760602-1109150004

INDEPENDENT VERIFICATION SURVEY REPORT FOR THE MIAMISBURG CLOSURE PROJECT, MIAMISBURG, OHIO

S. J. Roberts

Prepared for the
U.S. Department of Energy

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INDEPENDENT VERIFICATION SURVEY REPORT FOR THE MIAMISBURG CLOSURE PROJECT MIAMISBURG, OHIO

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Prepared for the
U.S. Department of Energy

FINAL REPORT

FEBRUARY 2007

This report is based on work performed by the Oak Ridge Institute for Science and Education under contract number DE-AC05-06OR23100 with the U.S. Department of Energy.

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FOR THE MIAMISBURG CLOSURE PROJECT
MIAMISBURG, OHIO

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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
μR/h	microroentgens per hour
μrem/h	microrem per hour
BKG	background
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
cm^2	square centimeter
cpm	counts per minute
COC	contaminants of concern
COS	Central Operations Support (building)
DOE	U.S. Department of Energy
D&D	Decontamination and Decommissioning
dpm/100 cm^2	disintegrations per minute per 100 square centimeters
DS	Development and Standards (building)
FSS	final status survey
FSSR	final status survey report
GM	Geiger-Mueller
ISM	Integrated Safety Management
ITP	Intercomparison Testing Program
IVC	Independent Verification Contractor
IVT	Independent Verification Team
JHA	job hazard analysis
keV	kiloelectron volts
LM	Legacy Management
m	meter
MAPEP	Mixed Analyte Performance Evaluation Program
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCP	Miamisburg Closure Project
MDC	minimum detectable concentration
MDCR	minimum detectable count rate
MeV	million electron volts
m^2	square meter
min	minute
mm	millimeter
MMCIC	Miamisburg Mound Community Improvement Corporation
MRC	Monsanto Research Corporation
mrem	millirem
NIST	National Institute of Standards and Technology
NPL	National Priorities List
NRIP	NIST Radiochemistry Intercomparison Program

ABBREVIATIONS AND ACRONYMS (Continued)

OEPA	Ohio Environmental Protection Agency
ORAU	Oak Ridge Associated Universities
ORISE	Oak Ridge Institute for Science and Education
OSC	On-Scene Coordinator
OSE	Operational Support East (Building)
OSW	Operational Support West (Building)
OU	Operable Units
pCi/g	picocuries per gram
PRS	Potential Release Site
PSP	project-specific plan
RA	Removal Action
sec	second
SW	Semi Work (building)
SU	survey unit
T	Technical (building)
TERF	Tritium Emissions Recovery Facility
USEPA	United States Environmental Protection Agency
VSAP	Verification Sampling and Analysis Plan
yr	year
yd^3	cubic yard

INDEPENDENT VERIFICATION SURVEY REPORT FOR THE MIAMISBURG CLOSURE PROJECT MIAMISBURG, OHIO

INTRODUCTION AND SITE HISTORY

The Mound Plant was constructed in the 1940's for the production of nuclear weapons components. The original site was run by the Monsanto Research Corporation (MRC) whose primary mission was to determine the chemical and metallurgical properties of polonium, beginning in 1948 (BWXTO 1999). In 1949, the Mound Plant began research operations involving other radionuclides. Over the course of its 50 years of operation, the facility produced detonators, recovered and purified tritium, and constructed plutonium heat generators for satellites. Mound was the first permanent facility in support of atomic weapons research for the U.S. Department of Energy (DOE) and prior to 1996, supplied stable isotopes to the DOE.

In 1989, the Mound Site was placed on the National Priorities List (NPL) because of chemical contamination in the site groundwater (BWXTO 1999). The DOE, U.S .Environmental Protection Agency (USEPA), and the Ohio Environmental Protection Agency (OEPA) developed a procedural framework for the remediation of the site under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Initially, the remediation of the Mound Plant was organized around nine Operable Units (OUs). However, as site remediation activities progressed, it became apparent that the OU clean-up strategy was not applicable at the Mound Site. In 2000, the DOE "core team"; including the DOE, USEPA, and the OEPA; designed a new decision-making process known as the "The Mound 2000 Approach". This process divided the Mound site into 19 release blocks containing over 400 Potential Release Sites (PRSs) (MERP 1997). Approximately 200 of the PRSs were contaminated soil areas and the remaining PRSs were contaminated buildings (BWXTO 1999).

The Miamisburg Closure Project contract was awarded to CH2MHill Mound, Inc. on December 5, 2002, with work beginning January 1, 2003.

The U.S. Department of Energy-Miamisburg Closure Project Office (DOE/MCP) is responsible for oversight of the remedial action and final status survey (FSS) activities at the Miamisburg Closure Project (MCP). It is the policy of the DOE to perform independent (third party) verification of FSS activities (DOE 2006). The purpose of these independent verifications is to confirm that remedial

actions have been effective in meeting established and site-specific guidelines and that the documentation accurately and adequately describes the radiological conditions at the site. The Oak Ridge Institute for Science and Education (ORISE) has been designated by the DOE as the independent verification contractor (IVC) responsible for this task at the MCP and has been requested to verify the final radiological status of the cleanup activities associated with the Buildings 45, 61, OSE, OSW, and the Technical (T) Building, as well land area parcels 6, 7, and 8. The history of each area is described in the following sections.

BUILDINGS 45, 61, OSE, AND OSW

Buildings 45, 61, Operational Support East (OSE), and Operational Support West (OSW) are four structures that have been addressed as part of the Mound 2000 process. Building 45 was originally constructed in 1969 as the Neutron Standards and Multiplication and Test Laboratory (CH2 2005a). Building 61 was constructed in 1980 and served as a Logistics Support Warehouse (CH2 2003a). Buildings OSE and OSW were constructed in 1974 and 1987, respectively, and were used for administrative office areas (CH2 2004b and c). A FSS has been completed for each building and the results documented in the respective building data packages. Based on the building data packages and the results of the FSS, the contractor has concluded that the buildings are acceptable for transfer to the Miamisburg Mound Community Improvement Corporation (MMCIC) for commercial/industrial use.

T-BUILDING

Construction of the T-Building was completed in 1948; the building was originally built to process radioactive polonium and minor amounts of other radionuclides. From 1949 to 1973, activities included a polonium processing and separation program; fuels research and development program; neutron source program; and a variety of other research, development and production programs with polonium. In the early 1970s, the T-Building underwent considerable decontamination and during the 1980s significant modifications to provide accommodation for tritium-processing operations. Other activities included non-destructive testing, environmental testing, radon testing, gamma and mass spectroscopy, calorimetry, neutron activation analysis, and safeguards research and development.

Building operations also included offices and administrative areas, laboratories, and material storage (chemical products, office supplies, and waste storage containers). The building also has a vault that was used to store secured nuclear materials.

Recently, the T-Building was used for radioactive and non-radioactive work, offices, and service rooms. The Tritium Emissions Recovery Facility (TERF), which operated until the second quarter of 2004, processed tritiated gases to recover waste tritium for disposal. The building was vacated in February, 2005, and only remediation and verification activities continued (CH2 2006a).

A Removal Action was initiated in June 2003 to remediate the T-Building to acceptable levels for industrial reuse. The primary contractor, CH2MHill Mound, Inc., planned and performed Removal Action oversight, building/structure decontamination, building/structure dismantlement and remediation, and onsite transportation and staging of debris. The project has met the Removal Action objectives pertaining to the T-Building, and the major remediation activities in the T-Building are considered complete (CH2 2006b).

The contaminants of concern (COC) include uranium-235/238 (U-235/238), cobalt-60 (Co-60), silver-108m (Ag-108m), plutonium-238/239 (Pu-238/239), americium-241 (Am-241), radium-226 (Ra-226), bismuth-207/210m (Bi-207/210m), cesium-137 (Cs-137), strontium-90 (Sr/Y-90), polonium-209 (Po-209), and tritium (H-3). Previous measurements conducted by *in-situ* gamma spectroscopy have confirmed the presence of Bi-207, Bi-210m, Cs-137, Ag-108m, Am-241, Pu-238, Pu-239, Po-209 and Co-60 as COCs (CH2 2004a).

The T-Building is to be transitioned to the MMCIC in accordance with the MCP and must satisfy building release criteria specified in "The Mound 2000 Approach" prior to transitioning the building. During completion of the FSS activities, the decontamination and decommissioning (D&D) contractor, CH2MHill, prepared the Verification Sampling and Analysis Plan (VSAP) which summarized their approach to confirm that the T-Building meets the release criteria. This plan follows the guidance of the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) for format and content and was written to meet the release criteria of DOE Order 5400.5 (BWXTO 1999, CH2 2004a, NRC 2000 and DOE 1993).

There are a total of 178 survey units (SUs) in the T-Building that were evaluated and determined to meet the release criteria (CH2 2006b). Surface release criteria, based on guidance in DOE

Order 5400.5 (DOE 1993 and 1995), was applied to 164 survey units. RESRAD-Build-derived release criteria were applied to 14 SUs that contained residual volumetric contamination. The latter were based on a maximum dose limit to future occupants of less than 15 mrem/yr. Institutional controls have been put into place for the RESRAD areas in the T-Building, to include the prohibition against the removal of concrete floor material and a prohibition against allowing penetration of concrete floors without prior approval by the DOE.

PARCELS 6, 7, AND 8

The land area Parcels 6, 7, and 8 represent 332 PRSs at the MCP. The majority of the Parcels were designated as requiring no-further action. PRS 66, which is located within the Parcels on the northeastern portion of the site, had a high potential for contamination due to the burial of several radiologically-contaminated items; including thorium-contaminated drums, a contaminated flatbed truck, contaminated ventilation equipment from the Semi Work (SW) Building renovation, and other miscellaneous equipment. The PRS 66 Removal Plan also included several smaller PRSs located within the vicinity of PRS 66, including PRS 38, 39, 40, and 80, and 398. The Removal Action was completed in 2005 and resulted in the removal of 78,093 cubic yards (yd^3) of low-level radioactive waste, 90 yd^3 of metal, and 3 yd^3 of nonfriable asbestos (CH2 2005b).

SITE DESCRIPTION

The Mound Plant is located on 305 acres within the southern city limits of Miamisburg, Ohio and is approximately ten miles southwest of Dayton and 45 miles north of Cincinnati. The site is bounded by Mound Avenue to the north which curves to the south becoming Mound Road and the eastern boundary of the site (Figure 1). The southern boundary is formed by Benner Road with the Conrail Railroad generally forming the western boundary. To the west of the plant is the Great Miami River flowing from northeast to southwest and the plant is surrounded by residential, recreational and agricultural areas.

BUILDINGS 45, 61, OSE, AND OSW

Building 45 is a two-story structure (including an addition built in 1994) originally built in 1969 with 9,582 square feet of floor space. The building, referred to as the Neutron Standards and

Multiplication Test Facility, has been used for many purposes, including the nondestructive testing of encapsulated radioactive components and a Health Physics Calibration Laboratory. Building 61 is a two-story structure (including the addition of the Production Support Facility built in 1984) located near the site entrance. Originally built in 1980 to serve as the Logistics Support Warehouse, Building 61 was used for offices, waste storage, and site shipping and receiving functions. Building OSW is a four-story structure built in 1974 as an administrative office area, and encompasses 52,280 square feet of floor space. Building OSE is a four-story structure built in 1987 as an administrative office area, and encompasses 90,072 square feet of floor space.

T-BUILDING

The T-Building is a heavily reinforced subterranean concrete structure located almost entirely under the former Development and Standards (DS) Building. Construction activities of the T-Building included the excavation of the side of a hill, assembling the basic reinforced concrete building shell, and then backfilling the excavated area to essentially the original slope and grade. Interior dimensions of the basic building shell are 345 feet long by 150 feet wide and the roof is 15 feet thick reinforced concrete. The T-Building consists of two floors which are compartmentalized into three general areas (bays) by two 30-inch thick reinforced concrete firewalls and contains more than 200 rooms and 20 corridors. There were two brick and mortar, two-hundred-foot tall exhaust airshafts which were removed during building D&D activities. There are three towers along the north wall, one at each end and one at the center. The end towers contain stairways, passenger elevators, airshafts for intake ventilation air, and pedestrian entrances at grade level; the middle tower was used for providing intake ventilation air. The eastern-most tower is designated the East Tower (or Tower 1) and the western-most tower is designated the West Tower (or Tower 1A). The southern section of the building tunnel area is exposed above ground and abuts the multi-story Central Operations Support (COS) Building. A vehicular tunnel extends along the south side of the second floor of the building with large doors at each end permitting vehicles and personnel to enter the building (CH2 2004a).

PARCELS 6, 7, AND 8

Parcels 6, 7, and 8 represent a large area made up of 332 PRSs. The PRS selected to represent Parcels 6, 7, and 8 for a Type A review is PRS 66. PRS 66 is located on the northeastern portion of the MCP and encompasses approximately 3.5 acres.

OBJECTIVES

The objectives of the independent verification survey were to confirm that remedial actions have been effective in meeting established release criteria and that documentation accurately and adequately describes the final radiological conditions of the MCP.

DOCUMENT REVIEW

The Independent Verification Team (IVT) reviewed the work plans, verification sampling plans, and supporting data and documentation for Buildings 45, 61, OSE, OSW, and the T-Building. The focus of the review included the survey methodology and instrumentation detection capabilities and calibration, in order to develop an applicable and appropriate project-specific plan (PSP) for radiological field surveys in these buildings.

TYPE A VERIFICATION

A Type A verification was performed for the Parcels 6, 7, and 8 land areas, given that remediation activities had already been completed and the area backfilled with clean soil. The objective of the Type A verification was to perform a comprehensive technical review of the Verification Sampling & Analysis Plan (VSAP) and Data Report for PRSs to be evaluated. Because the number of PRSs associated with Parcels 6, 7, and 8 was large (332 PRSs in Parcels 6, 7, and 8), ORISE focused the data review on PRS 66, which was a large land area PRS with a high potential for contamination. The scope of ORISE's review included evaluation of the COC, the guidelines for each contaminant, the application of the guidelines for demonstrating compliance with cleanup criteria, instrumentation and corresponding minimum detectable concentrations (MDC), soil sampling procedures, and survey and analytical results. Comments pertaining to the VSAP and Data Report were sent via email to the DOE for discussion and resolution (refer to Appendix E).

TYPE B VERIFICATION

The Type B verification at the MCP included an on-site assessment and evaluation of the remediation process. Type B verification surveys were performed in Buildings 45, 61, OSE, OSW, and the T-Building. The Type B verification included data acquisition through scans and static measurements, in addition to collecting removable activity measurements (smears).

VERIFICATION SURVEY PROCEDURES

During the period of September 18 to October 13, 2006, ORISE performed radiological verification survey activities of Buildings 45, 61, OSE, OSW, and the T-Building (Figures 1 and 2). The building surveys included alpha and beta surface scans, surface measurements for total and removable activity, and some limited exposure rate measurements. ORISE judgmentally selected SUs for verification surveys where either the contractor had identified and remediated residual contamination; or where other suspect areas existed (e.g., high-traffic areas, areas with visible staining, drains, etc.). ORISE performed alpha and beta scans in approximately 50% of the survey units/areas in Buildings 45 and 61 (Figures 3, 4, and 5). Judgmental scans were concentrated in high-traffic areas (entryways, hallways, etc.) in Buildings OSE and OSW (Figures 6 and 7). ORISE judgmentally selected 16 of the 178 SUs in the T-Building to perform verification surveys (Figures 8 and 9). ORISE focused verification survey efforts on areas where the surface release criteria were applied. Limited surveys were performed in the RESRAD areas of the T-Building based on site inspections and input from the DOE, but were generally limited to the portions of the RESRAD areas where the surface release criteria applied (i.e., wall and ceiling surfaces).

Verification survey activities were performed in accordance with the ORISE Survey Procedures and Quality Assurance Manuals (ORISE 2006a and 2005). Data and sample media collected during ORISE verification surveys were returned to the ORISE laboratory for data interpretation and analyses. Survey activities performed by ORISE were conducted in accordance with site-specific survey plans that were submitted to and approved by the DOE (ORISE 2006b and c).

Reference System

ORISE established a grid system for referencing random measurement locations in the T-Building. Site maps and prominent site features were utilized to identify judgmental measurement locations in the T-Building and all other buildings at the MCP.

Alpha and Alpha Plus Beta Surface Scans

Alpha and beta radiation surface scan coverage was based on the SU classification. Scan coverage in Class 1 and Class 2 SUs selected for verification were generally as follows: 50 to 100% of the floor surfaces; 10 to 50% of lower wall surfaces; and judgmental scans on upper wall/ceiling surfaces. Scanning was performed on a judgmental basis in Class 3 SUs (typically on floor surfaces only). Particular attention was given to floors and cracks and joints where material may have accumulated. Scans were performed using gas proportional detectors coupled to ratemeters or ratemeter-scalers with audible indicators. Any locations of elevated direct radiation detected by surface scans were marked for further investigation—to include additional surface scans, as deemed necessary to delineate contamination boundaries.

Surface Activity Measurements

Direct alpha and beta measurements were performed at any locations of elevated radioactivity and/or areas distinguishable from background detected during surface scans that potentially exceeded the surface release criteria. Direct measurements were performed using gas proportional detectors coupled to portable ratemeter-scalers. A smear sample for determining removable gross alpha and gross beta activity was collected from each direct measurement location. Tritium smears were also collected at each elevated direct measurement location identified by surface scans.

Surface activity measurements were collected at areas of elevated activity identified during scanning in Buildings 45, 61, OSE, OSW. No random measurements were collected in these buildings.

Seven survey units in the T-Building were selected for random H-3 sampling due to the fact that H-3 is a low-energy beta emitter that cannot be detected with conventional survey instrumentation. Direct alpha and beta measurements, as well as removable alpha and beta activity measurements

(gross alpha/beta smears), were collected at each random location in addition to H-3 smears (Figures 10 to 16). The Sign Test was used to compare each survey unit directly with the applicable release criterion for H-3. The random measurement locations were selected using a random number generator. Additional details regarding the survey design are presented in Appendix D.

Areas of residual activity in excess of the site release criteria were brought to the immediate attention of the CH2MHill and DOE site representatives.

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples were returned to the ORISE laboratory in Oak Ridge, Tennessee for analysis and interpretation. Sample analyses were performed in accordance with the ORISE Laboratory Procedures Manual (ORISE 2006d). Smear samples collected for the quantification of gross alpha/beta activity were analyzed using a low-background proportional counter. Smear samples collected for the quantification of H-3 were analyzed using liquid scintillation spectroscopy. Smear sample and direct measurement results are reported in units of disintegrations per minute per one-hundred square centimeters (dpm/100 cm^2).

The data generated were compared with the approved release criteria established for the MCP site. Data and samples collected, as part of this survey, will be archived by ORISE.

APPLICABLE SITE GUIDELINES

The primary COCs at the T-Building were alpha emitters (polonium and transuranics), beta-gamma emitters (with Sr/Y-90 being a mixed fission product and subject to the mixed fission product criteria), and H-3. CH2MHill used the most restrictive radionuclide group as listed in the applicable guidelines from DOE Order 5400.5 (DOE 1993 and 1995). The same limits were also applied at the non-process buildings, including Buildings 45, 61, OSE, and OSW. The release criteria are as follows:

<u>Total Alpha Activity</u>

100 dpm/100 cm^2, averaged over a 1 m^2 area

300 dpm/100 cm^2, maximum in a 100 cm^2 area

Removable Alpha Activity

20 dpm/100 cm^2

Total Beta Activity

5,000 dpm/100 cm^2, averaged over a 1 m^2 area

15,000 dpm/100 cm^2, maximum in a 100 cm^2 area

Removable Beta Activity

1,000 dpm/100 cm^2

Removable Tritium Activity

10,000 dpm/100 cm^2

FINDINGS AND RESULTS

TYPE A VERIFICATION

ORISE reviewed the PRS 66 VSAP and associated documentation, the PRS Removal Action (On-Scene Coordinator) OSC Report, and the PRS 66 Data Report (CH2 2003b, 2005b, and 2005c). All identified comments were appropriately addressed by the contractor via email correspondence and several teleconferences (Appendix E). As discussed in a November 21, 2006 letter summarizing the conclusions of the Parcels 6, 7, and 8 data review (ORISE 2006e), the documentation review indicated that the contractor's verification survey design and data were technically defensible and support the final site conclusions. However, ORISE recommended that the MCP document the minimum detectable concentration (MDC) for the detection of Pu-238 during field scans, given that there appeared to be a discrepancy between the estimated *a priori* MDC of 1667 pCi/g (CH2 2003c) and the assumed actual scan MDC of 350 pCi/g which was determined based on field experience and data. The latter value was not documented and was communicated to ORISE by the contractor. Therefore, ORISE recommended that the derivation of this value be documented (ORISE 2006e). It should be noted that the contractor appropriately increased the sample density in areas where Pu-238 was a COC to account for the fact that the scan MDC for Pu-238 exceeded the hot spot criteria of 165 pCi/g. This additional set of samples was collected during "pre-verification" sampling,

which was a phase of sampling that was performed only in areas where the scan MDC exceeded the "hot spot" criteria.

TYPE B VERIFICATION

Type B verifications were performed to verify that CH2MHill had met the guideline criteria established for the various areas of the site. ORISE implemented the approved plans to evaluate building and structural surfaces. A summary letter was issued by ORISE in October of 2006 to document the preliminary results for the Type B verification (ORISE 2006f). The results are discussed in the following section.

BUILDINGS/STRUCTURES

Surface Scans

The alpha and alpha plus beta surface scan results are presented in Table 2. The alpha floor scan results generally ranged from 0 to 45 counts per minute (cpm). The alpha plus beta floor scan results ranged from 400 to 3,400 cpm. The alpha wall/ceiling scan results ranged from 0 to 220 cpm and the alpha plus beta wall/ceiling scan results generally ranged from 105 to 640 cpm, with two "hot spots" on the lower walls of the T-Building that indicated up to 10,000 cpm. Several areas of elevated activity that required remediation and/or additional investigation were identified. Areas where elevated surface activity was identified included a source holder in Building 45, three locations on floor tile in the former tritium calibration lab in Building 45 (Room 108), three locations on carpeted surfaces on Building OSE, and five floor and lower wall locations in the T-Building. Direct surface activity measurements were collected at these locations.

Surface Activity Levels

A summary of elevated surface activity results for Buildings 45, 61, OSE, OSW, and the T-Building is provided in Table 1. The only area of elevated activity detected outside of the T-Building was detected on a source holder in Building 45. The result of 4,800 dpm/100 cm^2 (beta surface activity) was less than the guideline value. However, because the source holder had a cylindrical geometry and the measured area had a surface area less than 100 cm^2, this location was called to the attention

of the DOE. All other locations where direct measurements were collected in Buildings 45 and OSE were well below the site release limits.

Elevated beta surface activity was detected in three areas of the T-Building, with results ranging from 22,000 to 94,000 dpm/100 cm^2. Elevated alpha surface activity results were detected in two areas of the T-Building, with results ranging from 320 to 2,400 dpm/100 cm^2. All areas in Table 1 were remediated by CH2MHill and verified to be less than the applicable guidelines by the contractor. Because three locations of elevated activity were identified near the floor/wall interface where contamination could have potentially migrated into a seam, ORISE recommended that CH2MHill perform an investigation of potential contamination in these areas by removing a portion of the wall such that the floor beneath the wall could be accessed for survey. The results of this investigation were verified by an independent contractor (Stoller) under contract to DOE Legacy Management (LM) and were not re-verified by ORISE.

Table 1: **ELEVATED RESULTS SUMMARY**

Building	Room#/ Location	Survey Unit #	Location	Result (dpm/100 cm^2)	Applicable Guideline (dpm/100 cm^2)
45	001	1	Source holder	4,800 (β)[a]	5,000[b] (15,000)[c]
T-Building	N/A	1C-10	NW corner, lower wall at floor/wall interface	94,000 (β)	15,000[c]
T-Building	58	1C-12	North wall, lower wall at floor/wall interface	22,000 (β)	15,000[c]
T-Building	234	2S-07	Floor adjacent to south wall near door	22,000 (β)	15,000[c]
T-Building	277	2C-14	Floor adjacent to south wall at floor/wall interface	2,400 (α)	300[c]
T-Building	Main Tunnel (Room 204)	2S-02	Floor on east side near hatch	320 (α)	300[c]

[a]Result is in dpm due to cylindrical geometry and small surface area.
[b]Measurements of average contamination should not be averaged over an area of more than 1 m^2. For objects of smaller surface area, the average should be derived for each object.
[c]The maximum concentration level applies to an area of not more than 100 cm^2.

The removable H-3 and alpha and beta surface activity results for random measurements collected in the T-Building are provided in Tables 3 to 9. All random measurement results were less than the applicable guidelines.

It should be noted that the Mound 2000 Approach specifies a removable tritium limit of 10,000 dpm/100 cm^2 and indicates that tritium smears should be collected with a dry filter (BWXTO 1999). This method deviates from the guidance contained in a 1995 memo from the DOE Office of the Assistant Secretary for Environment, Safety, and Health (DOE 1995), "Application of DOE 5400.5 Requirements for Release and Control of Property Containing Residual Radioactive Material," which recommends an interim guideline of 10,000 dpm/100 cm^2 for removable tritium; and states that "The measurements should be conducted by a standard smear measurement but using a wet swipe or piece of styrofoam." As such, ORISE recommended that a further review and evaluation of the Mound 2000 Approach for the assessment of removable tritium activity be performed to assure conformance with the referenced guidance (ORISE 2006f).

COMPARISON OF RESULTS WITH GUIDELINES

All direct measurement results at areas identified by scanning and at random measurement locations were less than the applicable site guidelines, with the exception of the six locations summarized in Table 1. The six areas of elevated activity have been remediated by the contractor. Therefore, all areas evaluated by ORISE meet the applicable site guidelines.

CONCLUSION

During the period of September through November 2006, ORISE performed a comprehensive independent verification of the final status survey activities at the MCP. The scope of the ORISE verification included a Type A review of the contractor's procedures and measurement techniques for Parcels 6, 7, and 8 (ORISE 2006e), and verification surveys of the contractor's data for Buildings 45, 61, OSE, OSW, and the T-Building (ORISE 2006f). The verification surveys (scans) of the evaluated buildings were performed over an extensive area, with concentrated efforts in the buildings with the highest potential for contamination (Buildings 45, 61, and the T-Building). During the three-week survey effort, only six small areas of elevated activity were detected, and these areas were subsequently remediated by the contractor. Based on the results of the verification

activities performed by ORISE at the MCP, it is ORISE's conclusion that the evaluated areas meet the applicable site guidelines.

FIGURES

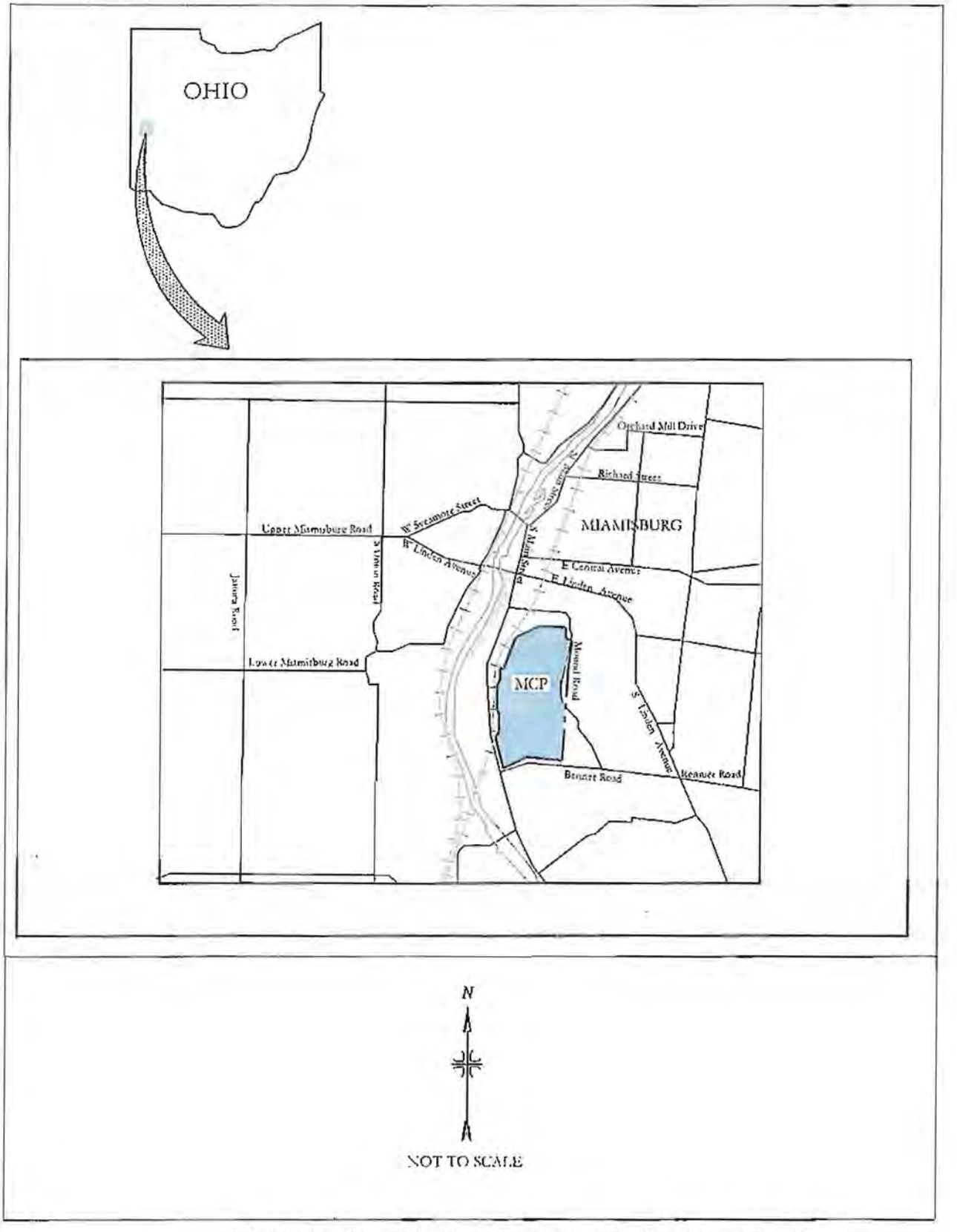

FIGURE 1: Map of Miamisburg, Ohio Area - Miamisburg Closure Project

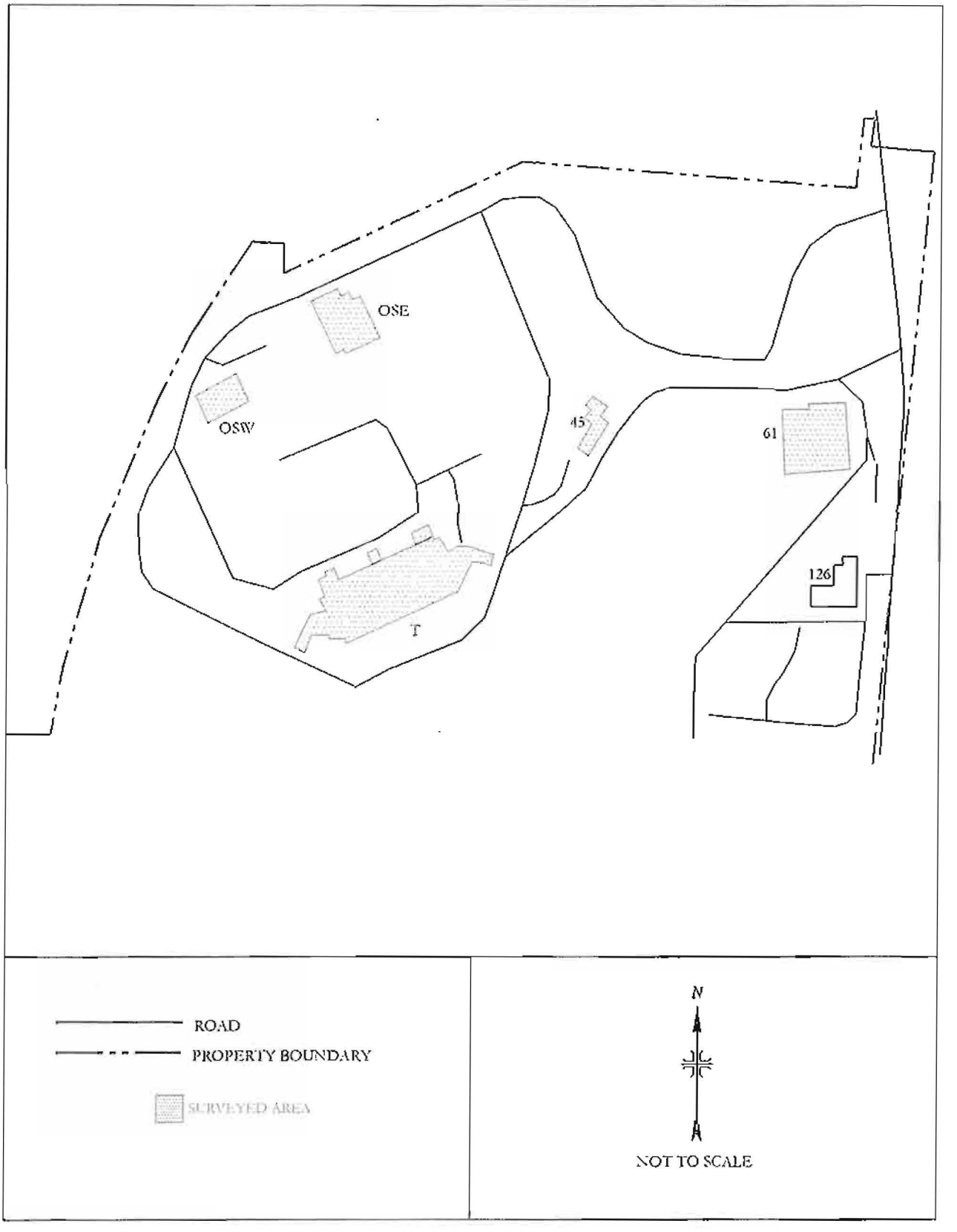

FIGURE 2: Site Plot Plan - Location of Buildings 45, 61, OSE, OSW and T

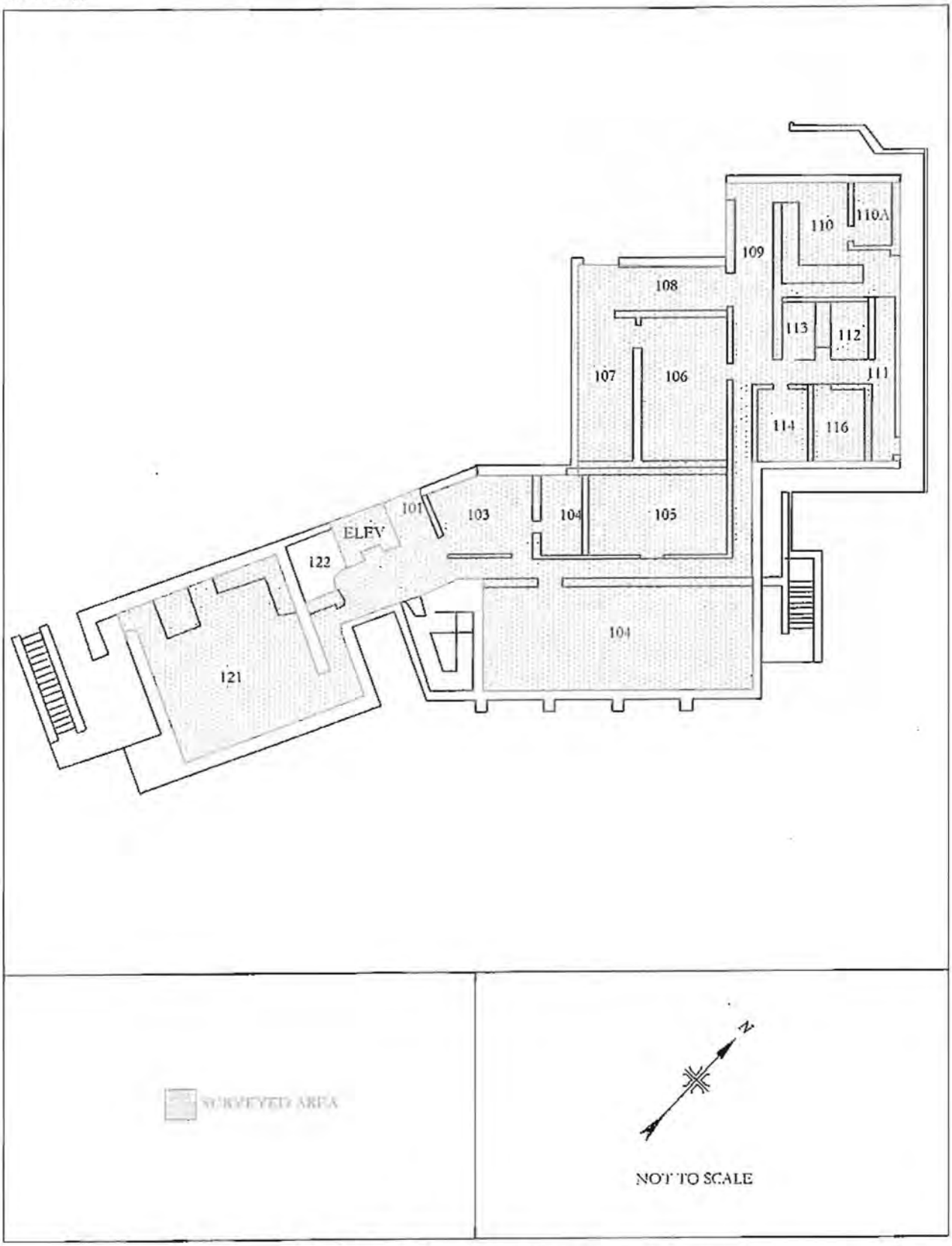

FIGURE 3: Building 45 First Floor - Surveyed Areas

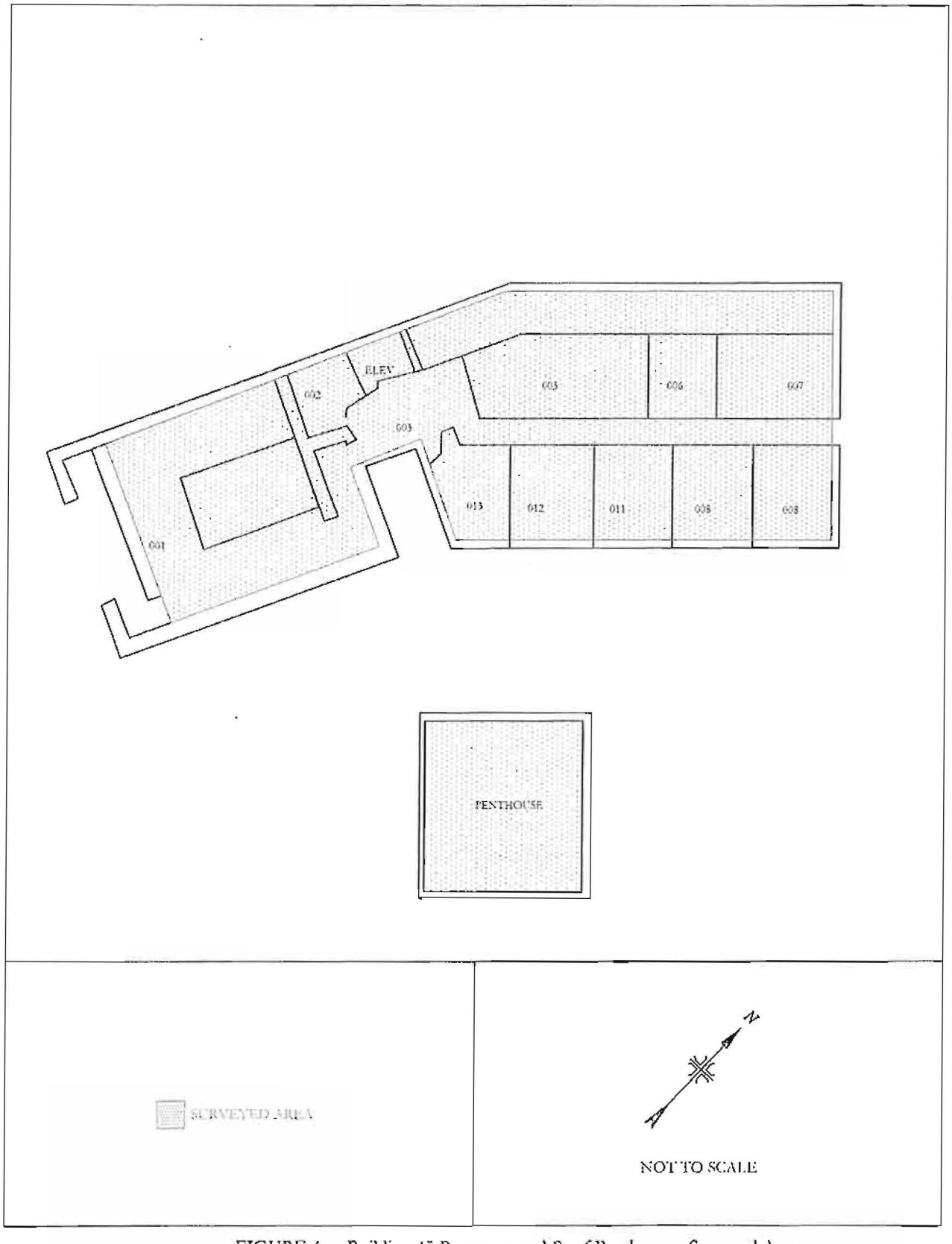

FIGURE 4: Building 45 Basement and Roof Penthouse - Surveyed Areas

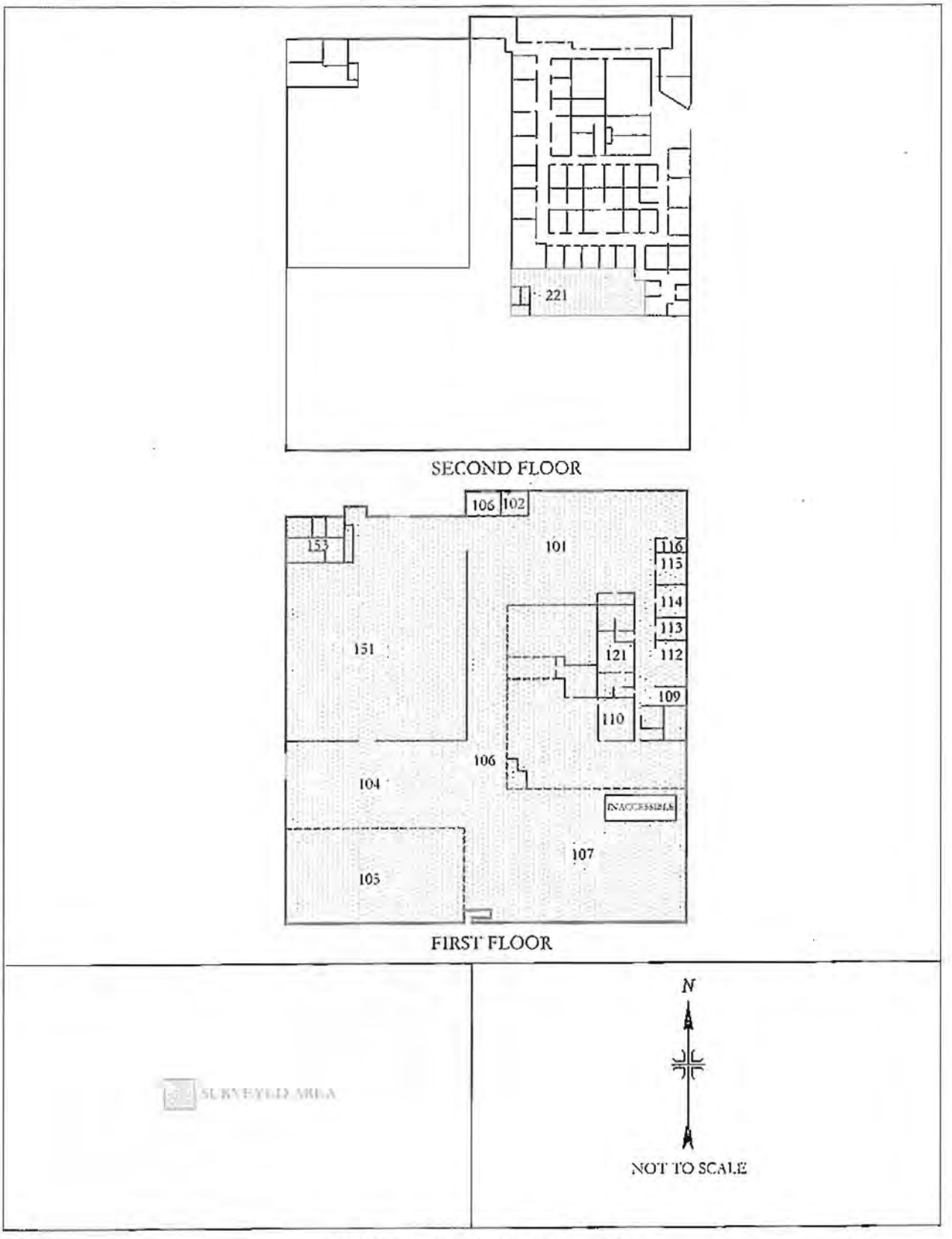

FIGURE 5: Building 61 - Surveyed Areas

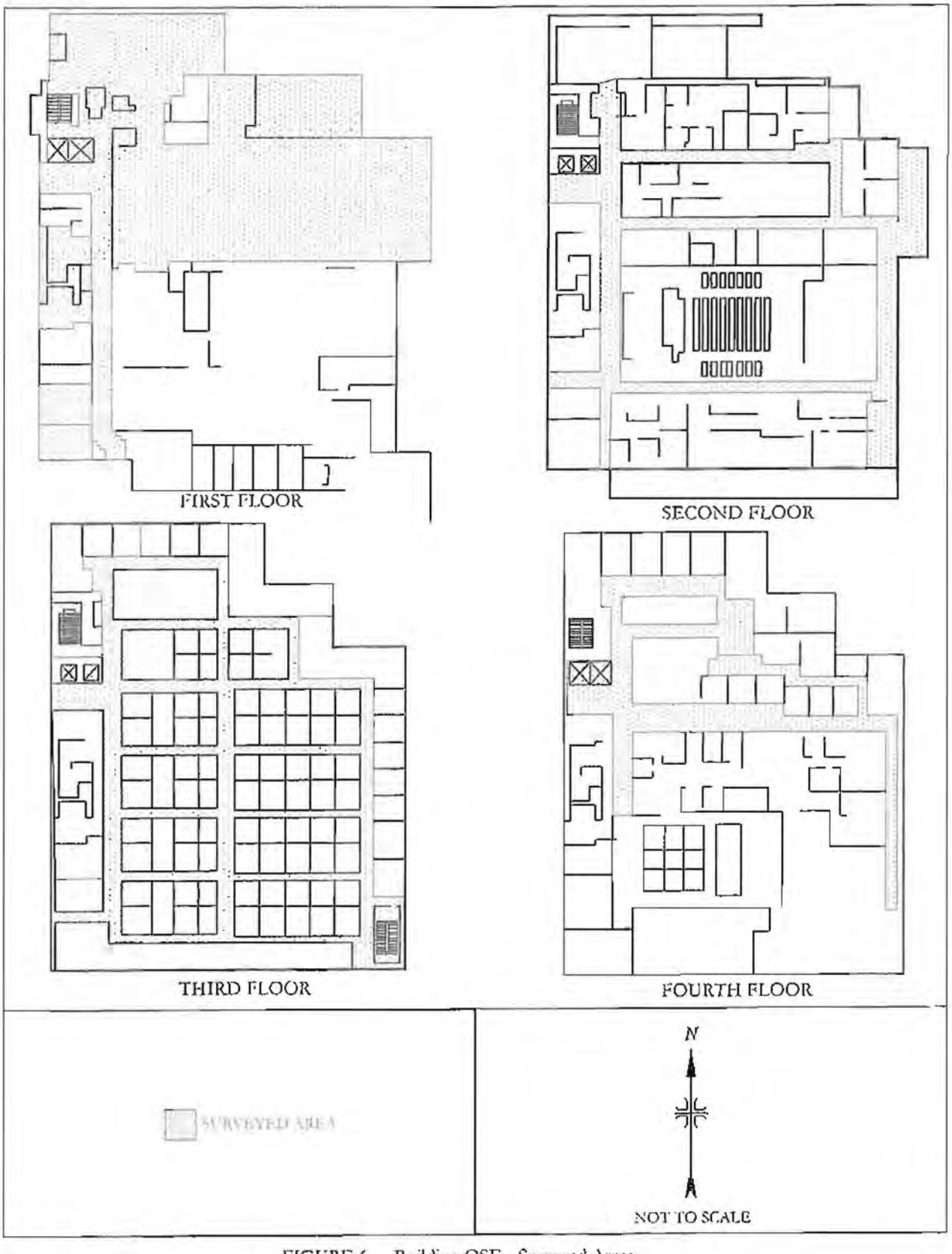

FIGURE 6: Building OSE - Surveyed Areas

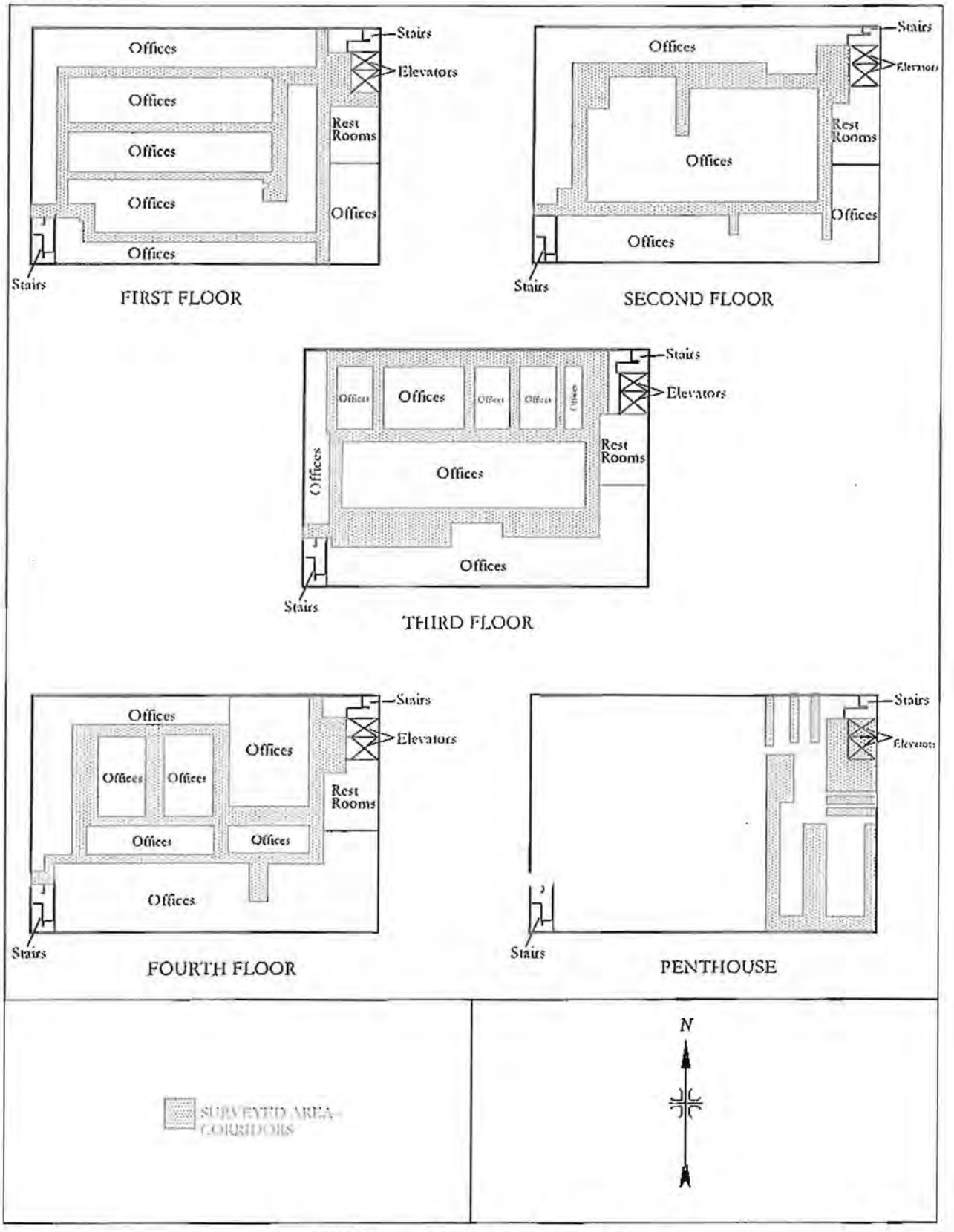

FIGURE 7 : Building OSW - Surveyed Areas

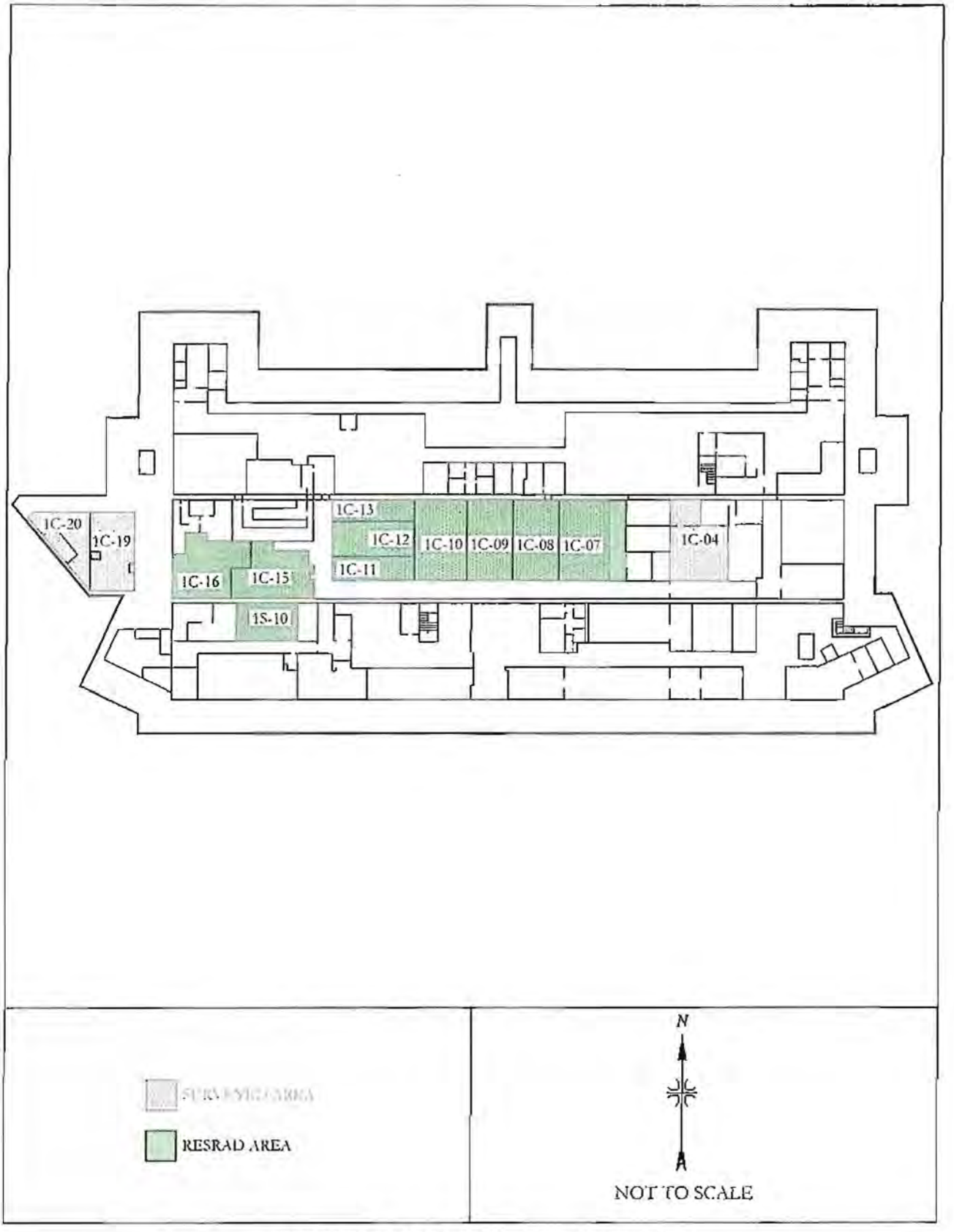

FIGURE 8: T-Building - First Floor - Surveyed Areas

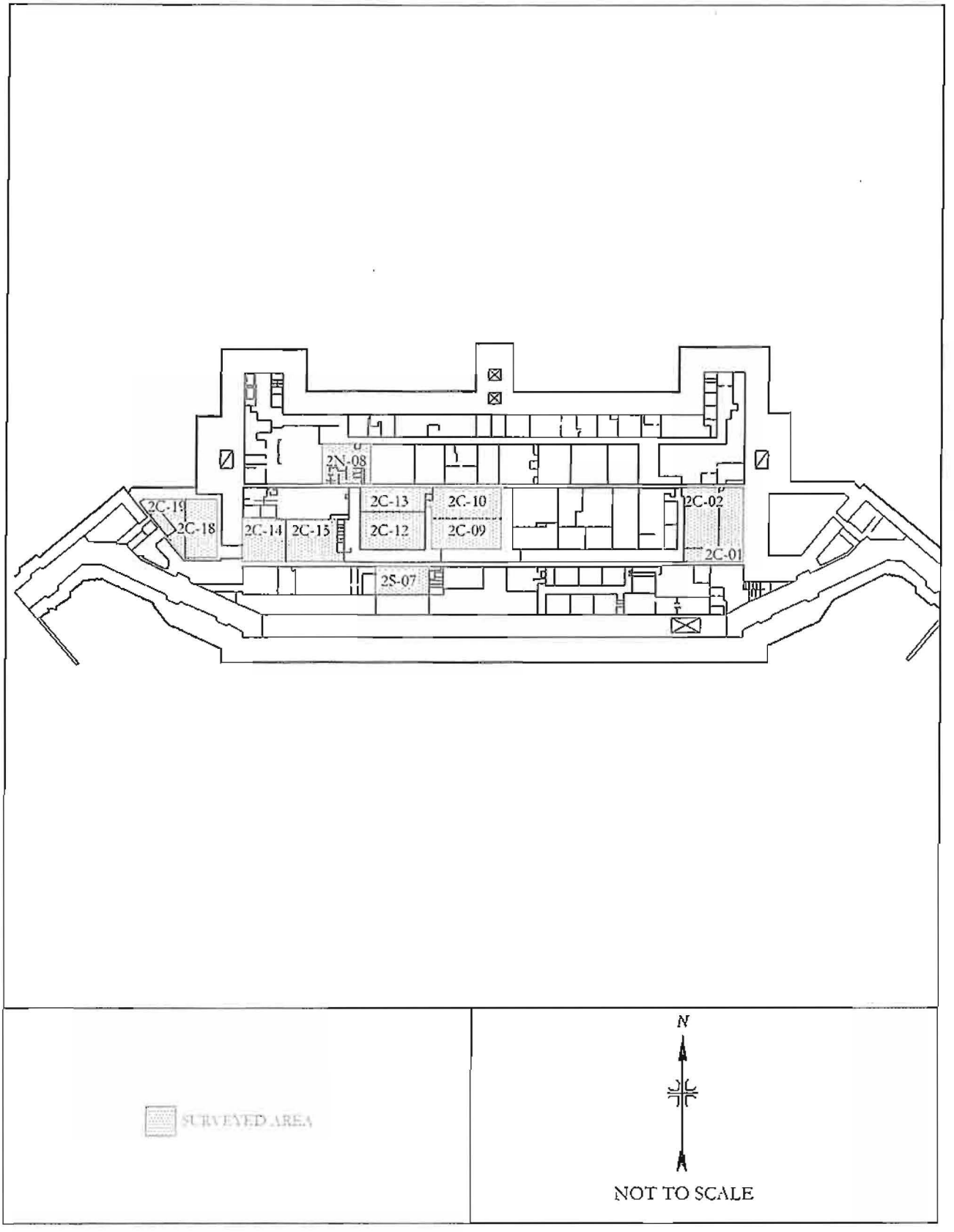

FIGURE 9: T-Building - Second Floor - Surveyed Areas

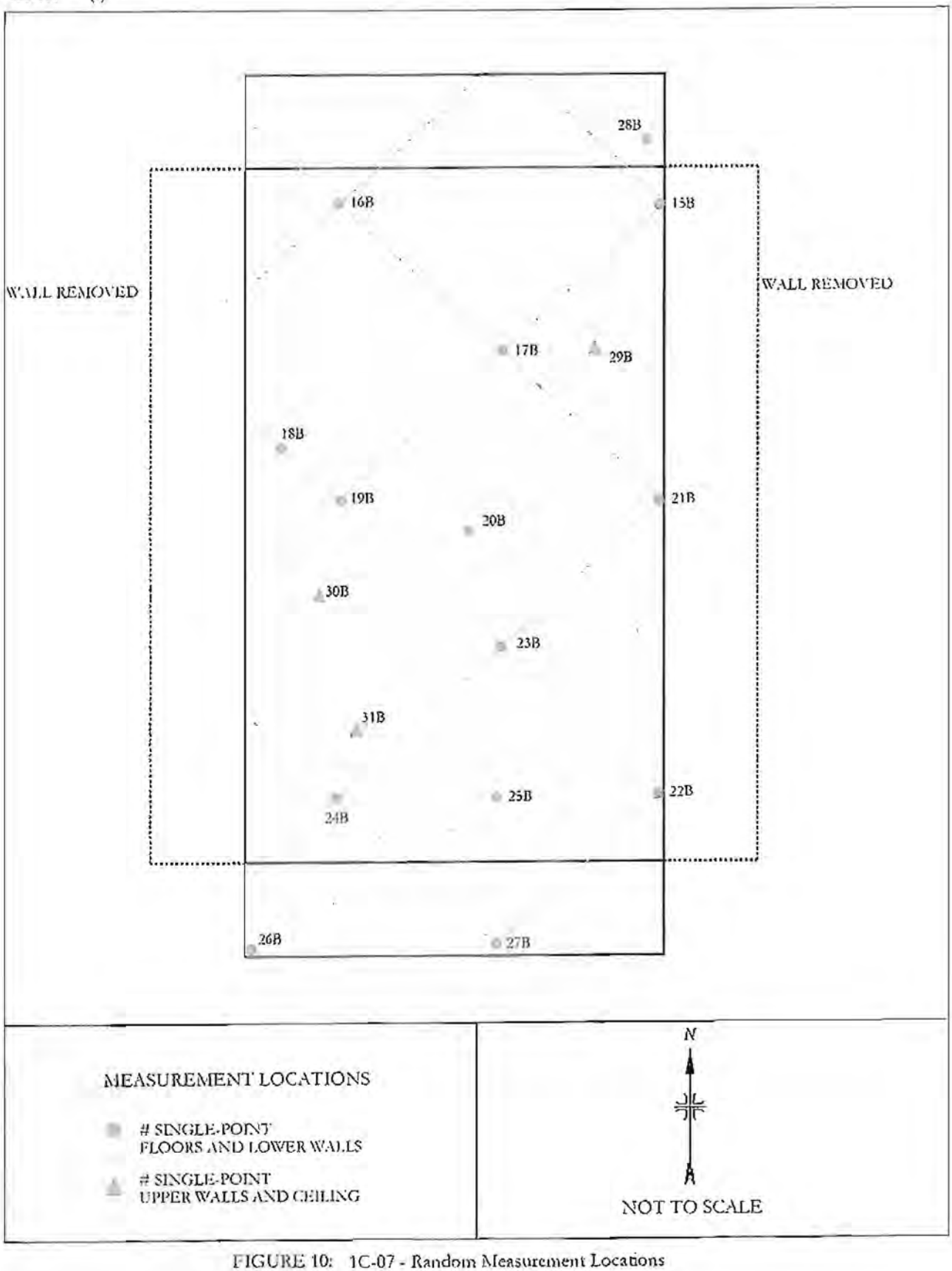

FIGURE 10: 1C-07 - Random Measurement Locations

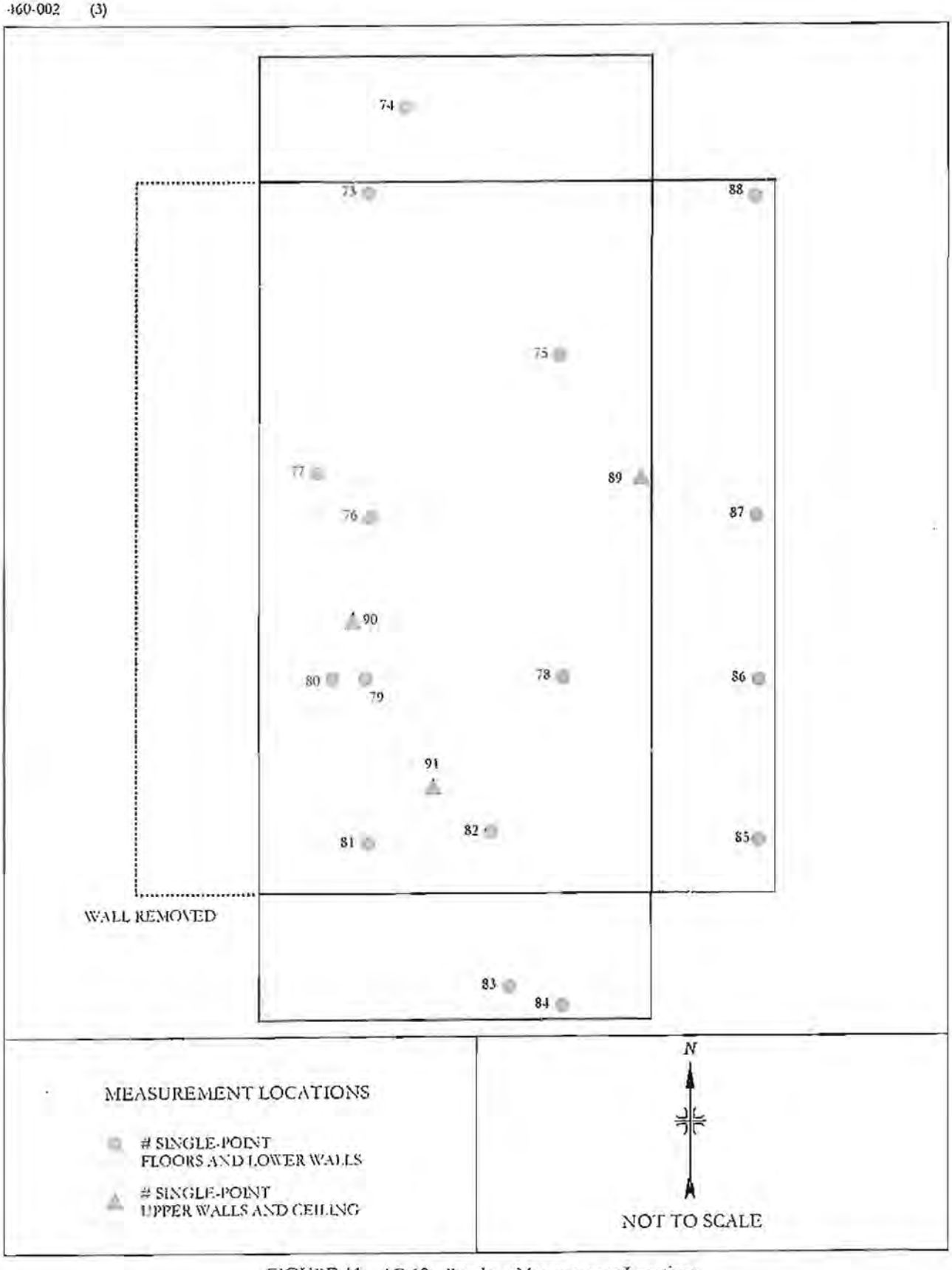

FIGURE 11: 1C-19 - Random Measurement Locations

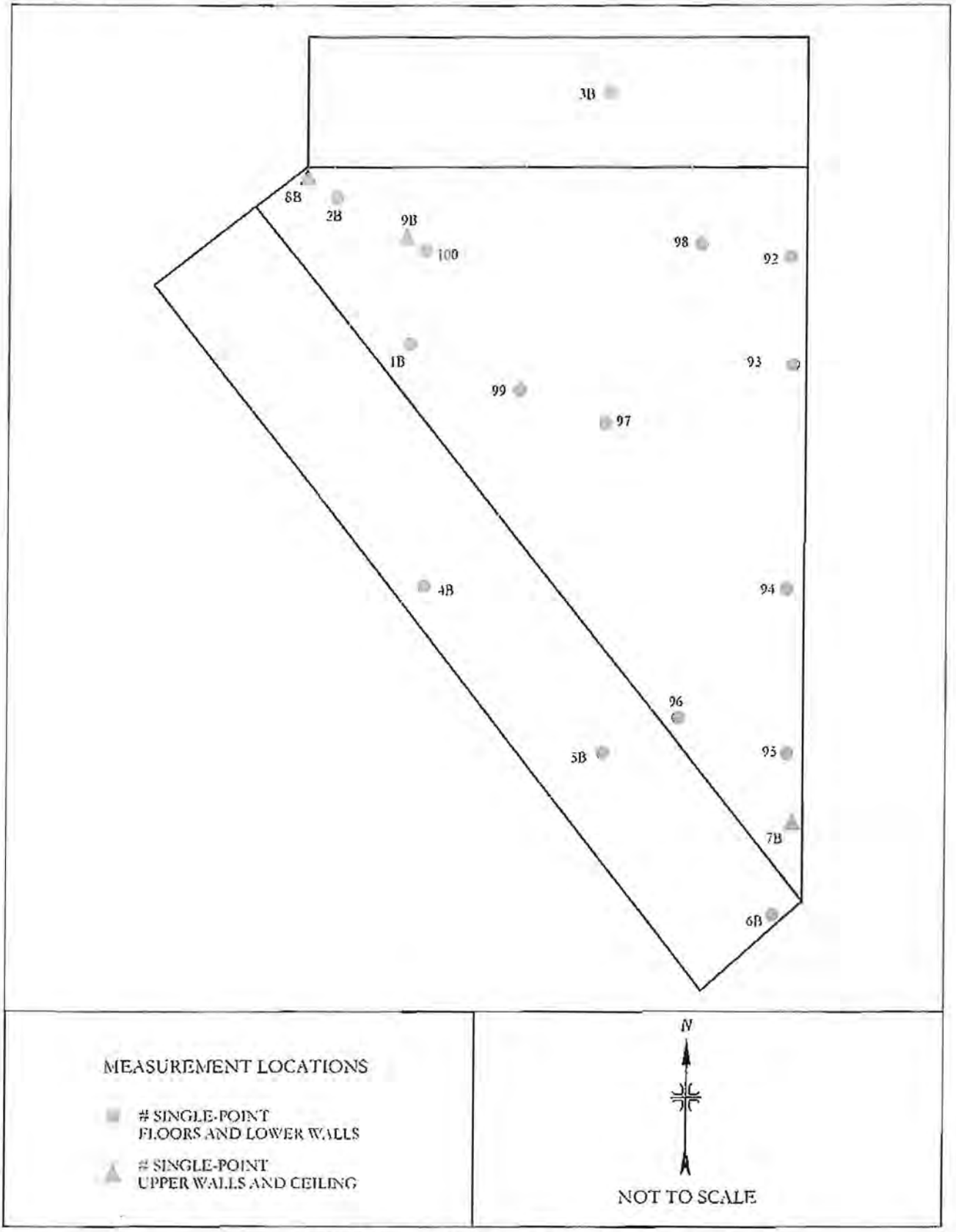

FIGURE 12: 1C-20 - Random Measurement Locations

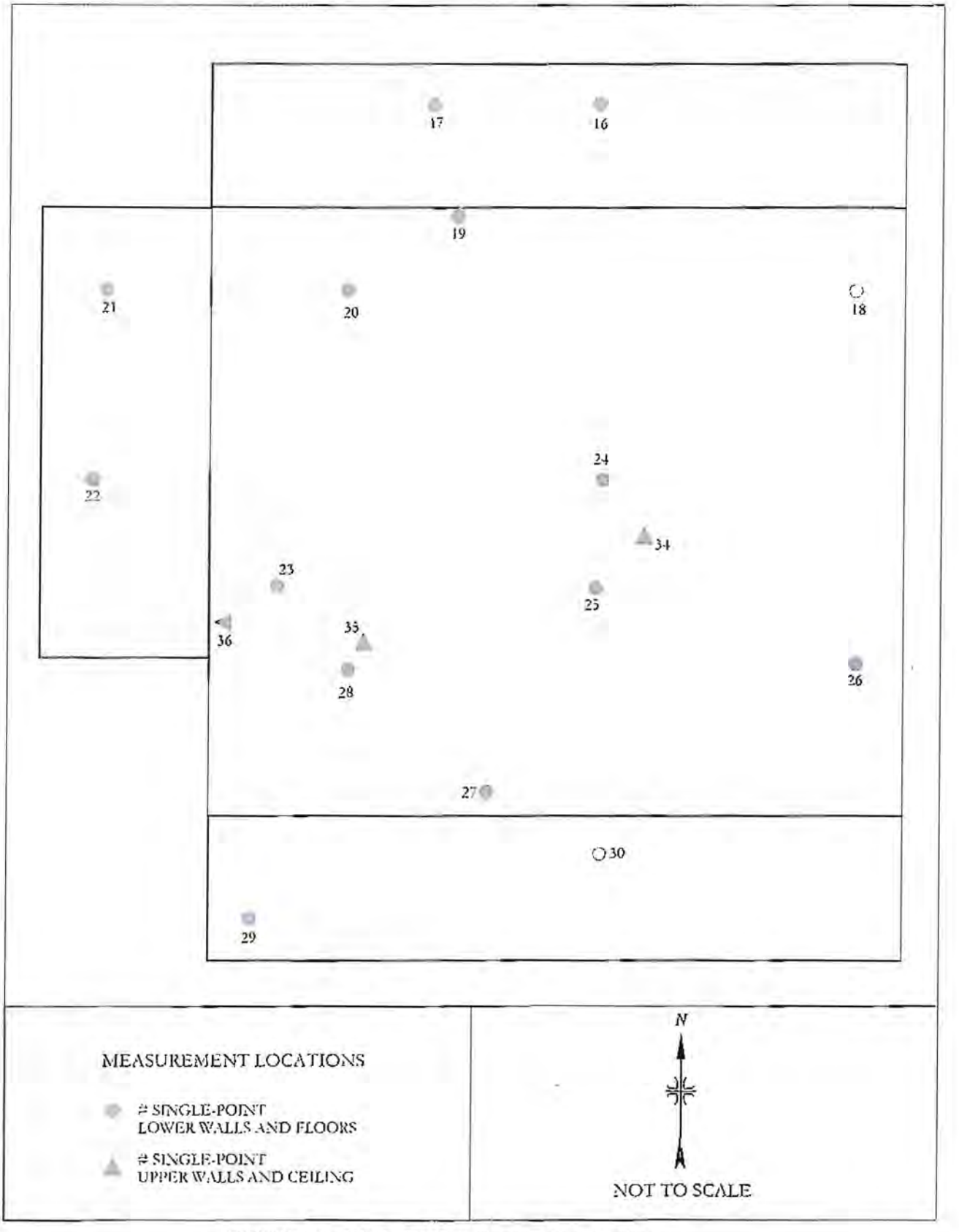

FIGURE 13: 2C-14 - Random Measurement Locations

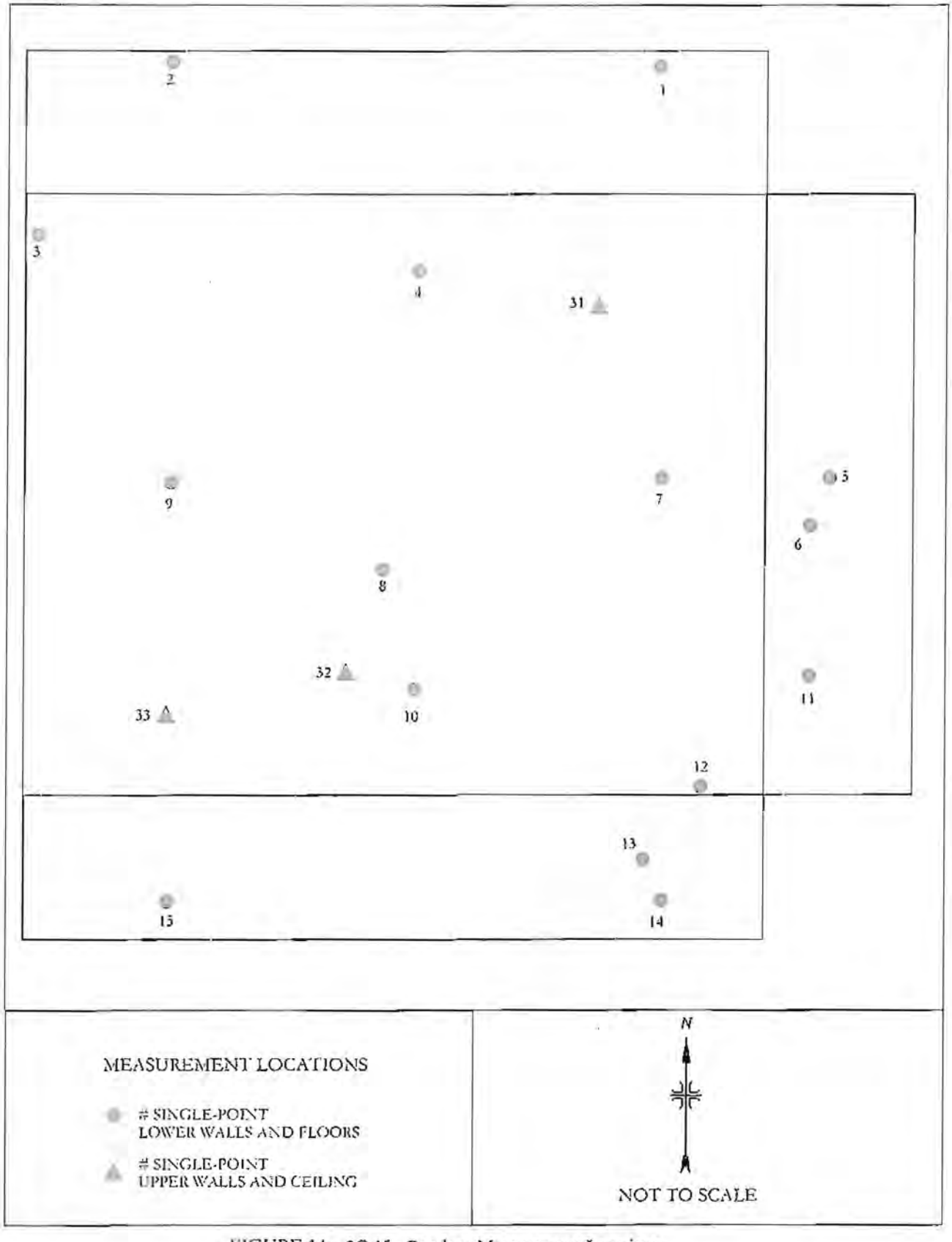

FIGURE 14: 2C-15 - Random Measurement Locations

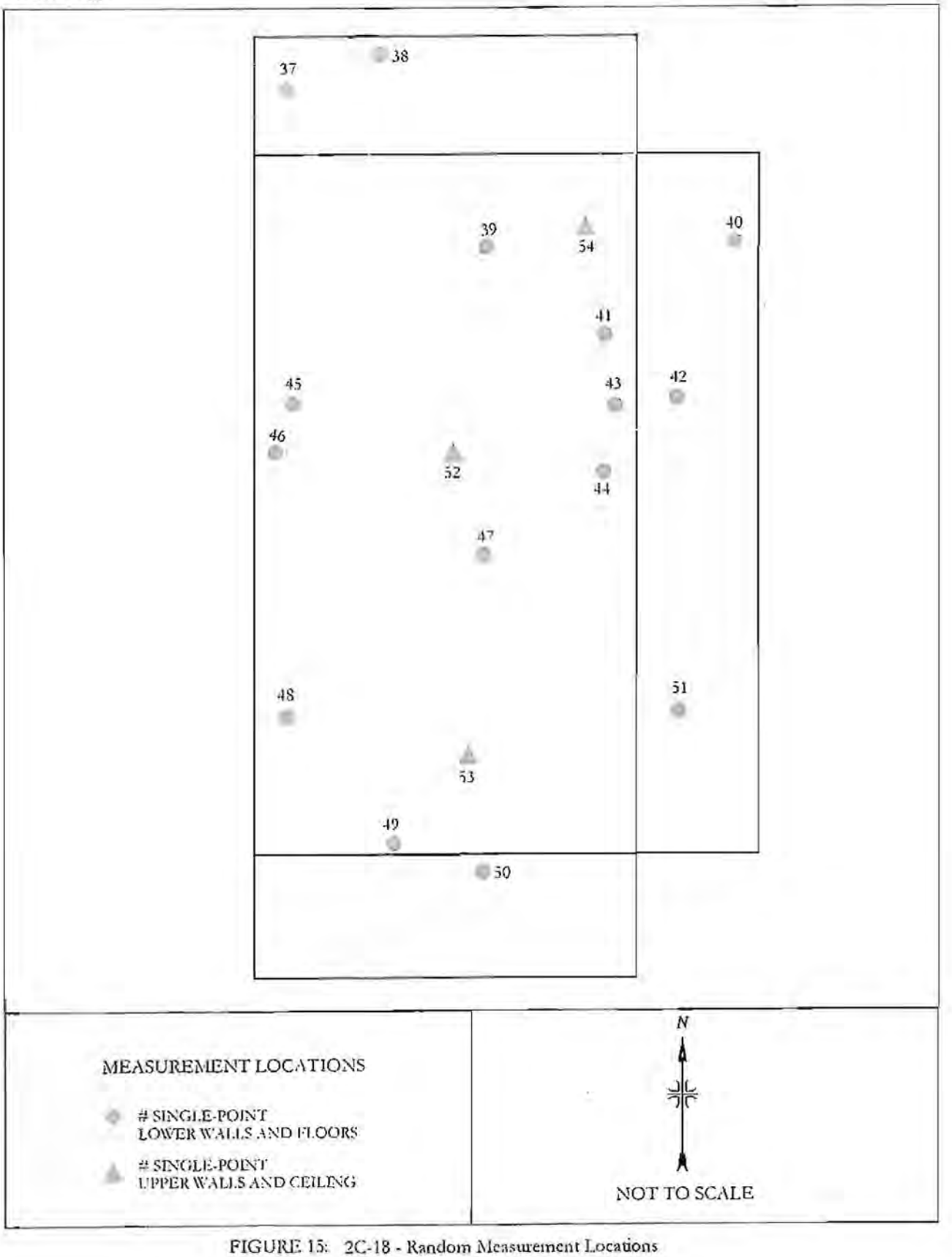

FIGURE 15: 2C-18 - Random Measurement Locations

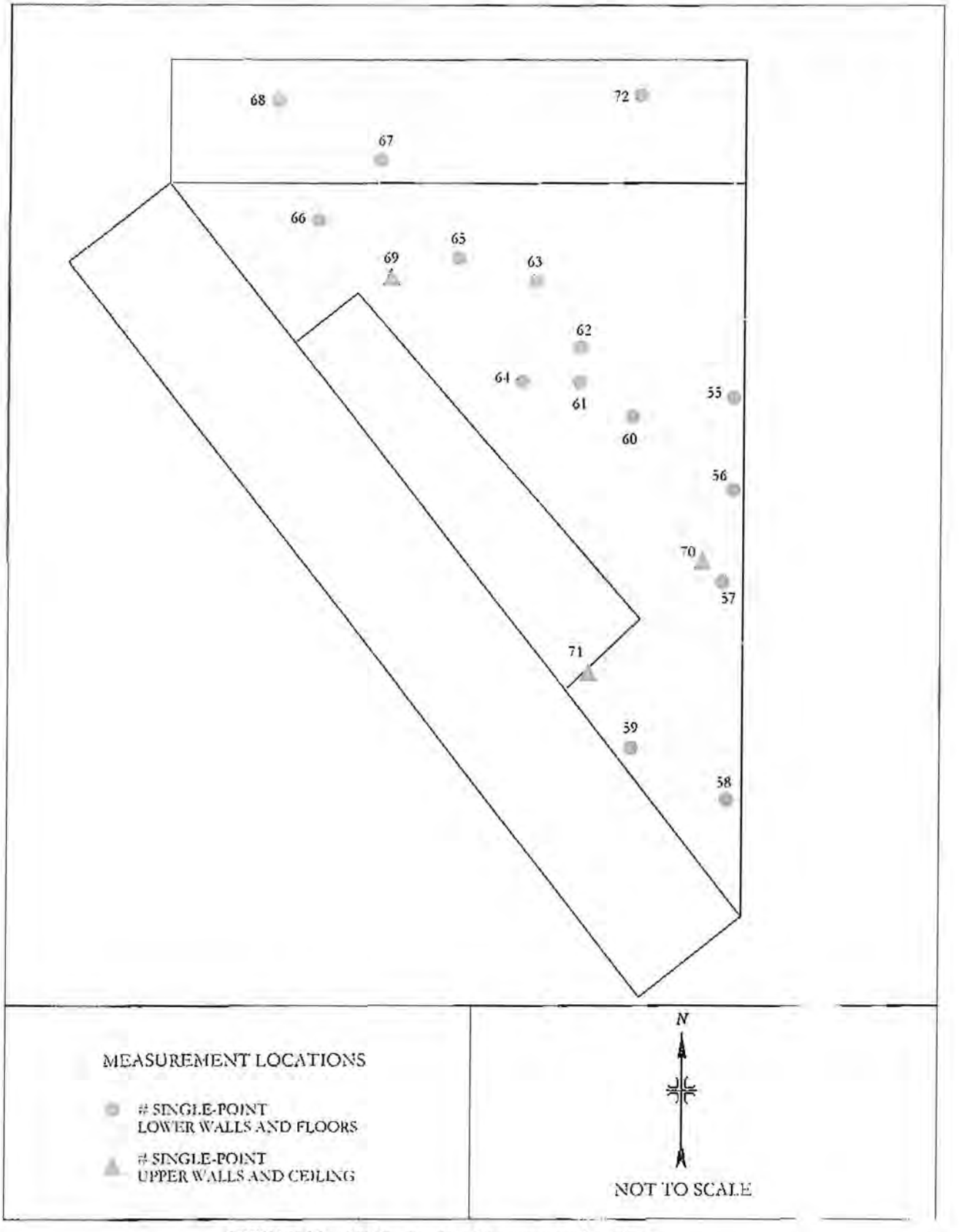

FIGURE 16: 2C-19 - Random Measurement Locations

TABLES

TABLE 2

SURFACE SCAN RESULTS

Building	Scan Ranges (cpm)					
	Floors		Lower Walls		Upper Walls/Ceiling	
	α	α+β	α	α+β	α	α+β
45	N/A[a]	850 to 1,750	0 to 19	110 to 640	—[b]	---
61	N/A[a]	700 to 2,100 (375 to 560)[c]	0 to 22	120 to 410	0 to 12	120 to 410
OSE	0 to 43	750 to 2,200	---	---	---	---
OSW	0 to 37	830 to 1,700	---	---	---	---
T	0 to 45	400 to 3,400	0 to 220	150 to 10,000	0 to 31	110 to 600

[a]Floor monitor used to perform α+β scans only.
[b]Not performed.
[c]Results for small area detector (126 cm^2) which was used to scan mezzanine floor.

TABLE 3

T-BUILDING
SURVEY UNIT 1C-07
SURFACE ACTIVITY LEVELS
MIAMISBURG CLOSURE PROJECT
MIAMISBURG, OHIO

Measurement/ Smear #	Location	ALPHA Surface Activity (dpm/100 cm²)		BETA Surface Activity (dpm/100 cm²)		Removable Tritium Activity (dpm/100 cm²)
		Total	Removable	Total	Removable	
15B/15C	Floor	45	-0.37	24	-1.6	-9
16B/16C	Floor	37	1.5	390	-1.6	-7
17B/17C	Floor	54	3.3	110	3.8	8
18B/18C	Floor	45	-0.37	-71	-3.8	-14
19B/19C	Floor	12	-0.37	290	-2.7	6
20B/20C	Floor	-5	-0.37	150	-1.6	17
21B/21C	Floor	-5	-0.37	59	0.54	17
22B/22C	Floor	29	-0.37	690	-1.6	8
23B/23C	Floor	12	1.5	380	-0.54	29
24B/24C	Floor	4	-0.37	460	1.6	2
25B/25C	Floor	20	-0.37	94	0.54	6
26B/26C	Lower Wall	4	-0.37	-610	0.54	5
27B/27C	Lower Wall	29	-0.37	-420	1.6	-7
28B/28C	Lower Wall	29	-0.37	250	1.6	4
29B/29C	Upper Wall	20	-0.37	-420	-0.54	19
30B/30C	Upper Wall	12	1.5	-360	2.7	16
31B/31C	Upper Wall	37	1.5	-410	0.54	14

TABLE 4

T-BUILDING
SURVEY UNIT 1C-19
SURFACE ACTIVITY LEVELS
MIAMISBURG CLOSURE PROJECT
MIAMISBURG, OHIO

Measurement/ Smear #	Location	ALPHA Surface Activity (dpm/100 cm^2)		BETA Surface Activity (dpm/100 cm^2)		Removable Tritium Activity (dpm/100 cm^2)
		Total	Removable	Total	Removable	
73/73A	Floor	12	1.5	-280	-2.7	86
74/74A	Lower Wall	20	1.5	-240	1.6	120
75/75A	Floor	12	1.5	-470	-3.8	85
76/76A	Floor	-5	-0.37	-170	-0.54	70
77/77A	Floor	4	-0.37	-270	-0.54	73
78/78A	Floor	-5	-0.37	71	-2.7	84
79/79A	Floor	4	-0.37	-250	-1.6	33
80/80A	Floor	29	-0.37	80	0.54	47
81/81A	Floor	54	-0.37	90	-0.54	70
82/82A	Floor	4	-0.37	470	-0.54	72
83/83A	Lower Wall	-5	1.5	47	0.54	150
84/84A	Lower Wall	12	1.5	-350	-2.7	330
85/85A	Lower Wall	29	-0.37	120	3.8	72
86/86A	Lower Wall	20	-0.37	-170	0.54	170
87/87A	Lower Wall	4	-0.37	-190	-0.54	140
88/88A	Lower Wall	-5	-0.37	-59	3.8	310
89/89A	Ceiling	20	-0.37	440	-1.6	16
90/90A	Ceiling	-5	-0.37	200	0.54	48
91/91A	Ceiling	20	-0.37	660	-2.7	30

TABLE 5

T-BUILDING
SURVEY UNIT 1C-20
SURFACE ACTIVITY LEVELS
MIAMISBURG CLOSURE PROJECT
MIAMISBURG, OHIO

Measurement/ Smear #	Location	ALPHA Surface Activity (dpm/100 cm²)		BETA Surface Activity (dpm/100 cm²)		Removable Tritium Activity (dpm/100 cm²)
		Total	Removable	Total	Removable	
92/92A	Floor	20	-0.37	520	-2.7	68
93/93A	Floor	-5	1.5	82	-4.9	100
94/94A	Floor	12	1.5	-35	-0.54	74
95/95A	Floor	-5	1.5	-47	3.8	63
96/96A	Floor	-5	1.5	-180	1.6	63
97/97A	Floor	29	-0.37	-270	0.54	150
98/98A	Floor	-5	-0.37	-340	1.6	130
99/99A	Floor	4	1.5	-380	3.8	84
100/100A	Floor	12	-0.37	94	-0.54	75
1B/1C	Floor	-5	-0.37	-140	-1.6	110
2B/2C	Floor	12	-0.37	-390	0.54	55
3B/3C	Lower Wall	-5	-0.37	180	-1.6	86
4B/4C	Lower Wall	-5	-0.37	-140	0.54	47
5B/5C	Lower Wall	29	1.5	-120	4.9	120
6B/6C	Lower Wall	29	-0.37	310	-1.6	130
7B/7C	Ceiling	20	-0.37	580	-1.6	45
8B/8C	Ceiling	-5	1.5	-720	-0.54	12
9B/9C	Ceiling	37	-0.37	550	4.9	43

TABLE 6

T-BUILDING
SURVEY UNIT 2C-14
SURFACE ACTIVITY LEVELS
MIAMISBURG CLOSURE PROJECT
MIAMISBURG, OHIO

Measurement/ Smear #	Location	ALPHA Surface Activity (dpm/100 cm²)		BETA Surface Activity (dpm/100 cm²)		Removable Tritium Activity (dpm/100 cm²)
		Total	Removable	Total	Removable	
16/16A	Lower Wall	20	-0.37	-180	-4.9	0
17/17A	Lower Wall	-5	-0.37	-530	-1.6	-9
18/18A	Floor	37	-0.37	790	-3.8	4
19/19A	Floor	12	1.5	1,100	-1.6	-2
20/20A	Floor	12	-0.37	-730	-0.54	290
21/21A	Lower Wall	29	-0.37	-670	-2.7	-3
22/22A	Lower Wall	29	1.5	-530	-1.6	20
23/23A	Floor	45	-0.37	960	-3.8	19
24/24A	Floor	29	-0.37	-410	2.7	83
25/25A	Floor	20	-0.37	-330	-1.6	75
26/26A	Floor	45	1.5	1,200	-3.8	19
27/27A	Floor	20	-0.37	270	1.6	9
28/28A	Floor	12	-0.37	140	-0.54	6
29/29A	Lower Wall	29	-0.37	82	0.54	12
30/30A	Lower Wall	12	1.5	-740	-3.8	13
34/34A	Ceiling	29	-0.37	-680	-2.7	7
35/35A	Ceiling	12	-0.37	-560	1.6	-5
36/36A	Ceiling	4	5.2	440	-0.54	56

TABLE 7

T-BUILDING
SURVEY UNIT 2C-15
SURFACE ACTIVITY LEVELS
MIAMISBURG CLOSURE PROJECT
MIAMISBURG, OHIO

Measurement/ Smear #	Location	ALPHA Surface Activity (dpm/100 cm²)		BETA Surface Activity (dpm/100 cm²)		Removable Tritium Activity (dpm/100 cm²)
		Total	Removable	Total	Removable	
1/1A	Lower Wall	-5	-0.37	-120	-2.7	-9
2/2A	Lower Wall	-13	-0.37	-110	-2.7	2
3/3A	Floor	62	-0.37	610	4.9	14
4/4A	Floor	20	1.5	1,000	-0.54	-1
5/5A	Lower Wall	4	-0.37	-35	-2.7	2
6/6A	Lower Wall	-5	1.5	71	3.8	4
7/7A	Floor	12	1.5	420	2.7	7
8/8A	Floor	45	-0.37	660	3.8	14
9/9A	Floor	12	1.5	440	11	-1
10/10A	Floor	-5	-0.37	760	1.6	-5
11/11A	Lower Wall	4	-0.37	59	1.6	23
12/12A	Floor	29	-0.37	800	-0.54	-2
13/13A	Lower Wall	-5	-0.37	-660	-1.6	15
14/14A	Lower Wall	-5	-0.37	-1,100	-2.7	-3
15/15A	Lower Wall	12	1.5	-750	2.7	-20
31/31A	Ceiling	-13	-0.37	-270	1.6	-2
32/32A	Ceiling	4	1.5	-760	-1.6	14
33/33A	Ceiling	12	-0.37	-670	-1.6	4

TABLE 8

T-BUILDING
SURVEY UNIT 2C-18
SURFACE ACTIVITY LEVELS
MIAMISBURG CLOSURE PROJECT
MIAMISBURG, OHIO

Measurement/ Smear #	Location	ALPHA Surface Activity (dpm/100 cm^2)		BETA Surface Activity (dpm/100 cm^2)		Removable Tritium Activity (dpm/100 cm^2)
		Total	Removable	Total	Removable	
37/37A	Lower Wall	29	-0.37	190	1.6	27
38/38A	Lower Wall	20	1.5	-960	-2.7	36
39/39A	Floor	-5	-0.37	450	-2.7	170
40/40A	Lower Wall	-5	1.5	130	-3.8	37
41/41A	Floor	20	-0.37	530	-0.54	3,200
42/42A	Lower Wall	12	1.5	24	-3.8	35
43/43A	Floor	29	-0.37	260	-0.54	11
44/44A	Floor	29	-0.37	-12	-4.9	120
45/45A	Floor	20	1.5	140	-1.6	84
46/46A	Floor	4	-0.37	150	0.54	55
47/47A	Floor	79	-0.37	-200	-3.8	140
48/48A	Floor	37	-0.37	200	-0.54	47
49/49A	Floor	12	-0.37	-82	-1.6	14
50/50A	Lower Wall	12	1.5	-1000	0.54	82
51/51A	Lower Wall	4	1.5	-510	-0.54	87
52/52A	Ceiling	4	-0.37	2,600	0.54	40
53/53A	Ceiling	37	3.3	-260	-1.6	65
54/54A	Ceiling	20	-0.37	-790	-0.54	22

TABLE 9

T-BUILDING
SURVEY UNIT 2C-19
SURFACE ACTIVITY LEVELS
MIAMISBURG CLOSURE PROJECT
MIAMISBURG, OHIO

Measurement/ Smear #	Location	ALPHA Surface Activity (dpm/100 cm²)		BETA Surface Activity (dpm/100 cm²)		Removable Tritium Activity (dpm/100 cm²)
		Total	Removable	Total	Removable	
55/55A	Floor	12	-0.37	280	0.54	160
56/56A	Floor	4	1.5	-240	3.8	38
57/57A	Floor	37	-0.37	-59	-2.7	58
58/58A	Floor	20	-0.37	-330	-3.8	44
59/59A	Floor	29	-0.37	190	-1.6	31
60/60A	Floor	20	-0.37	-82	-3.8	51
61/61A	Floor	-5	1.5	12	1.6	38
62/62A	Floor	29	-0.37	94	-1.6	350
63/63A	Floor	45	-0.37	71	1.6	78
64/64A	Floor	29	1.5	-170	-0.54	72
65/65A	Floor	12	-0.37	140	-1.6	42
66/66A	Floor	45	-0.37	940	-3.8	76
67/67A	Lower Wall	12	1.5	-1,000	-3.8	110
68/68A	Lower Wall	37	1.5	460	1.6	30
69/69A	Ceiling	20	-0.37	1,600	-0.54	34
70/70A	Ceiling	4	-0.37	-600	-3.8	72
71/71A	Ceiling	-5	-0.37	-740	-1.6	61
72/72A	Lower Wall	12	-0.37	-1,200	-0.54	14

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U.S. Department of Energy. Environment, Safety and Health Bulletin: A Guide to Good Practices for the Control and Release of Property. DOE/EH-0697. Washington, DC. July 2006.

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

SCANNING INSTRUMENT/DETECTOR COMBINATIONS

Alpha and 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)

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

DIRECT MEASUREMENT INSTRUMENT/DETECTOR COMBINATIONS

Alpha and Alpha plus 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)

Tri-Carb Liquid Scintillation Analyzer
Model 3100
(Packard Instrument Co., Meriden, CT)

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

PROJECT HEALTH AND SAFETY

The survey and sampling procedures were evaluated to ensure that any hazards inherent to the procedures themselves were addressed in current job hazard analyses (JHAs). All survey and laboratory activities were conducted in accordance with ORISE health and safety and radiation protection procedures.

Pre-survey activities included the evaluation and identification of potential health and safety issues. Site staff provided site-specific safety awareness training at the MCP for each individual ORISE survey effort. Verification surveys were performed according to the ORISE generic health and safety plan for Buildings 45, 61, OSE, and OSW and according to the project-specific health and safety plan for the T-Building (ORISE 2006g). All site activities were also performed in accordance with the site-specific Integrated Safety Management (ISM) pre-job hazard checklists and safety procedures discussed during the on-site training.

QUALITY ASSURANCE

Analytical and field survey activities were conducted in accordance with procedures from the following documents of the Independent Environmental Assessment & Verification program:

- Survey Procedures Manual (August 2006)
- Laboratory Procedures Manual (April 2006)
- 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.

CALIBRATION

Calibration of all field and laboratory 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 efficiency (ε_{total}) was determined for each instrument/detector combination and consisted of the product of the 2π instrument efficiency (ε_i) and surface efficiency (ε_s): $\varepsilon_{total} = \varepsilon_i \times \varepsilon_s$.

Tc-99 was used as the calibration source for assessing beta surface activity for the T-Building (maximum beta energy of 292 keV) as it provides a conservative representation of the radionuclide mixture. Tc-99 has a maximum beta energy similar to that of Co-60 (maximum beta energy of 318 keV), which is a primary COC in the T-Building. ISO-7503 recommends an ε_s of 0.25 for beta emitters with a maximum energy of less than 0.4 MeV (400 keV) and an ε_s of 0.5 for maximum beta energies greater than 0.4 MeV. Therefore an ε_s value of 0.25 was applied.

Tl-204 was used as the calibration source for assessing beta surface activity for Building 45, 61, OSE, and OSW (maximum beta energy of 746 keV) based on the contaminants of concern and for consistency with the contractor (contractor utilized Cl-36). ISO-7503 recommends an ε_s of 0.25 for

[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.

beta emitters with a maximum energy of less than 0.4 MeV (400 keV) and an ε_s of 0.5 for maximum beta energies greater than 0.4 MeV. Therefore an ε_s value of 0.5 was applied.

Th-230 was used as the calibration source for assessing alpha surface activity at the MCP. ISO-7503 recommends an ε_s of 0.25 for alpha emitters. Therefore an ε_s value of 0.25 was applied.

SURVEY PROCEDURES

Surface Scans

Surface scans were performed by passing the detector slowly over the surface of interest; while maintaining the distance between the detector and the surface at a minimum—nominally within 1 cm. Structural surfaces such as building floor and wall surfaces and equipment were scanned using gas proportional hand-held detectors. A large area detector (550 cm^2) was used to cover floor areas.

Hand-held detectors were placed on contact with the calibration sources. A postulated hot-spot size of 100 cm^2 was assumed *a priori* for determining scanning instrument efficiencies. The calculated scanning ε_{total} values ranged from 0.07 to 0.20 for the hand-held gas proportional detector calibrated with Tc-99 and Tl-204 (the lower range represents a detector calibrated using Tc-99 with a 3.8 $\mu g/cm^2$ mylar window, which was used for the T-Building to minimize interference from alpha-emitting isotopes); and from 0.10 to 0.11 for Th-230. Calibration source emission rates were not corrected for geometry when sources larger than the detectors were used.

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. Typical beta background count rates, which varied between the individual gas proportional detectors, ranged from 182 to 303 cpm. Alpha backgrounds ranged from 1 to 2 cpm. Additional parameters selected for the calculation of scan MDC 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. To illustrate an example for the hand-held gas proportional detectors, a nominal scan MDC can be calculated as follows:

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

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

The nominal beta scan MDC for the gas proportional detectors used (calculated using conservative parameters) was approximately 4,000 dpm/100 cm^2.

The alpha scan MDC was calculated using the method described in Section 6.7.2.2 of the MARSSIM, which is based on the probability of detecting an area of contaminated at a predetermined guideline level for given scan rates.

Given an assumed efficiency of 0.10 and a scan rate of approximately 2.5 cm per second, the probability of detecting a "hot-spot" of 300 dpm/100 cm^2 was approximately 92%.

The identification of elevated radiation levels that could exceed the site criteria was determined based on an increase in the audible signal from the indicating instrument.

Surface Activity Measurements

Measurements of total alpha and beta surface activity levels were performed using gas proportional detectors with 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 net count rate by ε_{total} and correcting for the physical area of the detector.

Because there were no non-impacted areas within the T-Building that could be used to determine a material-specific background for beta surface activity measurements, and because there appeared to be a large difference between the observed instrument backgrounds between the first floor, the second floor, and the TERF area, a statistical evaluation of the data for each area was used to determine the appropriate beta background. First, the areas were divided up based on geographical location and the observed backgrounds (first floor, 2C-14 and 2C-15, and 2C-18 and 2C-19). Next, a 10% trimmed mean was calculated for the data set. If the 10% trimmed mean was approximately equal to the mean, then the distribution was assumed to be symmetrical (normal) (Ott 1993). Therefore, the mean of the data set was a good approximation of background.

The average instrument background was used to represent background for direct alpha measurements.

The *a priori* MDC for surface activity measurements was calculated using the following equation:

$$MDC = \frac{3 + (4.65\sqrt{B})}{Tx\varepsilon_{Tot}xG}$$

Where:

B	=	background (total counts) in time interval, T
T	=	count time (min) used for field instruments
ε_{Tot}	=	total efficiency = ε_i x ε_s
ε_i =	=	instrument efficiency
ε_s	=	source efficiency
G	=	geometry (physical detector area $cm^2/100$)

The *a priori* beta static MDC was approximately 870 dpm/100 cm^2 and the *a priori* alpha static MDC was approximately 75 dpm/100 cm^2. The physical surface area assessed by the gas proportional detector used was 126 cm^2.

Removable Activity Measurements

Removable gross alpha and gross beta activity levels were determined 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 for two minutes 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 gross alpha and gross beta, respectively.

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 [$3 + (4.65\sqrt{BKG})$]. 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.

Uncertainties

The uncertainties associated with the analytical data presented in the tables of this report represent the total propagated uncertainties for that data. These uncertainties were calculated based on both the gross sample count levels and the associated background count level.

APPENDIX C

RESIDUAL RADIOACTIVE MATERIAL GUIDELINES SUMMARIZED FROM DOE ORDER 5400.5

APPENDIX C

RESIDUAL RADIOACTIVE MATERIAL GUIDELINES SUMMARIZED FROM DOE ORDER 5400.5 (DOE 1990)

BASIC DOSE LIMITS

The basic dose limit for the annual radiation (excluding radon) received by an individual member of the general public is 100 mrem/yr. In implementing this limit, DOE applies as low as reasonably achievable principles to set site-specific guidelines.

EXTERNAL GAMMA RADIATION

The average level of gamma radiation inside a building or habitable structure on a site that has no radiological restriction on its use shall not exceed the background level by more than 20 μR/h and will comply with the basic dose limits when an appropriate-use scenario is considered.

SURFACE CONTAMINATION GUIDELINES

	Allowable Total Residual Surface Contamination (dpm/100 cm²)[a]		
Radionuclides[b]	Average[c,d]	Maximum[d,e]	Removable[d,f]
Transuranics, Ra-226, Ra-228, Th-230 Th-228, Pa-231, Ac-227, I-125, I-129	100	300	20
Th-Natural, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000	3,000	200
U-Natural, U-235, U-238, and associated decay products	5,000	15,000	1,000
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above	5,000	15,000	1,000

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

[b] Where surface contamination by both alpha- and beta-gamma-emitting radionuclides exists, the limits established for alpha- and beta-gamma-emitting radionuclides should apply independently.

[c] Measurements of average contamination should not be averaged over an area of more than 1 m^2. For objects of less surface area, the average should be derived for each such object.

[d] The average and maximum dose rates associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h and 1.0 mrad/h, respectively, at a depth of 1 cm.

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

[f] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping an area of that size with dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. The numbers in this column are maximum amounts.

APPENDIX D

STATISTICAL SURVEY DESIGN FOR THE T-BUILDING

APPENDIX D

STATISTICAL SURVEY DESIGN FOR THE T-BUILDING

SURVEY DESIGN SUMMARY

The Sign Test was selected for the statistical test to evaluate the median concentration in each survey unit compared to the release criterion. This test was selected because H-3 is not expected to be present in background, and the test does not assume that the data follow any particular distribution. The null hypothesis and alternative hypotheses are presented below.

Null Hypothesis:

H_0: The median concentration of residual radioactivity in the survey unit is greater than the $DCGL_W$.

Alternative Hypothesis:

H_a: The median concentration of residual radioactivity in the survey unit is less than the $DCGL_W$.

The $DCGL_W$ for H-3 at the MCP is 10,000 dpm/100 cm^2 (removable activity based on collection with a dry filter). ORISE procedures require the collection of H-3 smears with a wet filter, which was the technique utilized at the MCP.

NOTE: The term "DCGL" is used to represent the applicable guidelines at the MCP. Because the DOE Order 5400.5 limits were applied, the "DCGLs" were not actually derived limits.

DETERMINATION OF NUMBER OF DATA POINTS

The number of data points was determined using the following parameters:

DCGL = 10,000 (dpm/100 cm^2)
LBGR = 4,000

σ = 3,000
Δ = 10,000 – 4,000 = 6,000
Relative shift (Δ/σ) = 2

$\alpha = 0.05$
$\beta = 0.05$

N = 15 (from Table 5.5 of the MARSSIM)

NOTE: All H-3 smear results were less than the DCGL of 10,000 dpm/100 cm^2, therefore the Sign Test was not performed. The actual standard deviation for each data set was verified to be less than σ.

APPENDIX E

ORISE COMMENTS AND CONTRACTOR RESPONSES ON PRS 66 DATA AND DOCUMENTATION

APPENDIX E

ORISE COMMENTS AND CONTRACTOR RESPONSES ON
PRS 66 DATA AND DOCUMENTATION

Comment Set #1 (November 6, 2006)

1) Page 2 of the VSAP discusses the walkover survey procedures, but does not provide details regarding the type of instrumentation used and the Scan MDC. Please provide this information or point to another document where this information is provided.

Response: The walkover instrument used was a FIDLER (Field Indication Detector for Lower Exposure Radiation). Scan MDCs are agreed upon and documented (PRS 66 pink soil document) as follows:

Pu-238	*350 pCi/g (value based on site experience and agreement with the regulators)*
Th-232	*1.0 pCi/g*
Ac-227+D	*4.48 pCi/g*
Cs-137	*1.3 pCi/g*
Ra-226+D	*0.96 pCi/g*
U-238+D	*11.16 pCi/g*

Detector Response to Th-232 Adjusted for Cleanup Criteria prepared by Argonne National Laboratories. Proposal: Re-characterization of "Pink" soils at PRS 66 Phase III, VI, and Phases VIII, IX, and X.

2) Section 3.4 of the VSAP (page 4) states the following: "As specified in Figure 4, and where excavation exceeds expected limits, verification analysis will be offsite isotopic alpha spec where plutonium, thorium, and/or uranium results are greater than the cleanup objectives." Please clarify the statement "where excavation exceeds expected limits." Is this based on field screening or onsite gamma spectroscopy results?

Response: It was based on both and visible debris. The removal plan required that we 'chase' visible debris, field indication (FIDLER readings) and soil sample results > hot spot (both offsite and onsite) to the extent of contamination above the set cleanup goal. Expected limits were defined by the characterization data but were also expected to exceed those limits, which it did.

3) Section 4.0 of the VSAP discusses "onsite alpha spec." Please provide a discussion of the onsite alpha spectroscopy analysis procedures, or point to another document where this information is provided.

Response: Chemical separation was performed for Th-227, Th-228, Th-230, and Th-232 run through a column, plated and counted. MDA (pCi/g) with a 100 min count time is 0.1 pCi/g. Procedure available upon request.

4) It is assumed based on the derivation of the COs for individual contaminants that a sum of ratios (SOR) calculation did not apply for PRS 66. A brief discussion of the comparison of sample results to the COs would be appreciated.

Response: You are correct that SOR did not apply. A comparison of individual sample results to individual hot spot criteria was manually performed and if >hot spot criteria additional excavation required. The results were then compared to the individual cleanup criteria ($10E^{-5}$ RBGV + background or as agreed).

5) Appendix A of the PRS 66 VSAP, page 3, states that "The Lower Bound of the Gray Region (LBGR) for Th-232 is selected at 95% of the mean of the measurement results in the characterization data set that are less than the cleanup objective." Please discuss why the results that exceeded the cleanup objective were excluded in the LBGR determination.

Response: Because it was anticipated that the removal action would result in Th-232 values less than the cleanup objective. Essentially, a simulated as left condition representing a potential LBGR.

6) Appendix B of the VSAP, page 3, states that "if a value of 7 nCi/g is present, it will be identified by the field instrumentation." This is in reference to Pu-238 contamination. This statement is not completely understood, given that the CO for Pu-238 is 55 pCi/g. Please clarify.

Response: At the time of this VSAP writing, no scan MDCs had been defined for the FIDLER. The historical sample result of 7 nCi/g was the basis of PRS 40 and was not confirmed through PRS 66 characterization sampling taken in that area. The statement was justification that a separate removal action and verification sample for PRS 40 was not required. Walkovers, verification and excavation of PRS 66 would sufficiently prove that a value of 7 nCi/g of Pu-238 would not be left undetected and PRS 40 could be closed out.

7) Appendix B of the VSAP, page 7, states that "Characterization revealed 11 isolated instances of isotopes that are not primary COCs but are present at levels above their cleanup objectives." Please provide a brief discussion of the decision model that was used to either include or discount individual COCs, especially in cases such at this where the COCs identified during characterization were not included in the list of primary COCs for the PRS.

Response: The Core Team agreed based on characterization results that these limited isolated Potential Contaminants of Concern (PCOC's) were co-located with primary COC in all cases and would be removed as the primary COC were addressed per the approved PRS 66 work plan. Additionally, field screening and verification sampling took in account all contaminants within these isolated areas. These activities were also overseen by Ohio EPA.

8) Figure 3 of the VSAP has a NOTE pertaining to removing Pu-238 from the list of COCs for PRS 66 because only one boring identified Pu-238 above the CO. Please provide a brief discussion of the decision model that was used to either include or discount individual COCs based on soil borings, especially in cases such at this where the COCs identified during soil borings were not included in the list of primary COCs for the PRS.

Response: The Core Team agreed that one instance of a contaminant was not statistically valid to be included in the COC list. Contaminants found >CO during characterization which were not identified as a COC were limited in occurrence and co-located with other waste or contaminants. It was anticipated that the sampling and analysis for screening and verifying the COC's would be sufficient to insure these isolated contaminants were no longer present. Mound 2000 allows for adding a COC, if a PCOC is found to be more prevalent than was originally believed or if the approved work plan does not address its proper detection as anticipated.

9) The PRS 66 OSC Report does not include Pu-239 and U-234 in the list of COCs on page iv. However, these isotopes are included in the VSAP (specified as "isolated"). Please provide an explanation for this discrepancy.

Response: During the removal action these isotopes were not identified as COCs; however they were analyzed for and reported in the PRS 66 Data Report.

Comment Set #2 (Request for Additional Clarification) (November 13, 2006)

1a) Regarding the scan MDC for Pu-238, is there empirical data to support the 350 pCi/g value? ORISE would also appreciate an explanation of the derivation of the scan MDCs for other contaminants, as well.

Response: Field experiments were performed on soils with known low levels of Pu-238. The instrument was passed over the soil areas, when the instrument indicated an audible response; a soil sample was taken and analyzed by onsite gamma spec. The average low sample of 350 pCi/g was detected. The other contaminates underwent a Monte Carlo modeling that was detailed in the "Pink Soil Proposed Plan".

4a) Please provide additional explanation as to why the SOR did not apply. It is assumed that the derivation of the (risk based not dose based) dose-based limits included the assumption that each COC could exist at the derived CO. Please clarify.

Response: PRS 66 was a pre MARSSIM removal and verification action. Some concepts of MARSSIM were applied to the verification. The risk based limits to include cumulative risk were calculated and evaluated on the parcel of land to be transferred that included PRS 66 as well as other PRSs (ref: Parcel 6, 7, & 8 Residual Risk Evaluation additionally this process is described in the Mound 2000 Work Plan).

6a) Please provide additional discussion regarding the extent of the characterization effort (#, location, and type of samples, etc.) used to identify the COCs and their locations within the PRS, and associated verification sampling and analysis performed, to further justify when Pu-238 was considered only an isolated COC and to justify the verification sampling methods.

Response: A brief description of the characterization effort is in the "pink soils proposed plan". Pu-238 was an isolated COC only in particular "phases" of the removal action. PRS 66 characterization samples were collected on a 30' grid pattern via core borings of various depths composited over five foot intervals. Approx. 500 sample locations resulting in several thousand samples being collected and analyzed for numerous contaminates, radiological and chemical. These characterization samples bounded the extent and depth of contamination over the entire PRS 66 footprint. As a result it was noted that PU-238 concentrations exceeding the 10-5 cleanup goal were co-located with more prevalent COCs such as Th-232 and that the Pu-238 hits were clustered in contiguous areas rather than isolated by themselves. These Pu-238 areas were identified as separate phases of the cleanup activity for verification purposes. Pu-238 was identified as a COC in these phases requiring an increased verification sampling frequency due to the inability to field screen for Pu-238 at screening levels. The removal action plan specified the boundaries of each phase, the data report contained "sketches" of each area identifying any additional COCs. In phases were Pu-238 was identified as a COC, alpha spec isotopic Pu analysis was performed on a 30' pre-verification grid. If any sample was above the 10^{5} cleanup goal of 55 pCi/g the sample area was excavated and re-sampled until all sample locations were found to be below the target cleanup level. Once this was achieved a formal 30' off-set final verification grid was established which allowed for isolated hotspots at 3 times the 10^{5} cleanup goal.

In areas not having Pu-238 as a COC the area was pre-verified via a field scan (COCs w/ scan MDC at or below the CO). Once the field scan demonstrated the area to be below action levels, a 30' final verification grid was utilized as above for the Pu-238 areas.

7a) Given that isolated COCs occurred with primary COCs, and because the amount of remediation was sometimes based on this assumption, please provide additional discussion regarding numerical comparisons that were performed regarding the ratios of the primary COCs to isolated COCs and how the concentration of a primary COC can be used to justify compliance with the isolated COC CO.

Response: When determining whether an exceedence was an isolated case and did not need to be identified as a COC the following items were considered. It was only identified as an exceedence to the CO in a couple of sample locations. When performing final verification analysis results would be reported for those contaminates in the suite of results. Example: offsite gamma spec analysis reports results for Ac-227, Cs-137, Th-228, Th-232, Co-60, Am-241, Pb-210, and Ra-226. So while Cs-137 (for example) was not identified as a COC the results are in the final status data report. These results are recorded in the Final, PRS 66 Data Report.
When any verification soil samples were collected, they were first analyzed by Mound onsite gamma spec analysis. The analysis included reporting a value for Pu-238 with an MDA <20 pCi/g. Then the sample was sent offsite for gamma spec which did not include analysis for Pu-238. The onsite value was not reported in the data report; the analysis was for DOT requirements, which was reviewed for <55 pCi/g results. If results would have indicated Pu-238 >55 pCi/g, Pu-238 would have been included as a COC and sent offsite for isotopic Pu analysis.

Comment Set #3 (Regarding "Re-Characterization of Pink Soils" Document) (CH2 2003c) (November 14, 2006)

1) Attachment 6 of the subject document cites 1667 pCi/g as the "Detectable Level" for Pu-238 using a FIDLER for walkover surveys. How does this relate to the 350 pCi/g MDC that was cited by Connie in the last response? I'm assuming that Connie cited the values for field screening of soil samples using the FIDLER. Please clarify.

Response:1667 pCi/g was determined by Monte Carlo model was theoretical and the 350 pCi/g was determined by field experimentation with analytical data supporting that finding.

2) Because Pu-238 is not detectable with field scanning (walkover scanning) at the CO, and because Pu-238 was a primary COC, was the verification sample size increased using the guidance in the MARSSIM? (for cases where actual scan MDC is >> required scan MDC)

Response: PRS 66 was a pre MARSSIM cleanup however some aspects of MARSSIM were incorporated in the plan. During verification the number of sample locations were increased in areas where Pu-238 was a primary COC. The sample frequency used was based on the evaluation of process history and the volume of material which could have been contained within the bed of a dump truck at the time of disposal. The statistical probability of finding a dump truck size hot spot at a 90% confidence level was negotiated and agreed upon with the regulators. This activity is further described in the Final, PRS 66 VSAP.