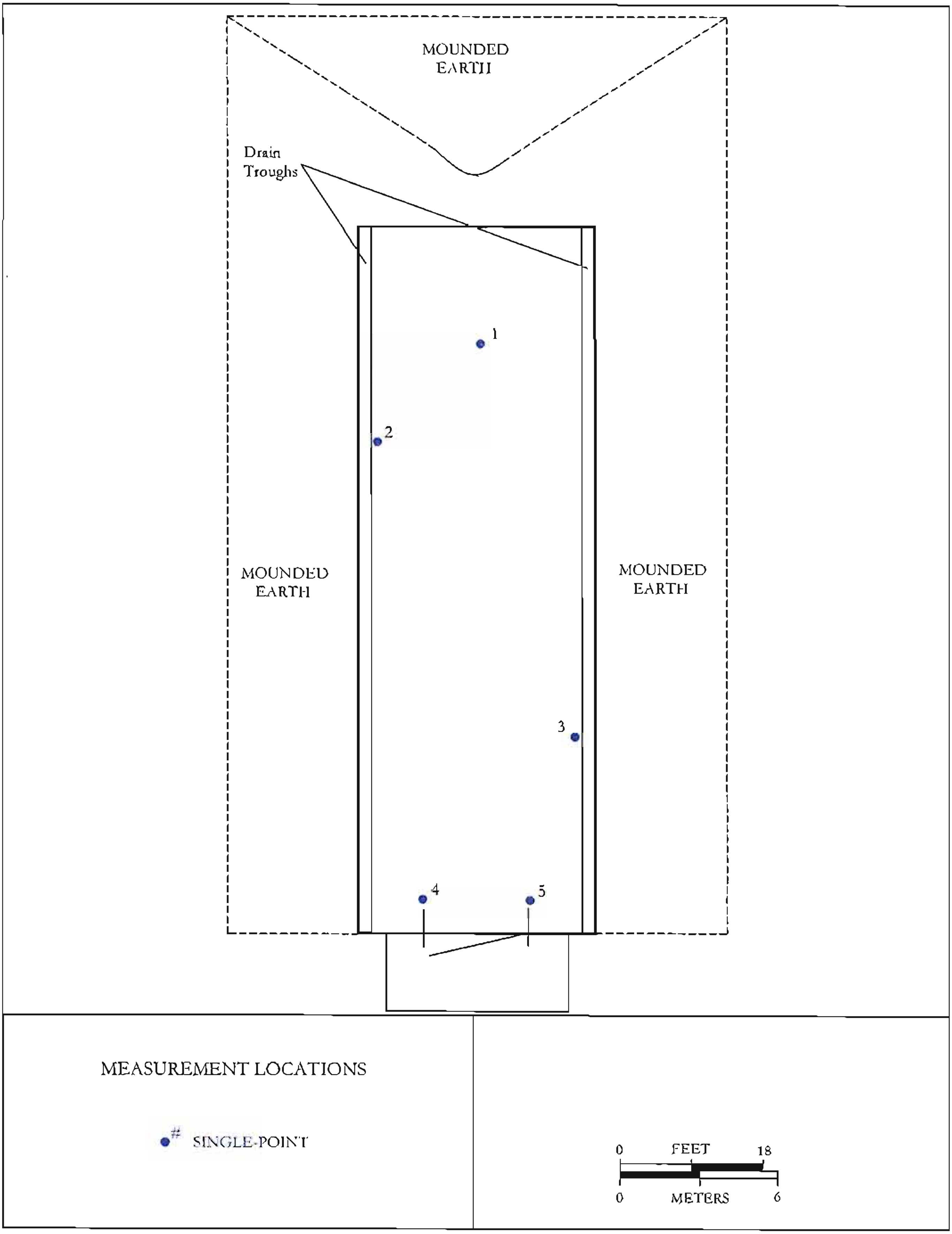

FIGURE 18: Igloo E0609 - Direct Measurement Locations

TABLES

TABLE 4

SURFACE ACTIVITY MEASUREMENTS
SENECA ARMY DEPOT ACTIVITY (SEDA)
ROMULUS, NEW YORK

Measurement Location[a]	Surface Type	Alpha plus Beta Surface Activity ($dpm/100\ cm^2$)
Building 5: DU $DCGL_w$ is 31,800 $dpm/100\ cm^2$		
1 FL	Concrete	2,370 ± 210[b]
2 LW	Block, Concrete	2,440 ± 210
3 LW	Block, Concrete	2,570 ± 220
4 FL	Concrete	2,280 ± 210
5 FL	Concrete	1,820 ± 180
6 LW	Block, Concrete	1,400 ± 160
7 FL	Concrete	2,010 ± 190
8 FL	Concrete	2,060 ± 200
9 FL	Concrete	2,340 ± 210
10 FL	Concrete	2,250 ± 200
Building 306: DU $DCGL_w$ is 31,800 $dpm/100\ cm^2$		
1 LW	Sheetrock	1,280 ± 150
2 FL	Floor Tile	1,430 ± 160
3 FL	Concrete	2,900 ± 230
4 FL	Concrete	1,790 ± 180
5 LW	Block, Concrete	1,300 ± 160
6 LW	Concrete	1,460 ± 170
7 FL	Concrete	1,380 ± 160
8 FL	Concrete	1,870 ± 190
9 LW	Tile	2,800 ± 230
10 FL	Linoleum	1,620 ± 170
Warehouse 356: Th-232 $DCGL_w$ is 3,090 $dpm/100\ cm^2$		
1 LW	Block, Concrete	347 ± 32
2 FL	Concrete	225 ± 26
3 FL	Concrete	312 ± 30
4 FL	Concrete	307 ± 30
5 LW	Block, Concrete	396 ± 34

TABLE 4 (Continued)

SURFACE ACTIVITY MEASUREMENTS
SENECA ARMY DEPOT ACTIVITY (SEDA)
ROMULUS, NEW YORK

Measurement Location[a]	Surface Type	Alpha plus Beta Surface Activity ($dpm/100\ cm^2$)
Warehouse 356 (continued): Th-232 $DCGL_w$ is 3,090 $dpm/100\ cm^2$		
6 FL	Concrete	323 ± 31
7 LW	Block, Concrete	358 ± 32
8 LW	Block, Concrete	443 ± 36
9 FL	Concrete	355 ± 32
10 LW	Block, Concrete	323 ± 31
Building 612: DU $DCGL_w$ is 31,800 $dpm/100\ cm^2$		
1 FL	Concrete	1,700 ± 180
2 LW	Metal	920 ± 130
3 FL	Concrete	1,920 ± 190
4 FL	Concrete	1,820 ± 180
5 LW	Concrete	1,290 ± 160
6 EQ	Metal	1,360 ± 160
7 FL	Concrete	1,990 ± 190
8 LW	Concrete	1,510 ± 170
9 FL	Floor Tile	1,730 ± 180
10 LW	Block, Concrete	1,690 ± 180
Building 2073: DU $DCGL_w$ is 31,800 $dpm/100\ cm^2$		
1 FL	Concrete	2,010 ± 190
2 LW	Wood	1,180 ± 150
3 FL	Concrete	2,100 ± 200
4 FL	Metal	1,490 ± 170
5 FL	Concrete	1,910 ± 190
Building 2084: DU $DCGL_w$ is 31,800 $dpm/100\ cm^2$		
1 FL	Concrete	1,990 ± 190
2 FL	Concrete	1,680 ± 180
3 FL	Concrete	2,220 ± 200
4 FL	Concrete	2,120 ± 200
5 FL	Concrete	1,770 ± 180

TABLE 4 (Continued)

SURFACE ACTIVITY MEASUREMENTS
SENECA ARMY DEPOT ACTIVITY (SEDA)
ROMULUS, NEW YORK

Measurement Location[a]	Surface Type	Alpha plus Beta Surface Activity ($dpm/100\ cm^2$)
Igloo A0508: Pu $DCGL_w$ is 4,240 $dpm/100\ cm^2$		
1 LW	Concrete	1,470 ± 170
2 FL	Concrete	2,160 ± 200
3 FL	Concrete	3,320 ± 250
4 LW	Concrete	2,820 ± 230
5 FL	Concrete	2,240 ± 200
Igloo A0707: DU $DCGL_w$ is 31,800 $dpm/100\ cm^2$		
1 LW	Concrete	1,720 ± 180
2 FL	Concrete	2,000 ± 190
3 FL	Concrete	2,040 ± 200
4 LW	Concrete	1,510 ± 170
5 FL	Concrete	2,200 ± 200
Igloo B0109: DU $DCGL_w$ is 31,800 $dpm/100\ cm^2$		
1 LW	Concrete	1,920 ± 190
2 FL	Concrete	2,180 ± 200
3 FL	Concrete	2,110 ± 200
4 LW	Concrete	2,030 ± 190
5 FL	Concrete	2,620 ± 220
Igloo B0701: DU $DCGL_w$ is 31,800 $dpm/100\ cm^2$		
1 FL	Concrete	2,180 ± 200
2 LW	Concrete	1,620 ± 170
3 FL	Concrete	2,190 ± 200
4 FL	Concrete	2,470 ± 210
5 LW	Concrete	1,680 ± 180
Igloo C0803: DU $DCGL_w$ is 31,800 $dpm/100\ cm^2$		
1 FL	Concrete	2,150 ± 200
2 LW	Concrete	2,310 ± 210
3 FL	Concrete	2,010 ± 190
4 LW	Concrete	2,250 ± 200
5 FL	Concrete	2,040 ± 190

TABLE 4 (Continued)

SURFACE ACTIVITY MEASUREMENTS
SENECA ARMY DEPOT ACTIVITY (SEDA)
ROMULUS, NEW YORK

Measurement Location[a]	Surface Type	Alpha plus Beta Surface Activity (dpm/100 cm^2)
Igloo C0807: DU $DCGL_w$ is 31,800 dpm/100 cm^2		
1 LW	Concrete	1,540 ± 170
2 FL	Concrete	1,820 ± 180
3 FL	Concrete	2,060 ± 200
4 FL	Concrete	3,360 ± 250
5 LW	Concrete	1,880 ± 190
Igloo D0105: DU $DCGL_w$ is 31,800 dpm/100 cm^2		
1 LW	Concrete	1,600 ± 170
2 FL	Concrete	1,980 ± 190
3 LW	Concrete	1,620 ± 170
4 FL	Concrete	1,990 ±190
5 LW	Concrete	1,970 ± 190
Igloo D0712: DU $DCGL_w$ is 31,800 dpm/100 cm^2		
1 FL	Concrete	2,230 ± 200
2 LW	Concrete	1,640 ± 170
3 FL	Concrete	2,110 ± 200
4 FL	Concrete	1,930 ± 190
5 LW	Concrete	1,680 ± 180
Igloo E0105: DU $DCGL_w$ is 31,800 dpm/100 cm^2		
1 FL	Concrete	2,200 ±200
2 LW	Concrete	1,630 ±170
3 FL	Concrete	2,130 ± 200
4 FL	Concrete	2,000 ± 190
5 LW	Concrete	1,440 ± 160
Igloo E0609: DU $DCGL_w$ is 31,800 dpm/100 cm^2		
1 FL	Concrete	1,930 ± 190
2 LW	Concrete	1,520 ± 170
3 FL	Concrete	1,960 ± 190
4 LW	Concrete	2,280 ± 210
5 FL	Concrete	2,350 ± 210

[a]Refer to Figures 3 to 18.
[b]Uncertainties represent the 95% confidence level base on counting statistics only.

REFERENCES

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Oak Ridge Institute for Science and Education (ORISE). Quality Assurance Manual for the Environmental Survey and Site Assessment Program. Oak Ridge, Tennessee; July 28, 2005.

Oak Ridge Institute for Science and Education. Proposed Confirmatory Survey Plan for the Seneca Army Depot Activity (SEDA) in Romulus, New York (Docket No. 040-08526; RFTA No. 06-011). Oak Ridge, Tennessee; October 27, 2006a.

Oak Ridge Institute for Science and Education. Survey Procedures Manual for the Independent Environmental Assessment and Verification Program. Oak Ridge, Tennessee; August 7, 2006b.

Parsons (Parsons). NRC License Termination Report, Seneca Army Depot Activity, Romulus, New York. Boston, MA; June 2004.

U.S. Nuclear Regulatory Commission (NRC). Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). NUREG-1575; Revision 1. Washington, DC; August 2000.

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-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)

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)

APPENDIX B

SURVEY PROCEDURES

APPENDIX B

SURVEY PROCEDURES

PROJECT HEALTH AND SAFETY

Pre-survey activities included the evaluation and identification of potential health and safety issues. Tripping hazards over building debris and other materials in the vacant buildings were of particular concern for the indoor area surveys. Also of concern were the many different animal species that inhabited the site. Survey work was performed per the ORISE generic health and safety plans and a site-specific integrated safety management (ISM) pre-job hazard checklist which was completed and discussed with field personnel. SEDA and Parsons also provided site-specific safety awareness training. All survey activities were conducted in accordance with ORISE health and safety and radiation protection procedures.

QUALITY ASSURANCE

Field survey activities were conducted in accordance with procedures from the following documents:

- Survey Procedures Manual (August 7, 2006)
- Quality Assurance Manual (July 28, 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.
- Training and certification of all individuals performing procedures
- Periodic internal and external audits.

CALIBRATION PROCEDURES

Calibration of all field instrumentation was based on standards/sources, traceable to the National Institute of Standards and Technology (NIST), when such standards/sources were available. In cases where they were not available, standards of an industry-recognized organization were used.

Detectors used for assessing surface activity were calibrated in accordance with ISO-7503[1] recommendations. The total surface (alpha plus beta) efficiency (ε_{total}) was determined for the instrument/detector combination used for all surface activity measurements and consisted of the product of the 2π instrument efficiency (ε_i) and surface efficiency (ε_s): $\varepsilon_{total} = \varepsilon_i \times \varepsilon_s$. The total surface efficiency was determined based on an alpha energy calibration and 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 depleted uranium (DU) decay series.

Th-230 was selected as the alpha calibration source. The 2π alpha instrument efficiency (ε_i) factor was 0.38 for the gas proportional detector. 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 DU and thorium (Th-232) decay series. The 2π interpolated ε_i factors for the detectable beta-emitters ranged from 0.20 to 0.66 for the gas proportional detector. 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 DU and thorium series multi-point calibration total weighted static ε_{total} values for the hand-held gas proportional detector used for the confirmatory surveys were 0.17 and 1.09 as presented in Figures B-1 and B-2.

The scanning ε_{total} was determined for the hand-held and floor monitor detectors in the same fashion as above for the static hand-held gas proportional detectors except typical scanning efficiencies for the detectors were used rather than specific calibrations for this survey. The scanning ε_{total} value for the hand-held gas proportional detector was 0.14 for DU (Figure B-3). For the floor monitor, the scanning ε_{total} for DU was 0.13 (Figure B-4).

[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.

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. A large surface area, gas proportional floor monitor with a 0.8 mg/cm^2 window and a NaI scintillation detector were used to scan the floors of the surveyed areas. Wall surfaces were scanned using small area (126 cm^2) hand-held detectors with a 0.8 mg/cm^2 window. Identification of elevated levels was based on increases in the audible signal from the recording and/or indicating instrument.

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. Site surface activity background levels were within the typical range of 800 to 1,400 cpm for the large area gas proportional detectors (floor monitors) and 200 to 450 cpm for the hand-held gas proportional detectors. The hand-held gas proportional background for surface activity was re-determined on site and was 391 cpm. Additional parameters selected for the calculation of scan MDC included a one-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. To illustrate an example for the hand-held gas proportional detectors with 0.8 mg/cm^2 windows, the minimum detectable count rate (MDCR) and scan MDC can be calculated as follows:

$$b_i = (391 \text{ cpm}) (1 \text{ s}) (1 \text{ min}/60 \text{ s}) = 6.5 \text{ counts}$$

$$\text{MDCR} = (2.32) (6.5 \text{ counts})^{1/2} [(60 \text{ s/min}) / (1 \text{ s})] = 355 \text{ cpm}$$

$$\text{MDCR}_{\text{surveyor}} = 355 / (0.5)^{1/2} = 503 \text{ cpm}$$

The scan MDC is calculated using the total scanning efficiency (ε_{total}) of 0.14:

$$\text{Scan MDC} = \frac{MDCR_{surveyor}}{\varepsilon_{total}} \text{ dpm/100 cm}^2$$

[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.

The scan MDC for the hand-held gas proportional detector was calculated to be 3,657 dpm/100 cm^2 as presented in Figure B-3. For the given floor monitor background of 1,423 cpm, the scan MDC was 7,528 dpm/100 cm^2 (Figure B-4).

Specific scan MDCs for the NaI scintillation detector for depleted uranium in concrete were not determined as the instrument was used solely as a qualitative means to identify elevated gamma activity. MDCs for radionuclides in the concrete would approximate those contained in NUREG-1507.

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. ORISE did not determine construction material-specific background for each surface type encountered for determining net count rates. Instead, ORISE took a conservative approach and did not subtract material specific backgrounds in determining surface activity levels. At the request of the NRC, ORISE also determined the uncertainties for the direct measurement results. The single-point 95% confidence level uncertainties were calculated as follows:

$$2\sigma = 2 \times \frac{\sqrt{counts}}{T \varepsilon_T G}$$

where, σ = standard deviation of the count
T = time (min)
ε_T = total efficiency
G = geometry factor

Surface activity measurements were performed on concrete, brick, terra cotta block, metal, and wood. The static surface activity MDC was 438 dpm/100 cm^2 for the gas proportional detector. The physical surface area assessed by the gas proportional detector used was 126 cm^2.

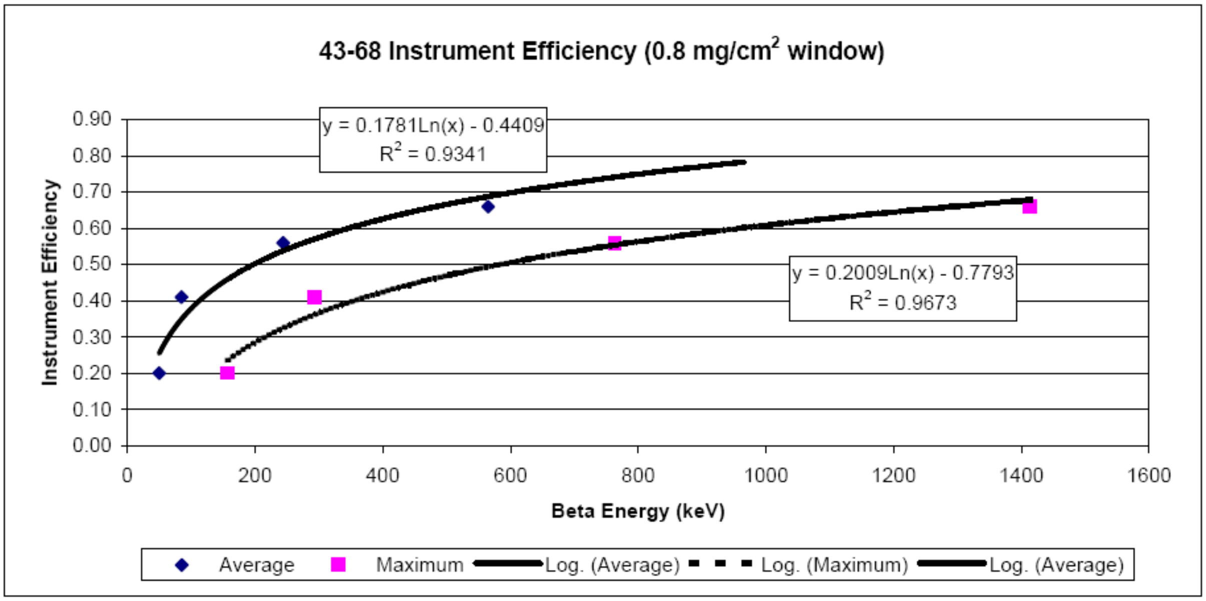
DETECTION LIMITS

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. The uncertainties associated with the direct measurement data presented in the tables of this report were calculated based on counting statistics only.

DU Decay Series Gas Proportional Detector Calibration Worksheet

Task Number:	1723	**Seneca Army Depot**	Data Entry
Instrument:	2221 #14		
Detector:	43-68 #14	(0.8 mg/cm[2] window)	
Cal. BKG Avg (cpm):	391		

Calibration Data			
Radionuclide	**Average Beta Energy (keV)**[1]	**Maximum Beta Energy (keV)**[1]	**Instrument Efficiency**
C-14	49.74	156.5	0.20
Tc-99	84.6	293.5	0.41
Tl-204	244.03	763.4	0.56
Sr/Y-90	564.75	1413.05	0.66



DU Decay Series Calculation					
Radionuclide	**Average Beta Energy (keV)**[1]	**Fraction**[2]	**Instrument Efficiency**[3]	**Surface Efficiency**	**Weighted Efficiency**
U-238	alpha	0.31	0.38	0.25	0.03
Pa-234	819	0.31	0.75	0.50	0.12
Th-234	44.9	0.31	0.24	0.25	0.02
U-234	alpha	0.08	0.38	0.25	0.01
				Total Efficiency[4] *:*	0.17
Beta to Alpha Ratio =	1.6			*Static MDC (dpm/100 cm*^{2}*):*	438

[1] http://www.nndc.bnl.gov/nudat2/indx_dec.jsp

[2] Fraction based on expected DU ratios with 1.6 betas to 1 alpha.

[3] Calculated using exponential curve shown above for average beta energy

[4] Direct measurements performed in alpha plus beta mode

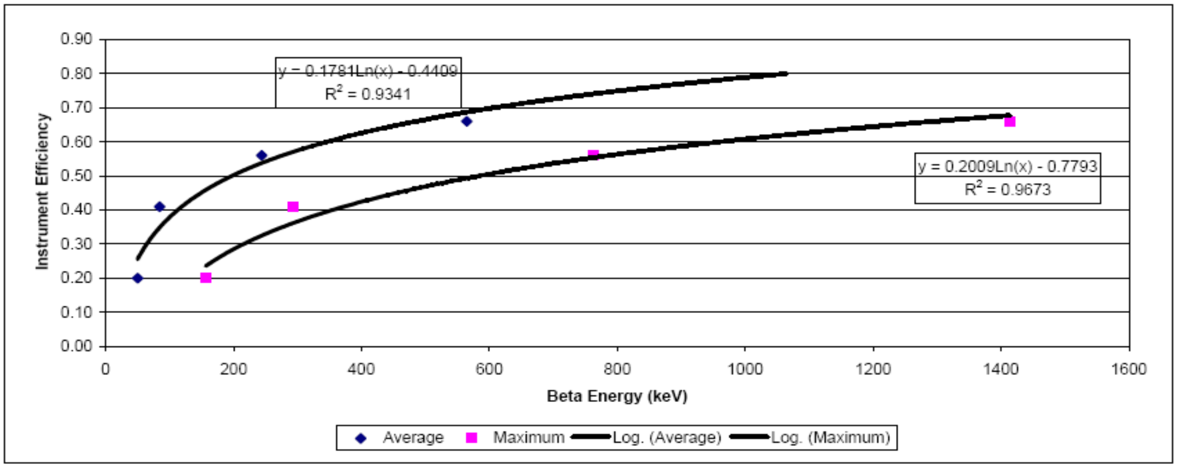
Figure B-1: Depleted Uranium Series Hand-Held Static Total Efficiency Calculation

Th-232 Decay Series Gas Proportional Detector Calibration Worksheet

Task Number: 1723 **Seneca Army Depot** Data Entry

Instrument:	2221 #14
Detector:	43-68 #14 (0.8 mg/cm[2] window)
Cal. BKG Avg (cpm):	391

Calibration Data			
Radionuclide	Average Beta Energy (keV)[1]	Maximum Beta Energy (keV)[1]	Instrument Efficiency
C-14	49.74	156.5	0.20
Tc-99	84.6	293.5	0.41
Tl-204	244.03	763.4	0.56
Sr/Y-90	564.75	1413.05	0.66



Th-232 Decay Series Calculation[2]					
Radionuclide	Average Beta Energy (keV)[1]	Fraction	Instrument Efficiency[3]	Surface Efficiency	Weighted Efficiency
Th-232	alpha	1	0.40	0.25	0.10
Ra-228	7.2	1	0.00	0.00	0.00
Ac-228	377	0.93	0.62	0.50	0.29
Th-228	alpha	1	0.40	0.25	0.10
Ra-224	alpha	1	0.40	0.25	0.10
Rn-220	alpha	0.75	0.40	0.25	0.08
Po-216	alpha	0.75	0.40	0.25	0.08
Pb-212	102	0.751	0.38	0.25	0.07
Bi-212	770	0.307	0.74	0.50	0.11
Bi-212	alpha	0.27	0.40	0.25	0.03
Po-212	alpha	0.48	0.40	0.25	0.05
Tl-208	557	0.268	0.69	0.50	0.09
				Total Efficiency:	1.09
				Static MDC (dpm/100 cm[2]):	69

[1] http://www.nndc.bnl.gov/nudat2/indx_dec.jsp

[2] Refer to Table 14.2 of *Decommissioning Health Physics: A Handbook for MARSSIM Users* . E W Abelquist, 2001. Fractions adjusted to account for Rn-220 loss.

[3] Calculated using exponential curve shown above for average beta energy

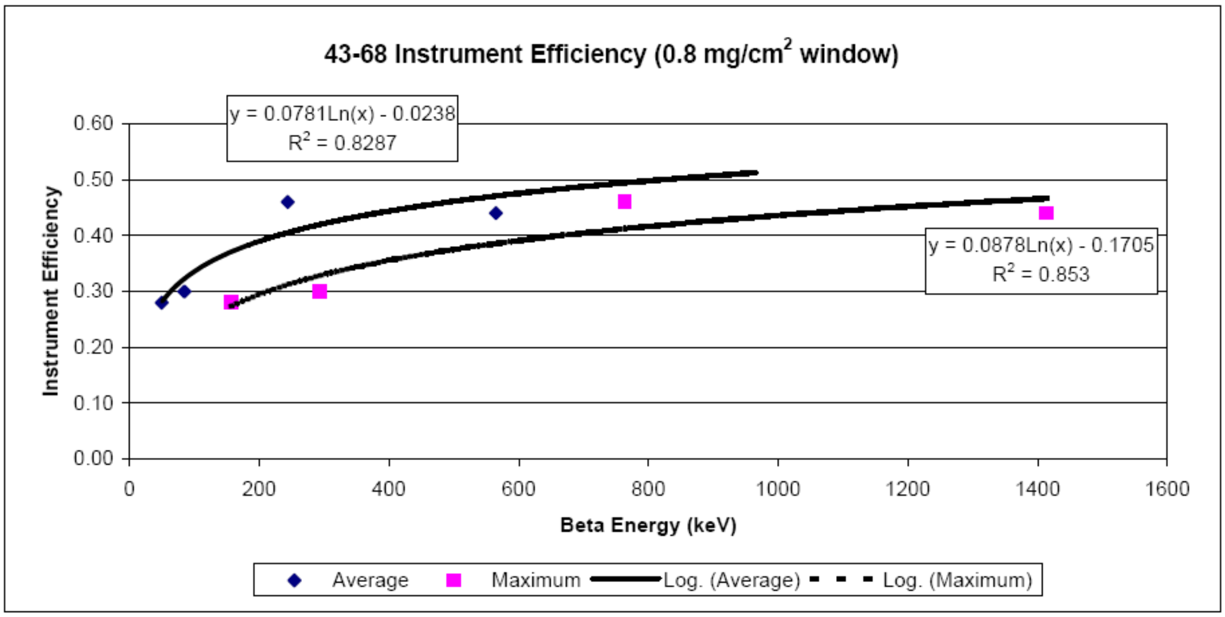
[4] Direct measurements performed in alpha plus beta mode

Figure B-2: Th-232 Decay Series Hand-Held Static Total Efficiency Calculation

DU Decay Series Gas Proportional Detector Calibration Worksheet

Task Number:	1723	Seneca Army Depot	Data Entry		
			o_i =	1	sec
Instrument:	2221 #14		Surveyor Eff. =	0.5	
Detector:	43-68 #14	(0.8 mg/cm2 window)	b_i =	6.5	counts
Cal. BKG Avg (cpm):	391		MDCR =	355	cpm
			$MDCR_{surveyor}$ =	503	cpm

Calibration Data			
Radionuclide	Average Beta Energy (keV)[1]	Maximum Beta Energy (keV)[1]	Instrument Efficiency
C-14	49.74	156.5	0.28
Tc-99	84.6	293.5	0.30
Tl-204	244.03	763.4	0.46
Sr/Y-90	564.75	1413.05	0.44



DU Decay Series Calculation					
Radionuclide	Average Beta Energy (keV)[1]	Fraction[2]	Instrument Efficiency[3]	Surface Efficiency	Weighted Efficiency
U-238	alpha	0.31	0.40	0.25	0.03
Pa-234	819	0.31	0.50	0.50	0.08
Th-234	44.9	0.31	0.27	0.25	0.02
U-234	alpha	0.08	0.40	0.25	0.01
				Total Efficiency[4]:	0.14
				Scan MDC (dpm/100 cm²):	3,657

Beta to Alpha Ratio = 1.6

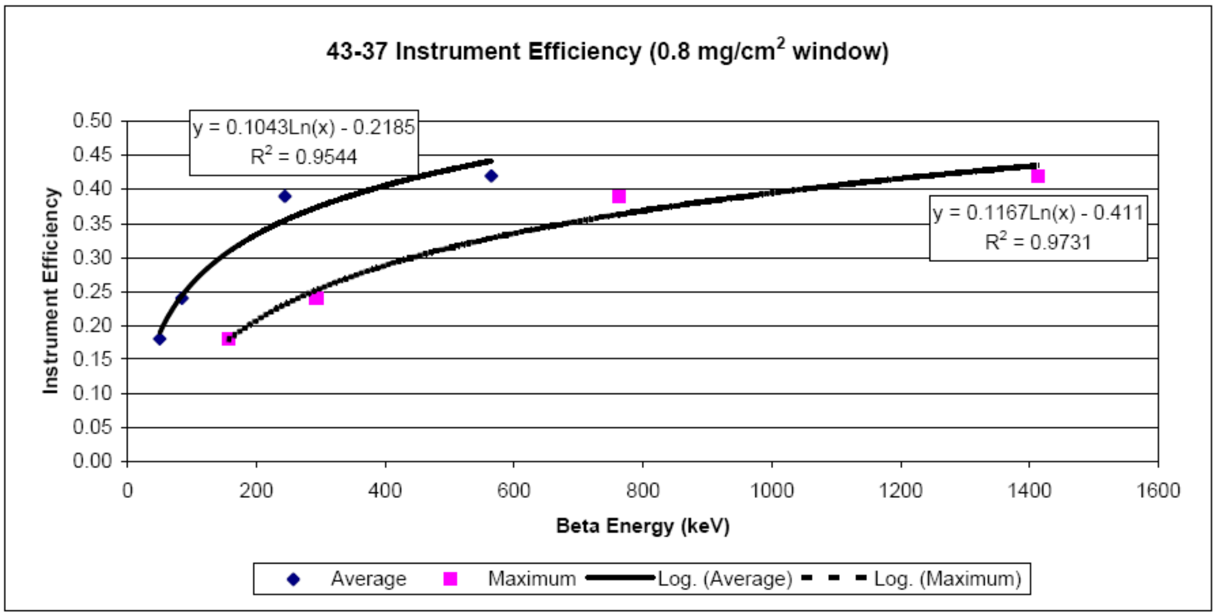
[1] http://www.nndc.bnl.gov/nudat2/indx_dec.jsp
[2] Fraction based on expected DU ratios with 1.6 betas to 1 alpha.
[3] Calculated using exponential curve shown above for average beta energy
[4] Direct measurements performed in alpha plus beta mode

Figure B-3: Depleted Uranium Series Hand-Held Scan Total Efficiency Calculation

DU Decay Series Gas Proportional Detector Calibration Worksheet

Task Number:	1723	Seneca Army Depot	Data Entry		
			o_i =	1	sec
Instrument:	2221 FM#2		Surveyor Eff. =	0.5	
Detector:	43-37 #10	(0.8 mg/cm2 window)	b_i =	23.7	counts
Cal. BKG Avg (cpm):	1423		MDCR =	678	cpm
			$MDCR_{surveyor}$ =	959	cpm

Calibration Data			
Radionuclide	**Average Beta Energy (keV)[1]**	**Maximum Beta Energy (keV)[1]**	**Instrument Efficiency**
C-14	49.74	156.5	0.18
Tc-99	84.6	293.5	0.24
Tl-204	244.03	763.4	0.39
Sr/Y-90	564.75	1413.05	0.42



DU Decay Series Calculation					
Radionuclide	**Average Beta Energy (keV)[1]**	**Fraction[2]**	**Instrument Efficiency[3]**	**Surface Efficiency**	**Weighted Efficiency**
U-238	alpha	0.31	0.40	0.25	0.03
Pa-234	819	0.31	0.48	0.50	0.07
Th-234	44.9	0.31	0.18	0.25	0.01
U-234	alpha	0.08	0.40	0.25	0.01
				Total Efficiency[4]:	0.13
Beta to Alpha Ratio =		1.6		***Scan MDC (dpm/100 cm[2]):***	7,528

[1] http://www.nndc.bnl.gov/nudat2/indx_dec.jsp

[2] Fraction based on expected DU ratios with 1.6 betas to 1 alpha.

[3] Calculated using exponential curve shown above for average beta energy

[4] Direct measurements performed in alpha plus beta mode

Figure B-4: Depleted Uranium Series Floor Monitor Scan Total Efficiency Calculation