REFERENCED DOCUMENT

DOE/OR/20722-179

Formerly Utilized Sites Remedial Action Program (FUSRAP)
Contract No. DE-AC05-81OR20722

RADIOLOGICAL AND LIMITED CHEMICAL CHARACTERIZATION REPORT FOR THE NATIONAL GUARD ARMORY

Chicago, Illinois

January 1988

Bechtel National, Inc.

DOE/OR/20722-179

RADIOLOGICAL AND LIMITED CHEMICAL CHARACTERIZATION REPORT FOR THE NATIONAL GUARD ARMORY CHICAGO, ILLINOIS

JANUARY 1988

Prepared for

UNITED STATES DEPARTMENT OF ENERGY

OAK RIDGE OPERATIONS OFFICE

Under Contract No. DE-AC05-81OR20722

By

C.R. Hickey, R.C. Robertson,
and T.M. Dravecky

Bechtel National, Inc.

Oak Ridge, Tennessee

Bechtel Job No. 14501

ABSTRACT

During January and February 1987, a radiological and limited chemical characterization was conducted at the National Guard Armory located in Chicago, Illinois. The characterization was performed as part of the Formerly Utilized Sites Remedial Action Program (FUSRAP), a U.S. Department of Energy effort to identify, clean up, or otherwise control sites where residual radioactive material remains from the early years of the nation's atomic energy program.

A radiological characterization conducted by Argonne National Laboratory established that contamination existed at the site. The 1987 characterization, conducted by the FUSRAP Program Management Contractor, Bechtel National, Inc., was necessary to define locations and boundaries of the contamination to support remedial action.

Measurements taken during the BNI characterization indicated that numerous isolated areas on building surfaces were contaminated in excess of current guidelines. Sludge samples collected from the catch basin system in Rooms 1 and 5 confirmed that the major contaminant was uranium-238. Contamination was found mainly on surfaces inside the building. In addition, contamination in excess of guidelines was found in the catch basin system between Rooms 1 and 5. This material is also contaminated with chemical constituents including volatiles, semi-volatiles, and priority pollutant metals.

TABLE OF CONTENTS

	Page
Abbreviations	ix
1.0 Introduction and Summary	1
1.1 Introduction	1
1.2 Purpose and Objectives	1
1.3 Summary	2
2.0 Site Description and History	3
2.1 Location and Description	3
2.2 Site History	3
2.3 Previous Radiological Surveys	6
2.4 Present Site Conditions	6
3.0 Health and Safety Plan	7
3.1 Subcontractor Training	7
3.2 Safety Requirements	7
4.0 Characterization Procedures	9
4.1 Surface Measurements Taken and Methods Used	9
4.1.1 Exterior Measurements	9
4.1.2 Interior Measurements	9
4.2 Sample Collection and Analyses	10
4.2.1 Exterior Samples	10
4.2.2 Interior Samples	10

CONTENTS
(continued)

	Page
5.0 Characterization Results	15
5.1 Remedial Action Guidelines	15
5.2 Background Radiation Measurements	15
5.3 Exterior Survey Results	16
5.4 Interior Survey Results	17
5.4.1 Floor Survey	17
5.4.2 Wall and Ceiling Survey	18
5.4.3 Survey of Miscellaneous Surfaces	18
5.4.4 Survey of Arena Floor Subsurface	18
5.4.5 Catch Basin Survey	19
5.5 Decontamination Test Surveys	20
References	65
Appendix A Summary of the Procedures and Results of the Limited Chemical Characterization at the NGA	A-1

LIST OF FIGURES

Figure	Title	Page
2-1	Location of the NGA	4
2-2	General Floor Plan of the NGA	5
4-1	Borehole Locations in the Arena	12
4-2	Catch Basin Locations - South Headhouse	13
5-1	Background Radiation Measurement Locations	22
5-2	Exterior Areas of Contamination	23
5-3	Plan of the First Floor - South Headhouse	24
5-4	Plan of the Second Floor - South Headhouse	25
5-5	Areas of Contamination - Bays 3 and 4 (Room 1, First Floor)	26
5-6	Areas of Contamination - Bay 5 (Room 1, First Floor)	27
5-7	Areas of Contamination - Column 1, North Face (Room 1, First Floor)	28
5-8	Areas of Contamination - Bay 6 (Room 1, First Floor)	29
5-9	Areas of Contamination - Column 2, South Face (Room 1, First Floor)	30
5-10	Areas of Contamination - Column 2, North Face (Room 1, First Floor)	31
5-11	Areas of Contamination - Bay 7 (Room 1, First Floor)	32
5-12	Areas of Contamination - Column 3, South Face (Room 1, First Floor)	33
5-13	Areas of Contamination - Bay 8 (Room 1, First Floor)	34
5-14	Areas of Contamination - Bay 9/Room 1A	35
5-15	Areas of Contamination - Room 1A (First Floor)	36

LIST OF FIGURES
(Continued)

Figure	Title	Page
5-16	Areas of Contamination - Room 1E (First Floor)	37
5-17	Area of Contamination - Room 5 (First Floor)	38
5-18	Areas of Contamination - Room 5B (First Floor)	39
5-19	Areas of Contamination - Rooms S201/S202 (Second Floor)	40
5-20	Area of Contamination - Room S212 (Second Floor)	41
5-21	Areas of Contamination - Room S213, Elevation of North Wall (Second Floor)	42
5-22	Area of Contamination - Room S250 (Second Floor)	43
5-23	Area of Contamination - Room S215 (Second Floor)	44

LIST OF TABLES

Table	Title	Page
5-1	Summary of Residual Contamination Guidelines at the National Guard Armory	45
5-2	Exterior Background Radionuclide Concentrations and Radiation Levels in the Area of the NGA	47
5-3	Exterior Subsurface Soil Sampling Results at the National Guard Armory	48
5-4	Gross Alpha Contamination from the Wipe Samples at the National Guard Armory	51
5-5	Radionuclide Concentrations in Brick Samples	59
5-6	Interior Subsurface Soil Sampling Results at the National Guard Armory	60
5-7	Radionuclide Concentrations in Samples Taken from Catch Basins	63
5-8	Radionuclide Concentrations in Scrapings from Catch Basin Walls	64
A-1	Summary of Chemical Analysis at NGA	A-2

ABBREVIATIONS

cm	centimeter
cm^2	square centimeter
cpm	counts per minute
dpm/100 cm^2	disintegrations per minute per hundred square centimeter
ft	foot
ft^2	square feet
h	hour
μR/h	microroentgens per hour
mg	milligram
mg/kg	milligrams per kilogram
μg	microgram
μg/kg	micrograms per kilogram
MeV	million electron volts
mrad/h	millirad per hour
pCi/g	picocuries per gram

1.0 INTRODUCTION AND SUMMARY

1.1 INTRODUCTION

A radiological survey performed by Argonne National Laboratory (ANL) established that contamination existed at the National Guard Armory (NGA) in Chicago, Illinois (Ref. 1). This characterization is the basis for its inclusion in the Formerly Utilized Sites Remedial Action Program (FUSRAP). The United States Government initiated FUSRAP in 1974 to identify, clean up, or otherwise control sites where residual radioactive material (exceeding current guidelines) remains from the early years of the nation's atomic energy program or from commercial operations that resulted in conditions Congress has mandated DOE to remedy. FUSRAP is under the direction of the DOE Division of Facility and Site Decommissioning Projects.

FUSRAP is currently being managed by DOE Oak Ridge Operations in Oak Ridge, Tennessee. As the Project Management Contractor for FUSRAP, Bechtel National, Inc. (BNI) is responsible to DOE for planning, managing, and implementing FUSRAP.

1.2 PURPOSE AND OBJECTIVES

The current radiological characterization by BNI was necessary to define the locations and boundaries of the contamination identified in the ANL characterization, and design any necessary remedial action at the site. The limited chemical characterization was performed to determine health and safety requirements during remedial action and to identify any disposal restrictions for the contamination identified by the ANL and BNI characterization. BNI and its radiological subcontractor, Thermo Analytical/Eberline (TMA/E), performed the characterization in 1987.

1.3 SUMMARY

This report describes the procedures and results of the radiological and limited chemical characterization conducted during January and February 1987 at the NGA.

Characterization activities included a review of historical data, a walkover tour of the property to identify significant features of the building and grounds, exterior gamma surveys, exterior surface and subsurface soil sampling, interior surface surveys, and interior subsurface surveys.

Measurements taken during the 1987 radiological characterization indicate that numerous isolated areas on building surfaces are contaminated in excess of current guidelines, and that uranium-238 is the primary contaminant. An analysis of sludge samples collected from the catch basin system between Rooms 1 and 5 also confirmed that the major contaminant was uranium-238. This sludge is also contaminated with chemical constituents including volatiles, semi-volatiles, and priority pollutant metals.

2.0 SITE DESCRIPTION AND HISTORY

2.1 LOCATION AND DESCRIPTION

The National Guard Armory (NGA) site is located at East 52nd Street and Cottage Grove Avenue approximately 6 miles south of the downtown business district of Chicago, Illinois. The location of the site is shown in Figure 2-1. The site is an active facility presently occupied by the Illinois National Guard, 1st Battalion, 178th Infantry, and 2nd Battalion, 122nd Field Artillery. The NGA is a 230- by 620-ft concrete building (approximately 290,000 ft^2) with outer walls of stone. An arena occupies the center of the building, and offices, classrooms, storage areas, and garages are located on four floors at the north and south ends (Figure 2-2). The 230- by 360-ft arena has a ceiling more than 100-ft high, with stadium bleachers located on the east and west sides. Before the dirt floor was surfaced with concrete, the arena had been used by the cavalry to train horses, and later for polo (Ref. 1).

2.2 SITE HISTORY

The NGA was used by the Manhattan Project to alleviate space shortages at the University of Chicago and the Metallurgical Laboratory (Ref. 1). Beginning in March 1942, the building was used jointly by the Manhattan Engineer District (MED) Metallurgical Laboratory and the University of Chicago. The Atomic Energy Commission (AEC), which succeeded the MED, terminated use of this facility in 1951, and the property was returned to the State of Illinois.

It is suspected that the arena in the armory could have involved both chemical processing and metal casting of uranium. After MED stopped using the facility, contaminated dirt from the arena was removed. No record could be found of where the dirt was taken. Later more dirt was removed from the arena and replaced with a concrete pad. Conversations with personnel who worked at the

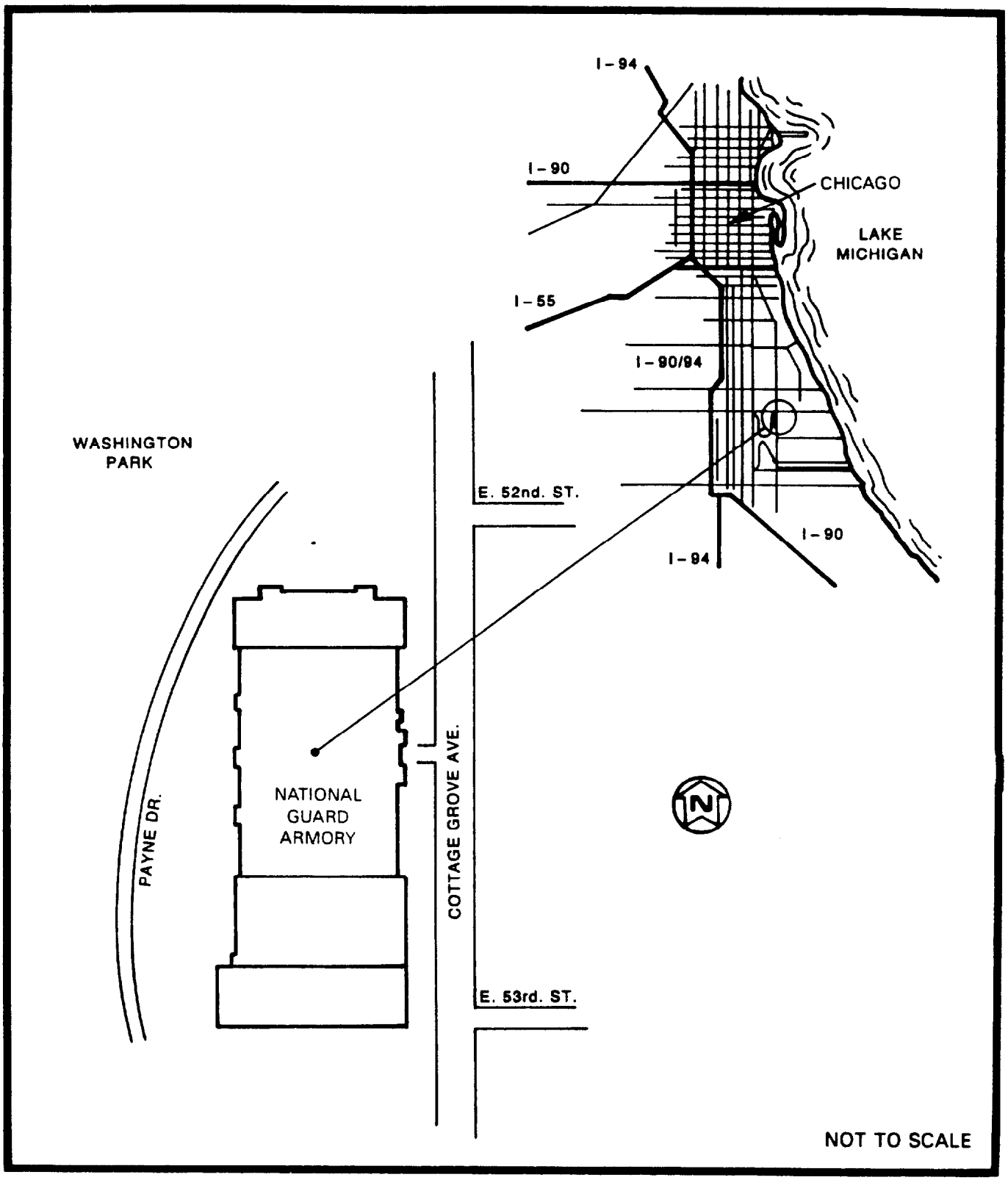


FIGURE 2-1 LOCATION OF THE NGA

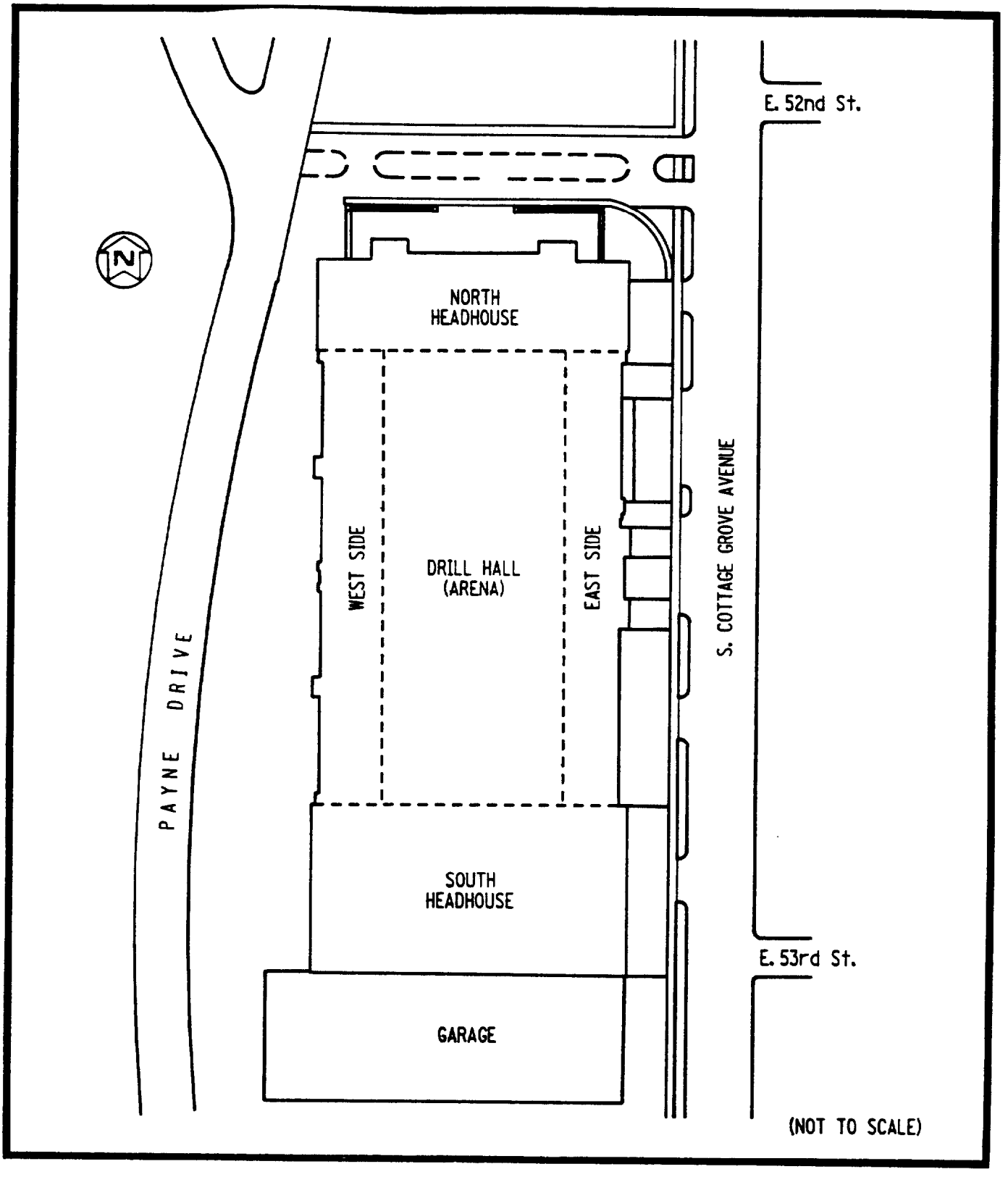


FIGURE 2-2 GENERAL FLOOR PLAN OF THE NGA

facility revealed that there was an effort to decontaminate some of the bleachers in the arena. However, no reports of radiological characterizations or decontamination efforts conducted at the facility upon termination of MED/AEC activities could be found (Ref. 1).

From available correspondence, it appears that the site was used at least for storing and processing uranium metal. In 1943 the building was the central procurement and shipping location for the Metallurgical Laboratory, and records from 1944 indicate that uranium metal stock was received and temporarily stored in the shipping and receiving room.

The armory storeroom (believed to be Room 1 in the ANL report) was apparently used to store uranium shavings and grinding wastes, because at least one of several uranium fires in the armory was reported to have occurred in the northeast corner of that room. That particular fire contaminated both the receiving and storerooms. These areas/rooms have not been positively identified in the historical data available to date; however, on the basis of current radiological findings, these areas may have been in the western half of the south headhouse ground floor.

2.3 PREVIOUS RADIOLOGICAL SURVEYS

The NGA was shown to be radioactively contaminated during a radiological survey conducted by ANL (Ref. 1). In general, the areas of contamination identified during the BNI characterization paralleled those identified by ANL in 1983.

2.4 PRESENT SITE CONDITIONS

The building has remained essentially unchanged since the earlier survey by ANL. The NGA is currently fully active and in operation 24 hours a day.

3.0 HEALTH AND SAFETY PLAN

BNI is responsible for protecting the health of personnel assigned to work at the site. As such, all subcontractors and their personnel are required to comply with the provisions of the applicable project instructions cited in this section or as directed by the on-site BNI representative.

3.1 SUBCONTRACTOR TRAINING

Before the start of work, all subcontractor personnel attend an orientation session presented by the BNI representative to explain the nature of the material to be encountered in the work and the required personnel monitoring and safety measures.

3.2 SAFETY REQUIREMENTS

Subcontractor personnel must comply with the following BNI requirements.

- Bioassay - Subcontractor personnel submit bioassay samples before or at the beginning of on-site activity, upon completion of the activity, and periodically during site activities as requested by BNI.
- Protective Clothing/Equipment - Subcontractor personnel are required to wear the protective clothing/equipment specified in the subcontract or as directed by the BNI representative.
- Dosimetry - Subcontractor personnel are required to wear, and return daily, the dosimeters and monitors issued by BNI.
- Controlled Area Access/Egress - Subcontractor personnel and equipment entering areas wherein access and egress are controlled for radiation and/or chemical safety purposes are surveyed by the BNI representative for contamination before leaving those areas.
- Medical Surveillance - Upon written direction from BNI, subcontractor personnel, who work in areas where hazardous chemicals might exist, are given a baseline and periodic health assessment defined in BNI's Medical Surveillance Program.

Radiation and/or chemical safety surveillance of all activities related to the scope of work is under the direct supervision of personnel representing BNI.

The health physics requirements for all activities involving radiation or radioactive material are defined in Project Instruction No. 20.01, the Project Radiation Protection Manual, and implementing procedures.

The industrial hygiene requirements for activities involving chemicals or chemically contaminated materials are defined in Project Instruction No. 26.00, the Environmental Hygiene Manual, and implementing procedures.

Copies of these project instructions and manuals are located on-site for subcontractor's use.

In addition to the standard safety procedures addressed in the project instructions, additional site-specific requirements were issued (Ref. 2) and a 24-hour Occupational Safety and Health Administration training course was given to all personnel who worked on-site.

4.0 CHARACTERIZATION PROCEDURES

The radiological measurements taken and the methods used for taking the measurements are described in the following subsections.

The following areas were investigated: the exterior grounds of the property, the interior building surfaces, subsurface soil beneath the arena floor, and sludges from the catch basin system serving Rooms 1 and 5. Additionally, any suspect area was scanned and sampled.

4.1 SURFACE MEASUREMENTS TAKEN AND METHODS USED

4.1.1 Exterior Measurements

An initial walkover scan on the NGA property was performed using a Field Instrument for Detection of Low-Energy Radiation (FIDLER). The FIDLER is specially designed to detect the low-energy radiation, such as that emitted by uranium. An informal grid was plotted on all areas with radiation levels exceeding one and one-half times the background level.

4.1.2 Interior Measurements

The entire floor area (290,000 ft^2) of the NGA was scanned using a FIDLER. All areas exhibiting radiation levels exceeding one and one-half times the background radiation level were temporarily marked. Within these marked areas, beta-gamma measurements were made to better define the horizontal boundaries of contamination. The beta-gamma measurements were made using a pancake geometry (Geiger-Muller) probe coupled to a digital rate meter/scaler [Eberline Instrument Corporation (EIC) models HP-210 and PRS-1, respectively.] Based on these measurements, contaminated areas were permanently marked with spray paint. To determine that the outer boundaries of contamination had been accurately established, both alpha and beta-gamma measurements were taken along the perimeter of

the delineated areas. Alpha measurements were made using an EIC AC-3 detector coupled to an EIC PRS-1 rate-meter/scaler.

Ceilings, ledges, ventilation ducts, furniture, selected roof areas, and other surfaces suspected of being contaminated were surveyed for alpha and beta-gamma contamination. Surveys on non-floor surfaces were concentrated in rooms and areas where floor contamination had been identified. In rooms where no floor contamination was found, only suspect areas, such as air-moving systems and horizontal surfaces, were scanned. All areas identified by the ANL report were surveyed.

4.2 SAMPLE COLLECTION AND ANALYSES

4.2.1 Exterior Samples

In areas identified during the FIDLER walkover scan as having readings in excess of one and one-half times the background radiation level, surface and subsurface soil samples were collected to quantify radionuclide concentrations. All soil samples were analyzed using a GeLi (germanium lithium) gamma spectroscopy system for concentrations of uranium-238, radium-226, and thorium-232. GeLi spectroscopy involves counting each sample for 10 minutes using an intrinsic germanium detector housed in a lead counting cave lined with cadmium and copper. The pulse height distribution was sorted using a computer-based, multi-channel analyzer. Radionuclide concentrations were determined by comparing the gamma spectrum of each sample with the spectrum of a certified counting standard for the radionuclide of interest.

4.2.2 Interior Samples

Samples collected consisted of smear (or wipe) samples, a sample of caulk from an expansion joint in the floor of Room 1, soil samples from beneath the arena floor, brick and floor tile samples, and sludge samples from the catch basin system in Rooms 1 and 5.

Smear samples were taken to determine if the contamination was removable. Smear samples are taken by "wiping" an area of approximately 100 cm^2 with smear paper in a Z-shaped pattern. The smear is then counted in a low-background alpha scintillation detector (Eberline Model SAC-4) to determine the gross alpha activity. For the purposes of this characterization, all observed alpha activity on the smears was assumed to arise from uranium contamination.

One sample of a caulk-type expansion joint was collected to determine how deep contamination had penetrated into the joint and to correlate counts per minute (cpm) to picocuries per gram (pCi/g). The sample was analyzed for uranium-238, radium-226, and thorium-232 using GeLi spectroscopy.

Because the arena floor was dirt when the uranium processing occurred, eight boreholes were drilled into the subfloor beneath the concrete floor, and each hole was continuously sampled. Borehole locations are shown in Figure 4-1. Additionally, two boreholes were drilled in the southeast corner of Room 1 to determine if contamination extended below the concrete slab in that room. All soil samples were analyzed for uranium-238, radium-226, and thorium-232 using GeLi spectroscopy.

During the course of the characterization, elevated radiation levels were detected around some of the building materials (bricks and tiles) in the armory. To determine the radionuclides present in these materials, samples were collected, pulverized, and analyzed for uranium-238, radium-226, and thorium-232 using GeLi spectroscopy.

Acting on the information provided by the ANL characterization, samples of the sludge in the catch basins in Rooms 1 and 5 were collected. The catch basin system is shown in Figure 4-2. Samples were collected from all catch basins except Catch Basin 5, which was sealed. Two of three grease traps were also sampled (the third grease trap also being sealed). One catch basin downstream of all

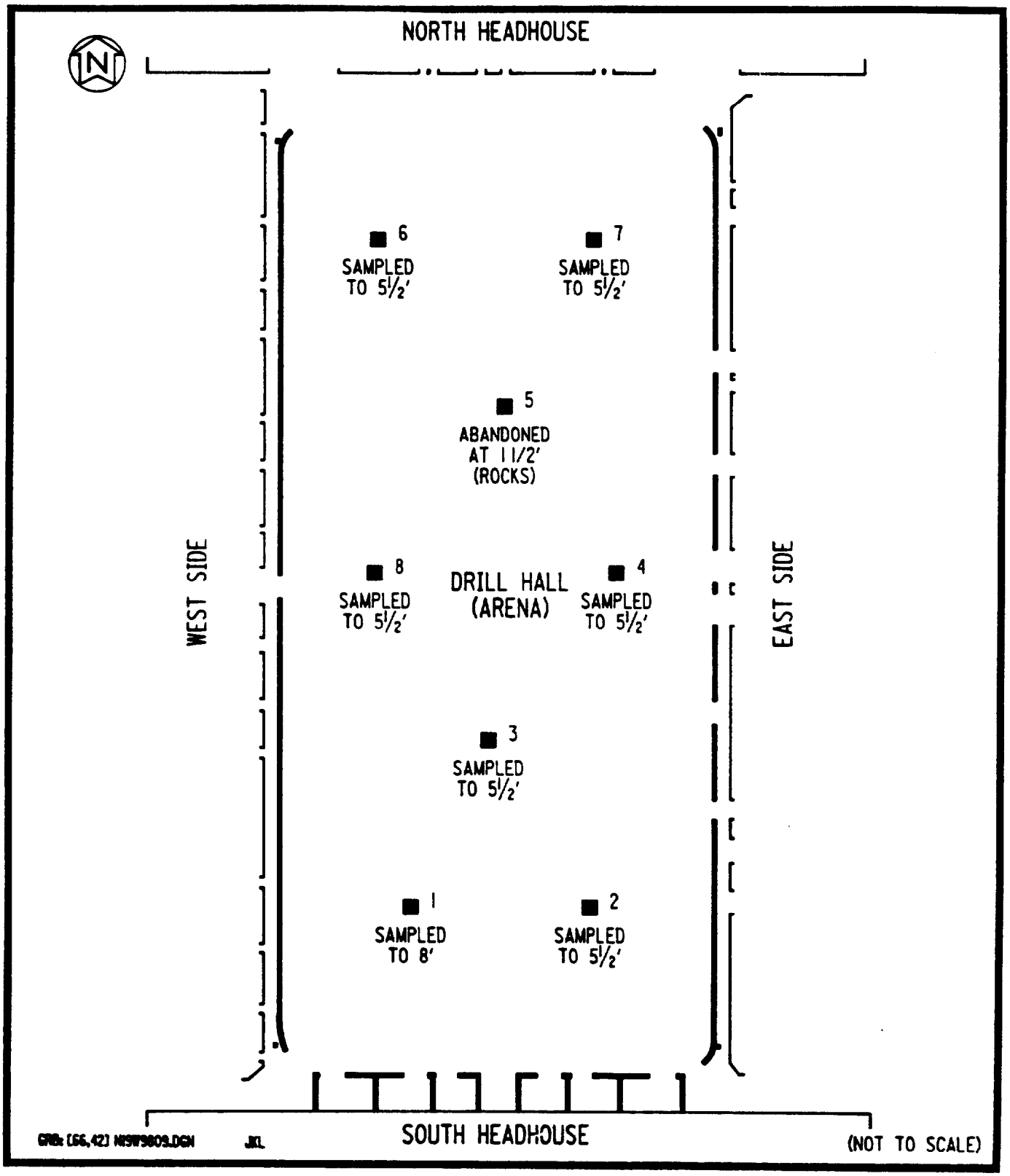


FIGURE 4-1 BOREHOLE LOCATIONS IN THE ARENA

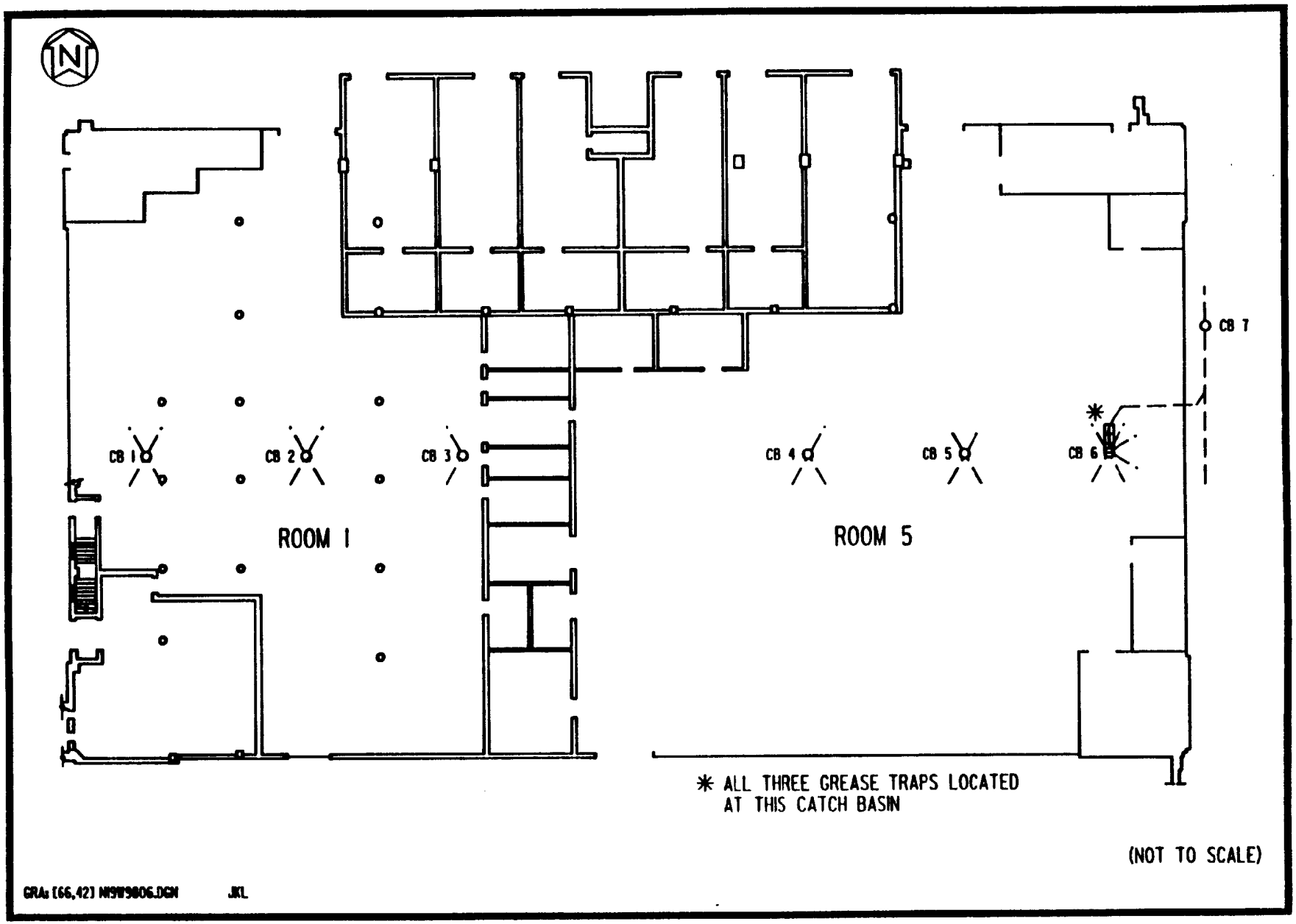


FIGURE 4-2 CATCH BASIN LOCATIONS — SOUTH HEADHOUSE

the other basins and grease traps and outside of the building also was sampled. Scrapings of the catch basin walls were also collected. All samples were analyzed by GeLi spectrometry for uranium-238, radium-226, and thorium-232. The sludge samples were also analyzed for various hazardous waste constituents. The procedures used to chemically sample the sludge, as well as the results of the chemical analysis, are contained in Appendix A.

5.0 CHARACTERIZATION RESULTS

5.1 REMEDIAL ACTION GUIDELINES

The DOE guidelines for residual contamination are summarized in Table 5-1. DOE developed these guidelines to be consistent with the guidelines established by the Environmental Protection Agency (EPA) for the Uranium Mill Tailings Remedial Action Program.

5.2 BACKGROUND RADIATION MEASUREMENTS

Surface gamma radiation was measured using a FIDLER (see Subsection 4.1.2). Surface beta-gamma radiation levels were measured with an HP-210 (see Subsection 4.1.2). Measurements were taken at five exterior background locations in the NGA area (Figure 5-1). The average surface gamma radiation level was approximately 8,500 cpm, and beta-gamma radiation levels at the ground surface averaged approximately 0.03 mrad/h. Individual background measurements are listed in Table 5-2.

Use of the "less than" (<) notation in reporting results indicates that the radionuclide was not present in concentrations that are quantitative with the instruments and techniques used. The less than value represents the lower bound of the quantitative capacity of the instrument and technique used and is based on various factors, including the volume, size, and weight of the sample; the type of detector used; the counting time, and the background count rate. The actual concentration of the radionuclide is less than the value indicated. In addition, since radioactive decay is a random process, a correlation between the rate of disintegration and a given radionuclide concentration cannot be precisely established. For this reason, the exact concentration of the radionuclide cannot be determined. As such, each value that can be quantitatively determined has an associated uncertainty term ($\pm$), which represents the amount by which the actual concentration can be expected to differ from the value given in the table. The uncertainty term has an associated confidence level of 95 percent.

The average background concentrations measured in the surface soil at the five background locations were less than 5.0 pCi/g for uranium-238, 1.0 pCi/g for radium-226, and 1.2 pCi/g for thorium-232. The analysis results for each background location are listed in Table 5-2.

5.3 EXTERIOR SURVEY RESULTS

The FIDLER survey of the grounds of the NGA identified three areas of elevated gamma activity. Figure 5-2 shows these general areas.

Area 1 was adjacent to the south end of the armory and abutted the building at a point which appeared to be a bricked-over vehicle entrance. The area was roughly rectangular and measured approximately 20 by 30 ft. Soil samples were collected from the area with elevated measurements and the adjacent areas. Surface (0 to 6 in.) and subsurface soil samples (6 to 12 in.) were collected from 36 locations. Two locations were augered and sampled to a depth of 5 ft. While a few of the samples exceed the guidelines when both the radium-226 and thorium-232 concentrations are considered, the ratios of radionuclides present in the samples indicate that the elevated concentrations are the result of naturally occurring material. The observed ratios and concentrations are typical of those found in cinder; observations by the field characterization team on the composition of the samples confirm this indication.

The maximum concentration detected for both radium-226 and thorium-232 was 5 pCi/g. No uranium-238 concentrations above the minimum detectable amount were detected. Table 5-3 gives the results of the soil sample analysis.

The second area with an elevated level of radioactivity identified during the FIDLER survey was approximately circular with a diameter of approximately 4 ft. Area 2 is located outside the west wall of Room 1. Surface and subsurface soil samples were collected. During

sample collection, a compass with a radium dial was discovered and removed. The subsurface soil sample showed a maximum radium-226 concentration of 360 pCi/g. Neither uranium-238 nor thorium-232 was present in detectable amounts. Table 5-3 gives the results of the soil sample analysis. Because the area of the contamination was small, it was decontaminated, and post-remedial action samples were collected. The results of the analysis of these samples will be reported in the post-remedial action report for the NGA.

A third area, along the outside west wall of the garage area (Room 2), found by the FIDLER survey was also small and measured approximately 4 ft in length. Two surface soil samples were collected from Area 2. Both showed elevated concentrations of uranium-238 (49 and 48 pCi/g) (Ref. 3); radium-226 and thorium-232 concentrations were at the background level. Table 5-3 gives the analysis results, which show these concentrations do not exceed remedial action guidelines (Ref. 4).

5.4 INTERIOR SURVEY RESULTS

Figures 5-3 and 5-4 illustrate the floor plans of the first and second floor in the south headhouse. Figures 5-5 through 5-23 show the areas of contamination and give the range of absorbed dose rates measured at each of the contaminated areas. Where only one measurement is given, only one measurement was taken.

5.4.1 Floor Survey

As previously stated, all floors were scanned with the FIDLER to identify general areas of concern. These areas were rechecked with beta-gamma and alpha survey instruments to define more precisely the boundaries of contamination. Within the contaminated areas, a smear survey was performed to determine if the radioactive materials were removable. For the floor areas, these surveys showed that virtually all of the contamination was fixed and not transferable. To document the extent of contamination, the identified areas were

spray painted to mark the areas for subsequent remedial action. To ensure that the boundaries of contamination were accurately identified, direct measurement and smear surveys were performed at various points surrounding the marked area. The locations at which these measurements were made are shown in the figures. The gross alpha measurements from the smear survey are presented in Table 5-4, and are identified by the sample numbers given in the figures.

Expansion joints and cracks were often identified as contaminated from direct measurement readings. To determine picocuries per gram (pCi/g) for these areas, one sample of the caulk-like material in the expansion joint was analyzed. This analysis indicated a uranium-238 concentration of approximately 2,600 pCi/g and a radium-226 concentration of 2 pCi/g. The concentration for thorium-232 was reported as less than detectable.

5.4.2 Wall and Ceiling Survey

Surveys of the walls and ceilings were conducted in rooms where floor contamination was found or where the ANL report had identified contamination. In other rooms, spot checks were made of some of the walls and/or ceilings. Areas of contamination were marked and documented as described in Subsection 5.4.1, and are shown in the figures. Measurements from the smear survey are reported in Table 5-4.

During the course of the wall surveys, it was noticed that elevated radiation levels corresponded to certain types of brick. To determine if the elevated readings were being caused by uranium-238, samples of three different types of brick were collected: white, red, and yellow. Each was analyzed for uranium-238, radium-226, and thorium-232. Concentrations are given in Table 5-5.

5.4.3 Survey of Miscellaneous Surfaces

Other surfaces were monitored to locate any contamination. These included ledges, columns, fans, ventilation ducts, and some roofs.

The methodology and documentation used were those described in Subsection 5.4.1. Areas exceeding guidelines are shown in the figures; measurements from the smear survey are reported in Table 5-4.

These surveys identified contamination on some columns and in several bolt holes in the columns. No contamination was found on the roofs.

5.4.4 Survey of Arena Floor Subsurface

Eight boreholes were drilled through the arena floor (Figure 4-1) to determine if contamination was present below the concrete slab. Six of the holes were advanced to 5.5 ft, one hole to 8 ft, and one hole reached refusal at only 1.5 ft. Natural soil was encountered at depths of 3 to 3.5 ft as determined by the geologist attending the drilling. Two additional boreholes were drilled in the southeast corner of Room 1 to determine if contamination had migrated below the concrete slab (Figure 5-6).

All holes were sampled in 0.5-ft increments from the concrete/soil interface to the bottom of the boreholes. Soil sampling results are provided in Table 5-6. In all samples, the uranium-238 concentration was less than detectable; radium-226 and thorium-232 concentrations were at background levels. Based on this sampling, contamination does not appear to be present under the arena floor, and no further action is warranted.

5.4.5 Catch Basin Survey

Material in each of the five accessible interior catch basins, two grease traps, and one exterior sediment trap (Catch Basin 7, Figure 4-2) was sampled. In Catch Basin 3 (see Figure 4-2), the material was sampled at discrete 6-in. depths. Composite samples were collected from all other catch basins and traps. All samples were analyzed for uranium-238, radium-226, and thorium-232. Results

are presented in Table 5-7. In all cases, uranium-238 concentrations are elevated above background radiation levels; however, only the material in Catch Basin 3 exceeded remedial action guidelines. Concentrations ranged from less than 7 to 220 pCi/g for uranium-238, from 0.3 to 3 pCi/g for radium-226, and from less than 0.3 to less than 1 pCi/g for thorium-232.

To determine if the walls of the catch basins were contaminated, scrapings of the walls were collected and analyzed. Table 5-8 shows the results of the analyses. Uranium-238 concentrations ranged from less than 22 to 16,000 pCi/g. Scrapings from Catch Basins 2, 3, and 4 all had concentrations above the remedial action guideline for uranium-238. Radium-226 concentrations ranged from 2 to 4 pCi/g and thorium-232 ranged from less than 1 to 5 pCi/g.

Because the presence of cesium-137 and europium-152 in some samples from Catch Basin 3 had been mentioned in the ANL survey report (Ref. 1), analyses for these radionuclides were performed on the three samples with the highest measured concentrations of other radionuclides. All analyses showed the cesium-137 and europium-152 concentrations were either less than detectable levels or were at levels of less than 0.2 pCi/g.

Samples of the sludges were also analyzed for hazardous waste constituents. Results of the analyses showed elevated levels of volatile and semi-volatile organic compounds as well as some metals such as lead and chromium (Ref. 5). In addition, the wastes were determined to be ignitable at a temperature of less than 70°F. These characteristics demonstrate that the sludges are hazardous waste. Appendix A contains a tabular summary of the sampling results.

5.5 DECONTAMINATION TEST SURVEYS

To allow remedial action planning to proceed based on the characterization results, additional information was needed to

assess the removability of the contamination. Two types of tests were performed: one to determine the depth of fixed contamination and one to test the ease of removing transferable contamination.

To test the depth of fixed contamination, an area in the mess hall identified during the floor survey as having contamination in excess of guidelines was selected. Direct readings were made at a particular point in the area and recorded. The designated area was then scabbled and remonitored. The process was repeated until the area conformed to applicable guidelines. Typically, the depth of contamination was less than 0.125 in. deep.

Decontamination tests were also performed on the transferable contamination on the ceiling of Room 1. This was done by wiping the ceiling and remonitoring the cleaned area. These tests showed that most of the contamination was easily removed. Only isolated spots remained after the wiping.

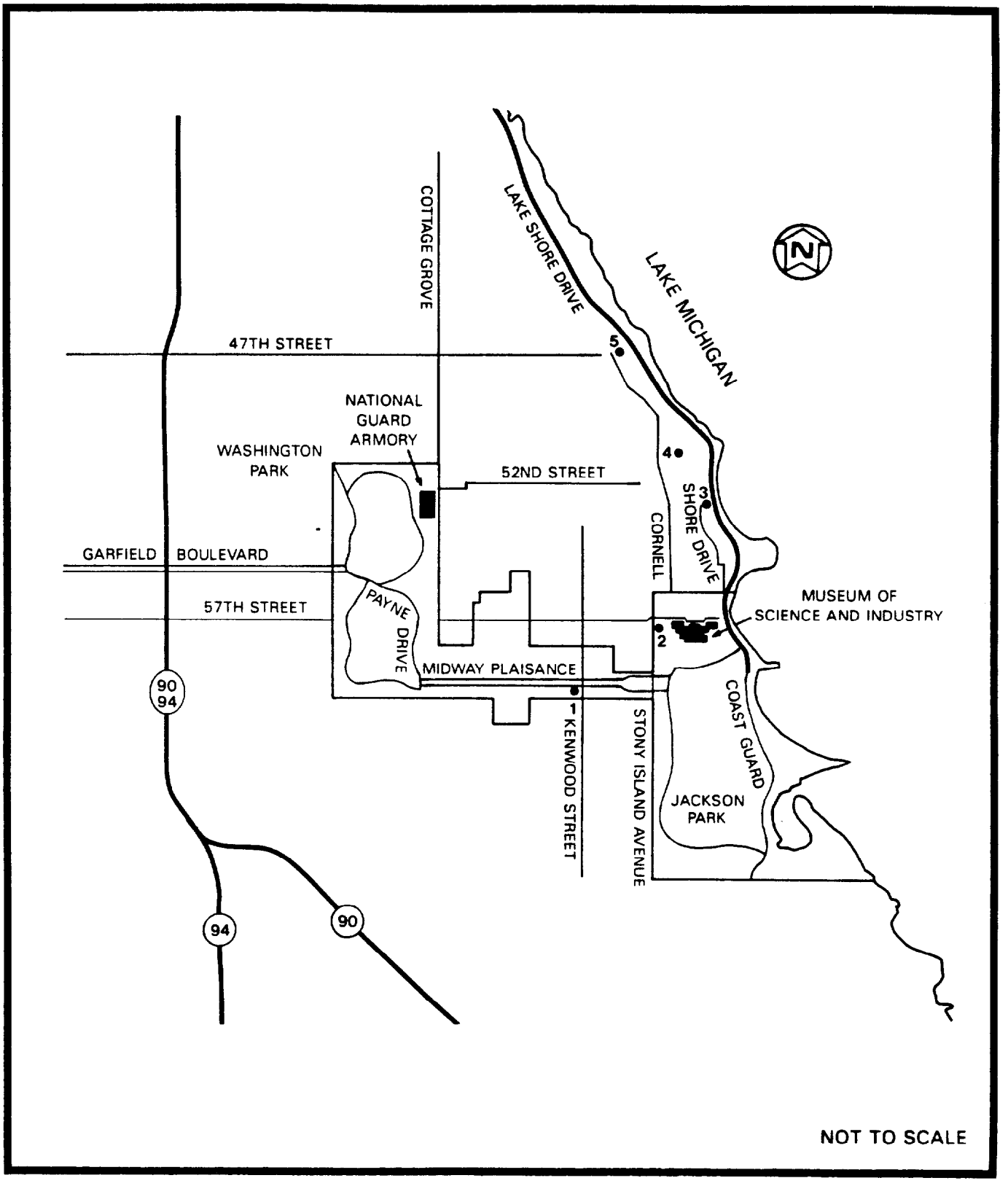


FIGURE 5-1 BACKGROUND RADIATION MEASUREMENT LOCATIONS

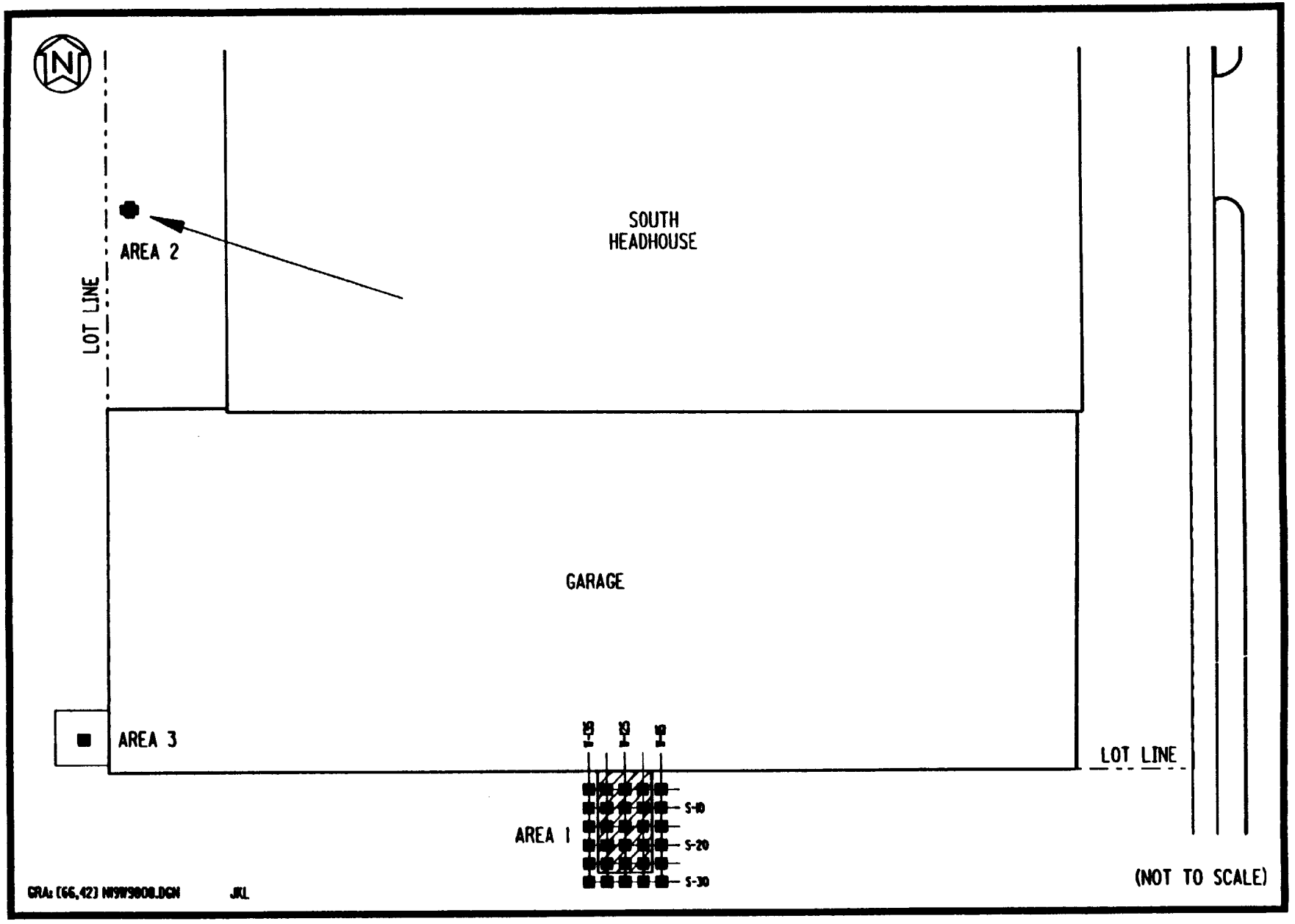


FIGURE 5-2 EXTERIOR AREAS OF CONTAMINATION

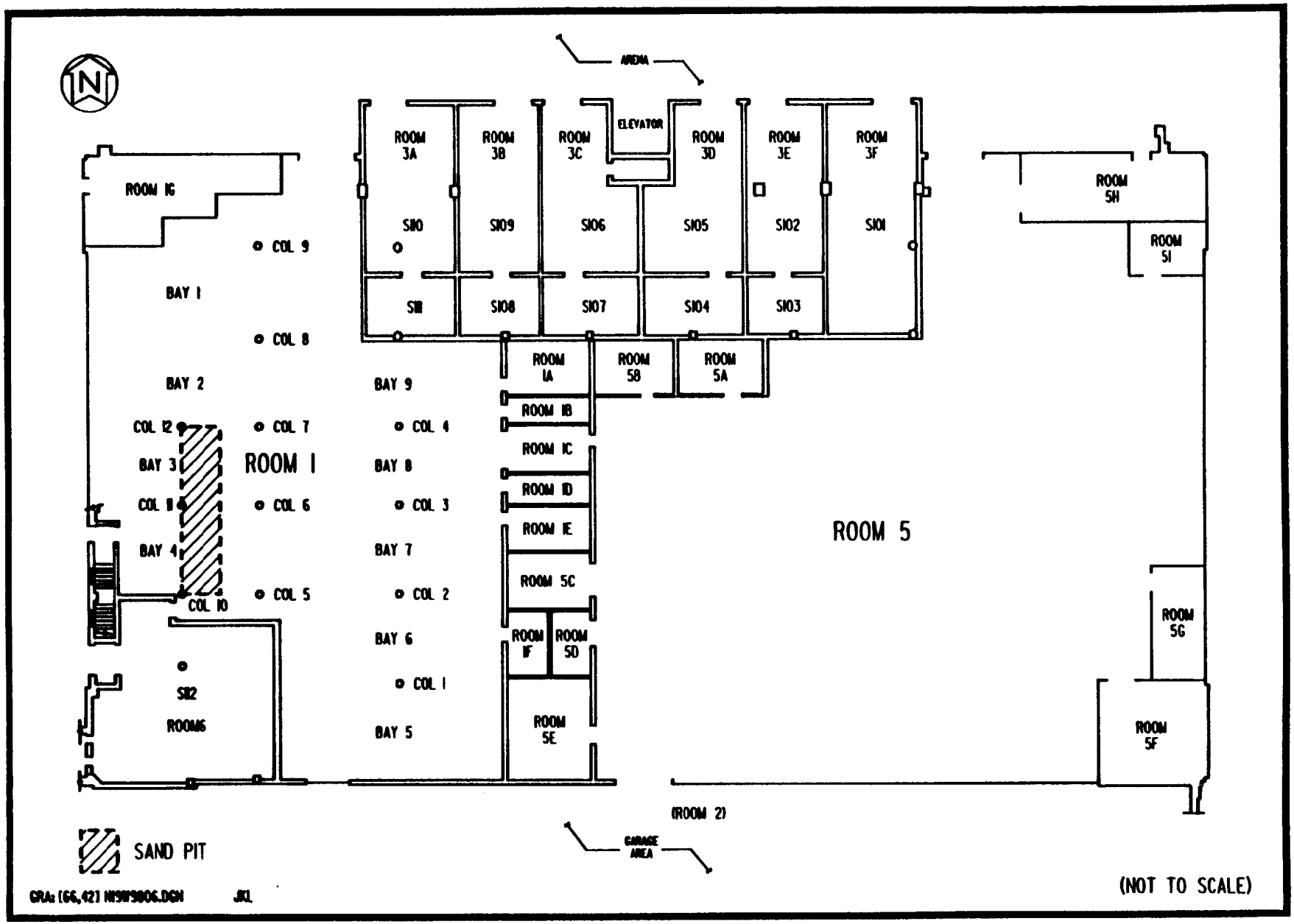


FIGURE 5-3 PLAN OF THE FIRST FLOOR - SOUTH HEADHOUSE

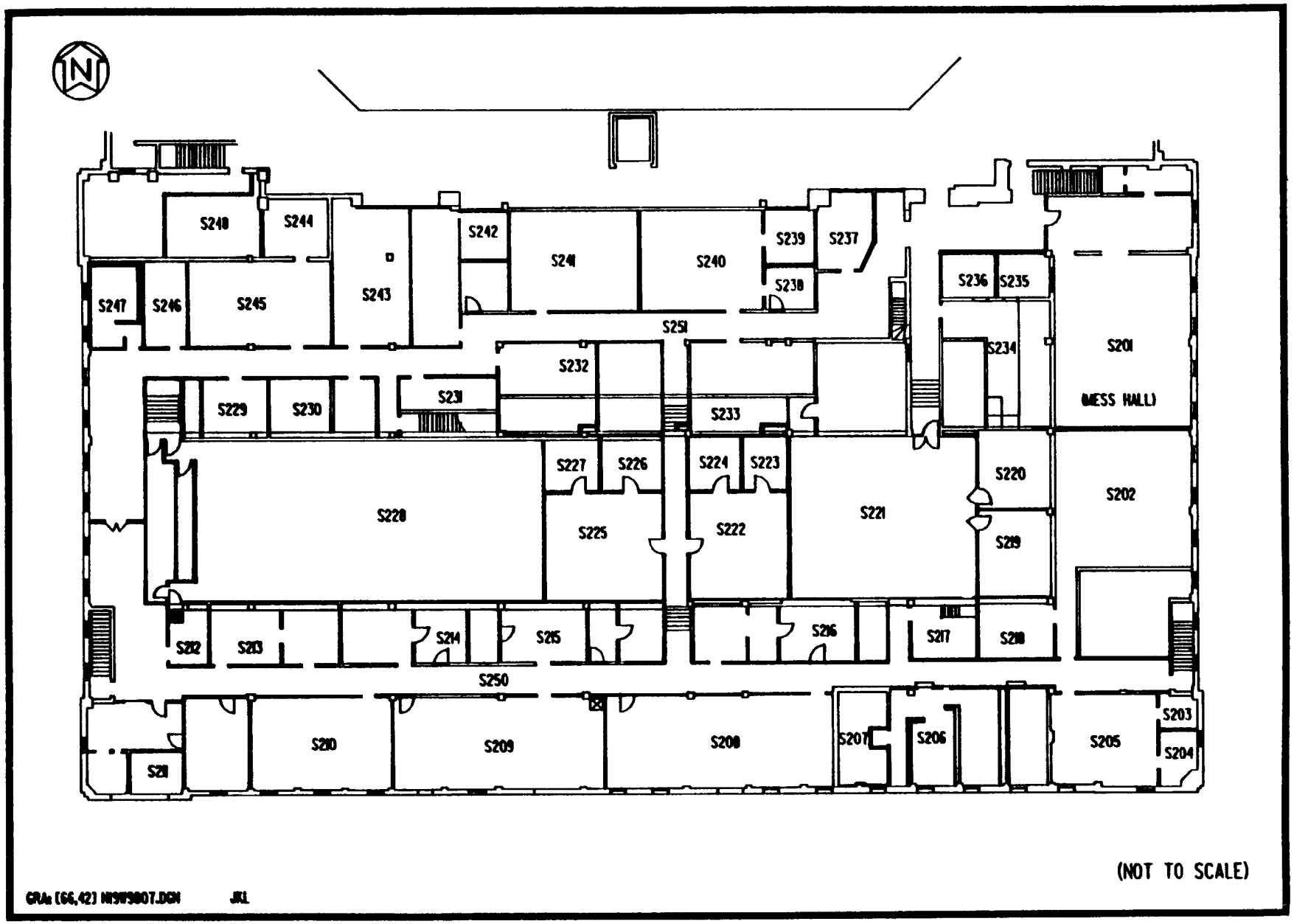


FIGURE 5-4 PLAN OF THE SECOND FLOOR - SOUTH HEADHOUSE

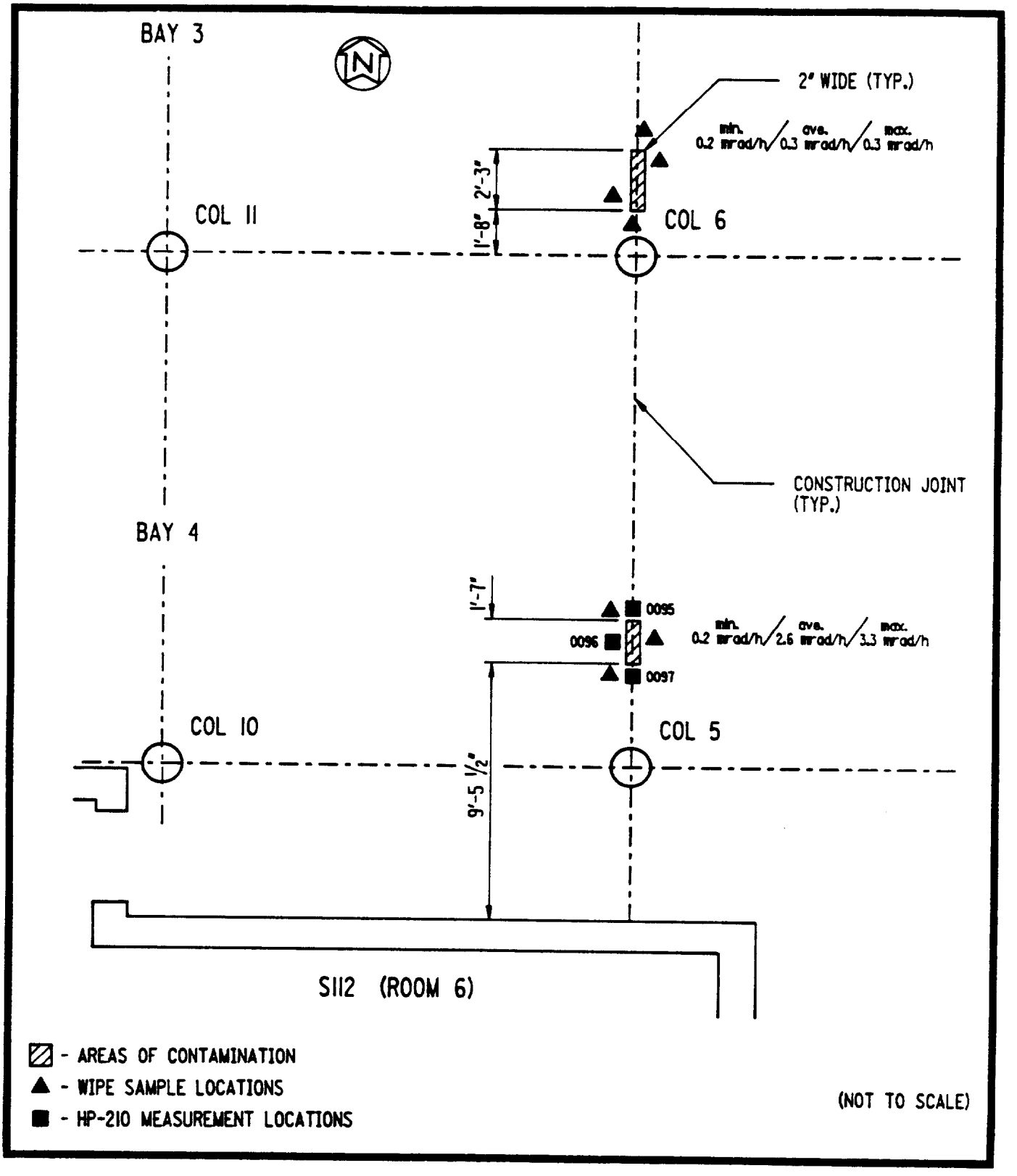


FIGURE 5-5 AREAS OF CONTAMINATION — BAYS 3 AND 4 (ROOM 1, FIRST FLOOR)

GRE. (-12,7) NI9W980LDGN JKL

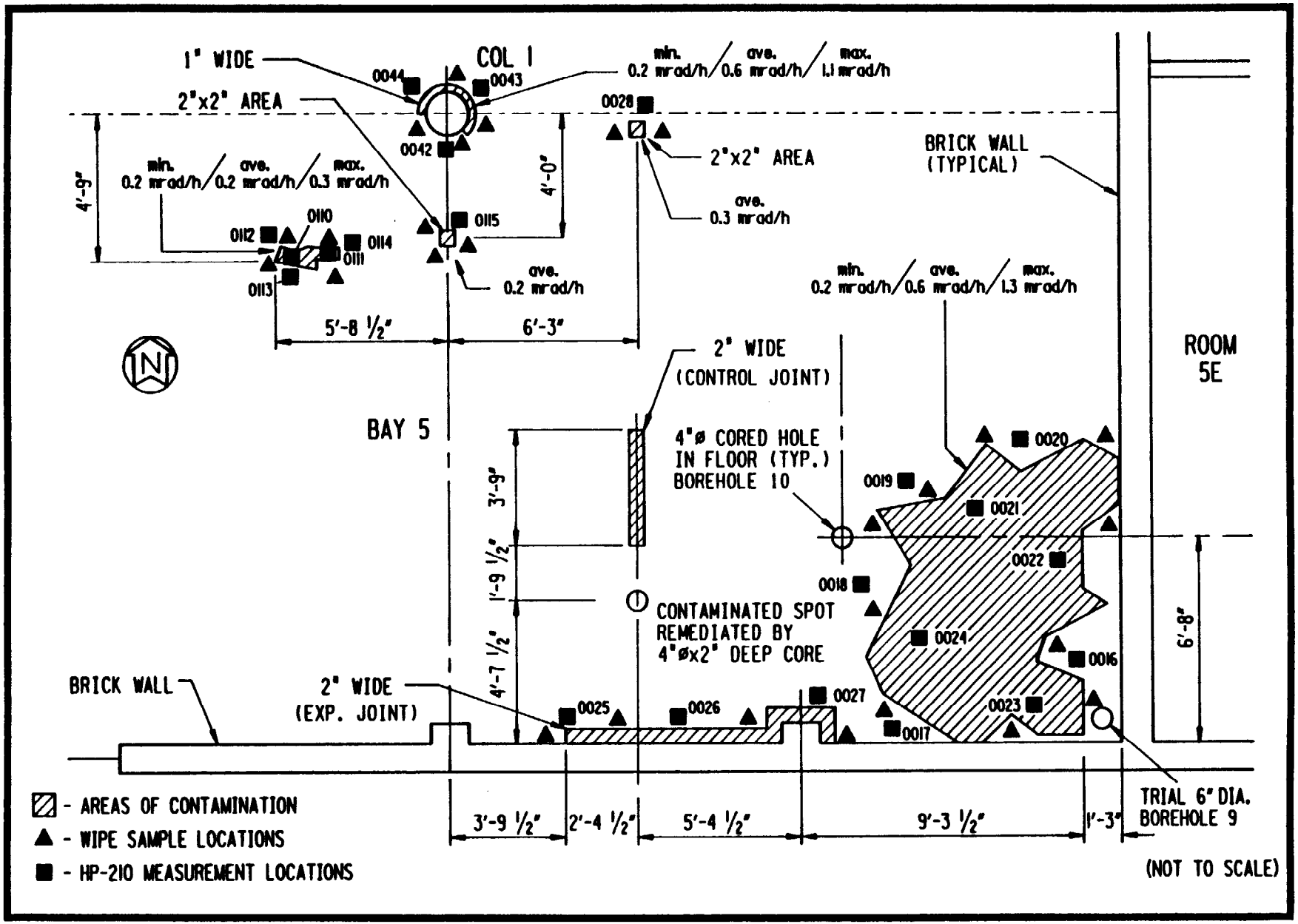


FIGURE 5-6 AREAS OF CONTAMINATION - BAY 5 (ROOM 1, FIRST FLOOR)

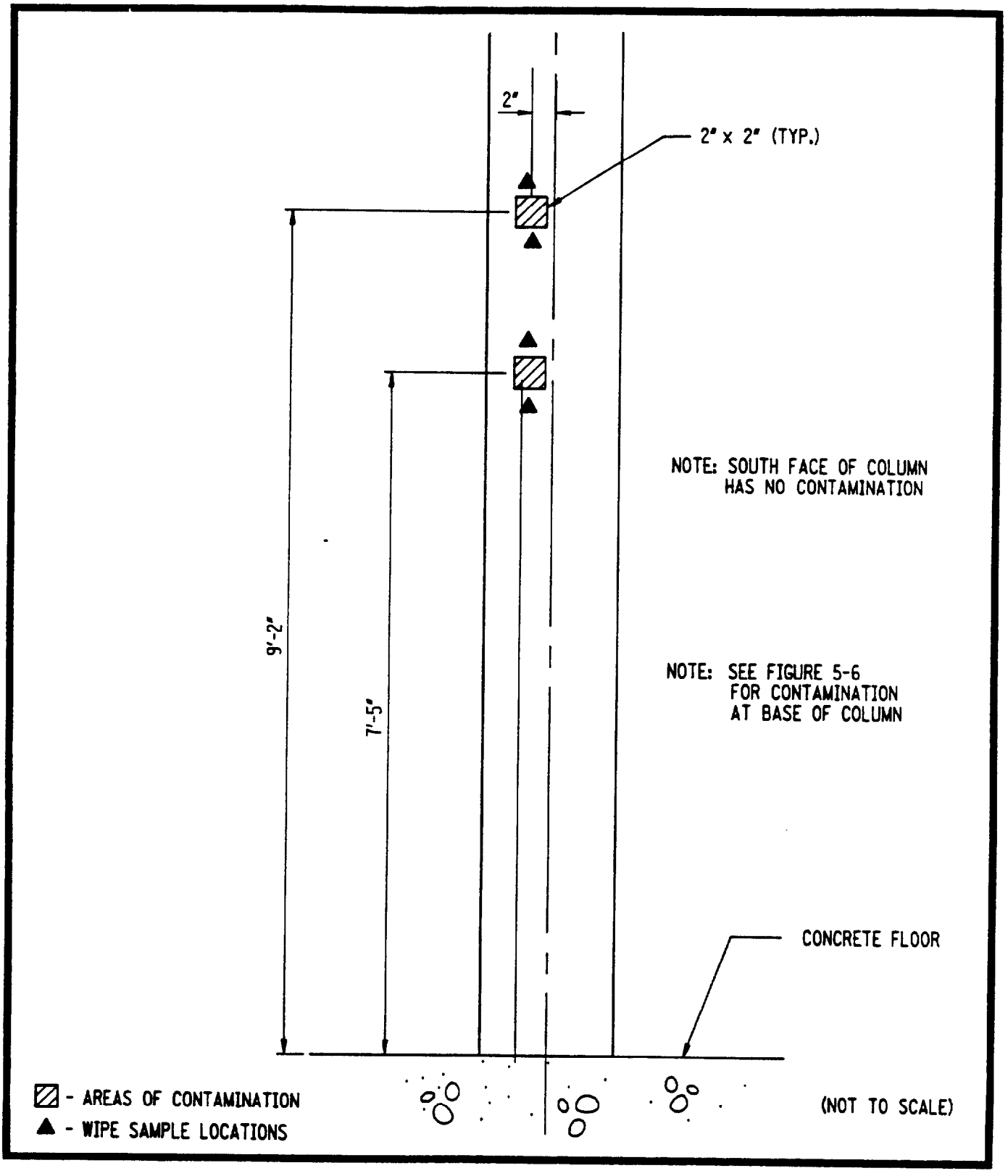
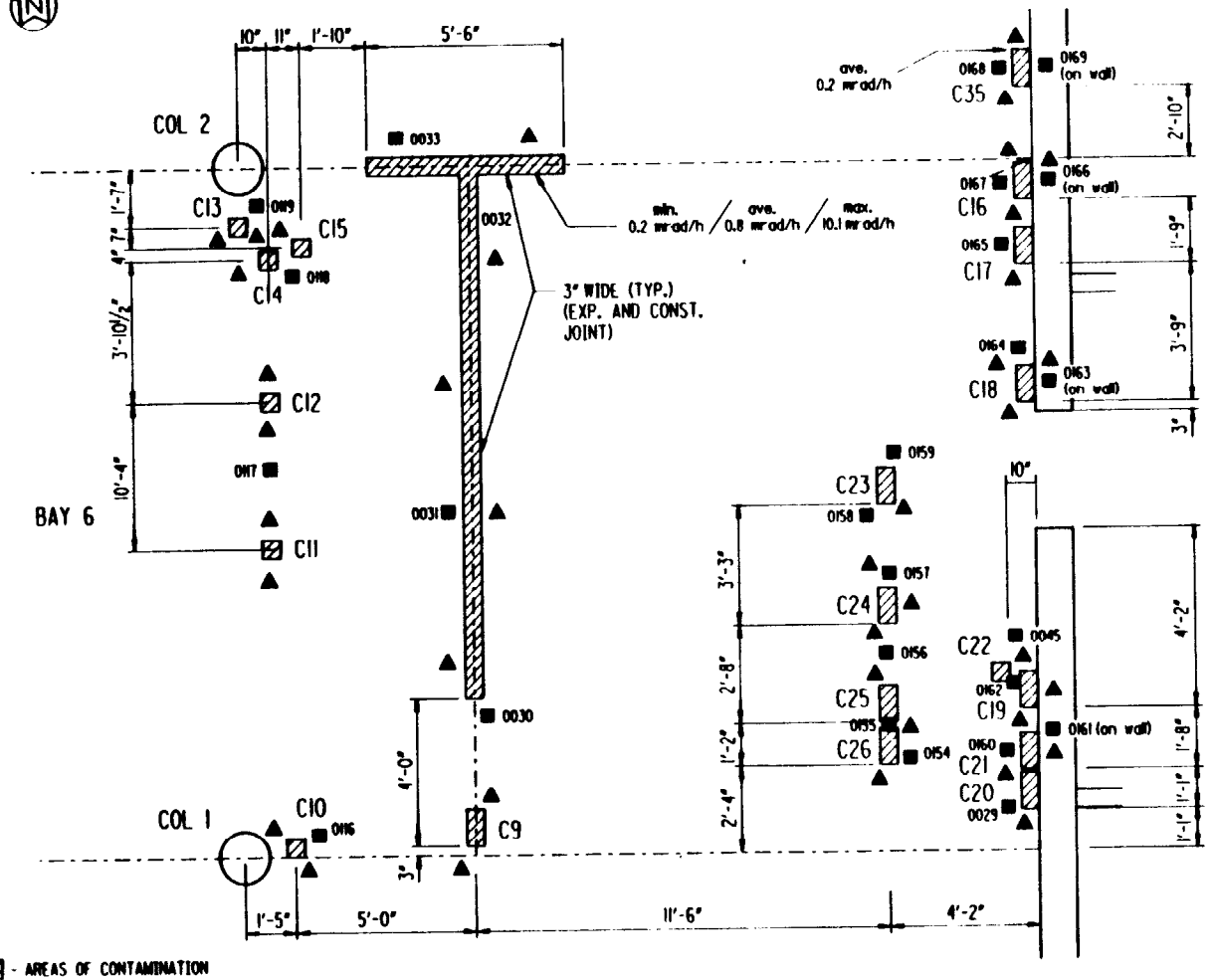


FIGURE 5-7 AREAS OF CONTAMINATION — COLUMN 1, NORTH FACE (ROOM 1, FIRST FLOOR)

GRB: (-2,7) N19W980LDGN JKL



CONTAMINATED AREA DATA		BETA-GAMMA DOSE RATE RANGE (mrad/h)
NO.	TYPE/SIZE	AVERAGE
C9	3" x 1"	0.2
C10	1" SQ. - BOLT HOLE	0.9
C11	2" SQ. - BOLT HOLE	1.4
C12	2" SQ. - BOLT HOLE	1.0
C13	1" SQ. - BOLT HOLE	3.2
C14	1" SQ. - BOLT HOLE	1.4
C15	1" SQ. - BOLT HOLE	0.2
C16	4" x 1"	0.2
C17	5" x 1"	0.2
C18	10" x 1"	0.2
C19	8" x 2"	0.3
C20	3" x 2"	0.3
C21	3" x 2"	0.2
C22	2" SQ. - BOLT HOLE	0.3
C23	5" x 2"	0.4
C24	5" x 2"	0.2
C25	4" x 2"	0.2
C26	4" x 2"	0.2

FIGURE 5-8 AREAS OF CONTAMINATION - BAY 6 (ROOM 1, FIRST FLOOR)

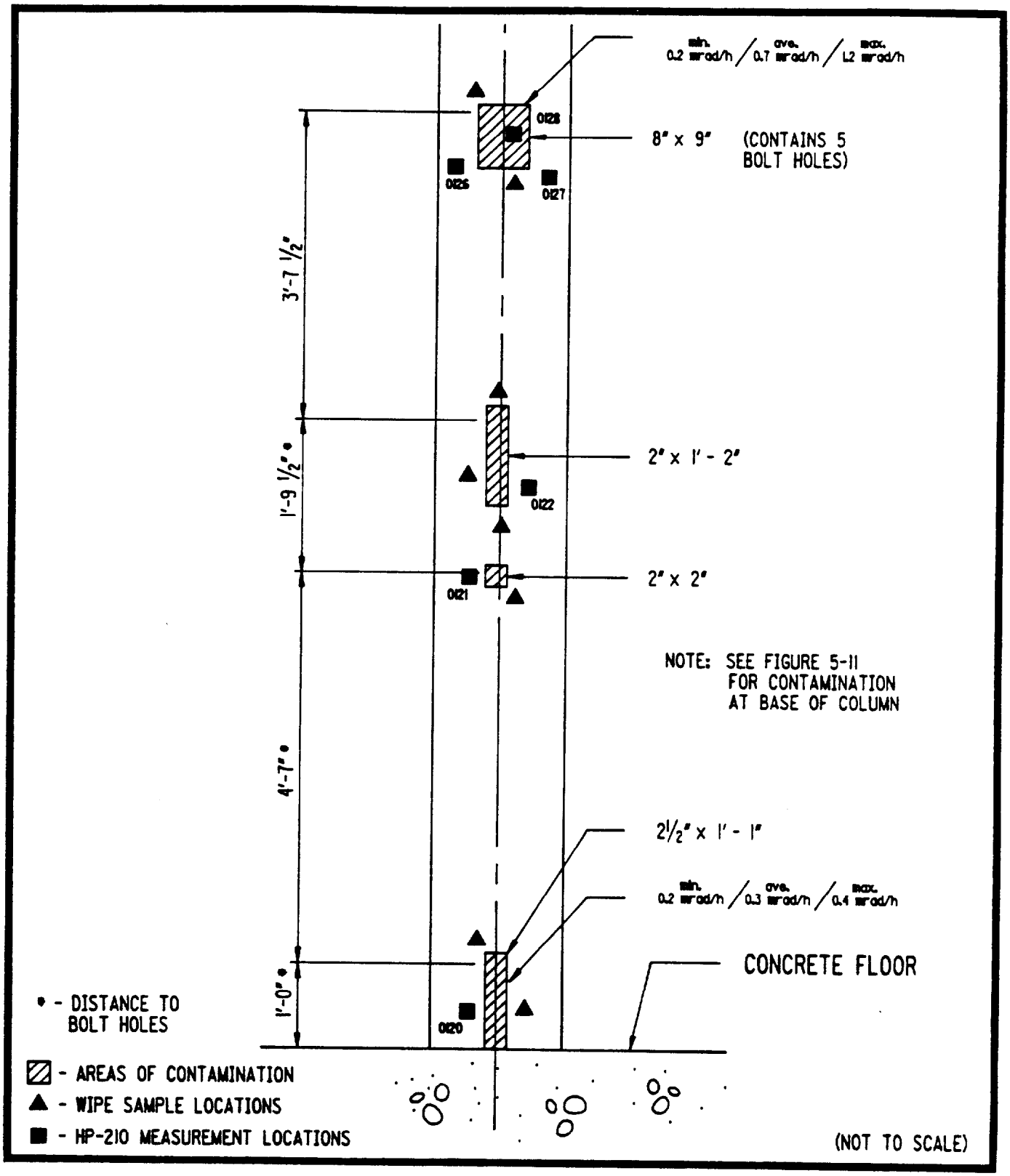


FIGURE 5-9 AREAS OF CONTAMINATION - COLUMN 2, SOUTH FACE (ROOM 1, FIRST FLOOR)

GRB: [42,7] N9TW98OLDGN JKL

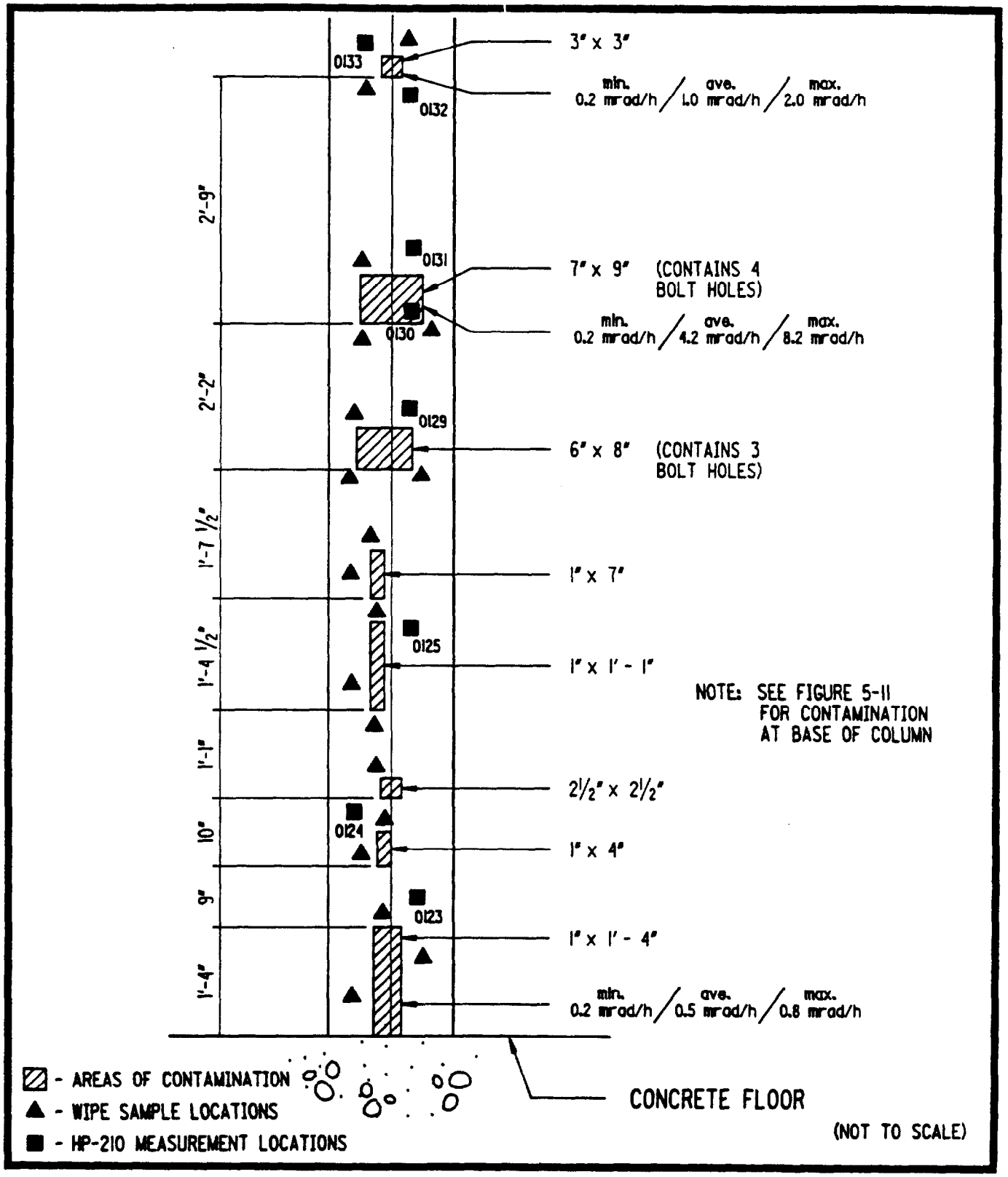
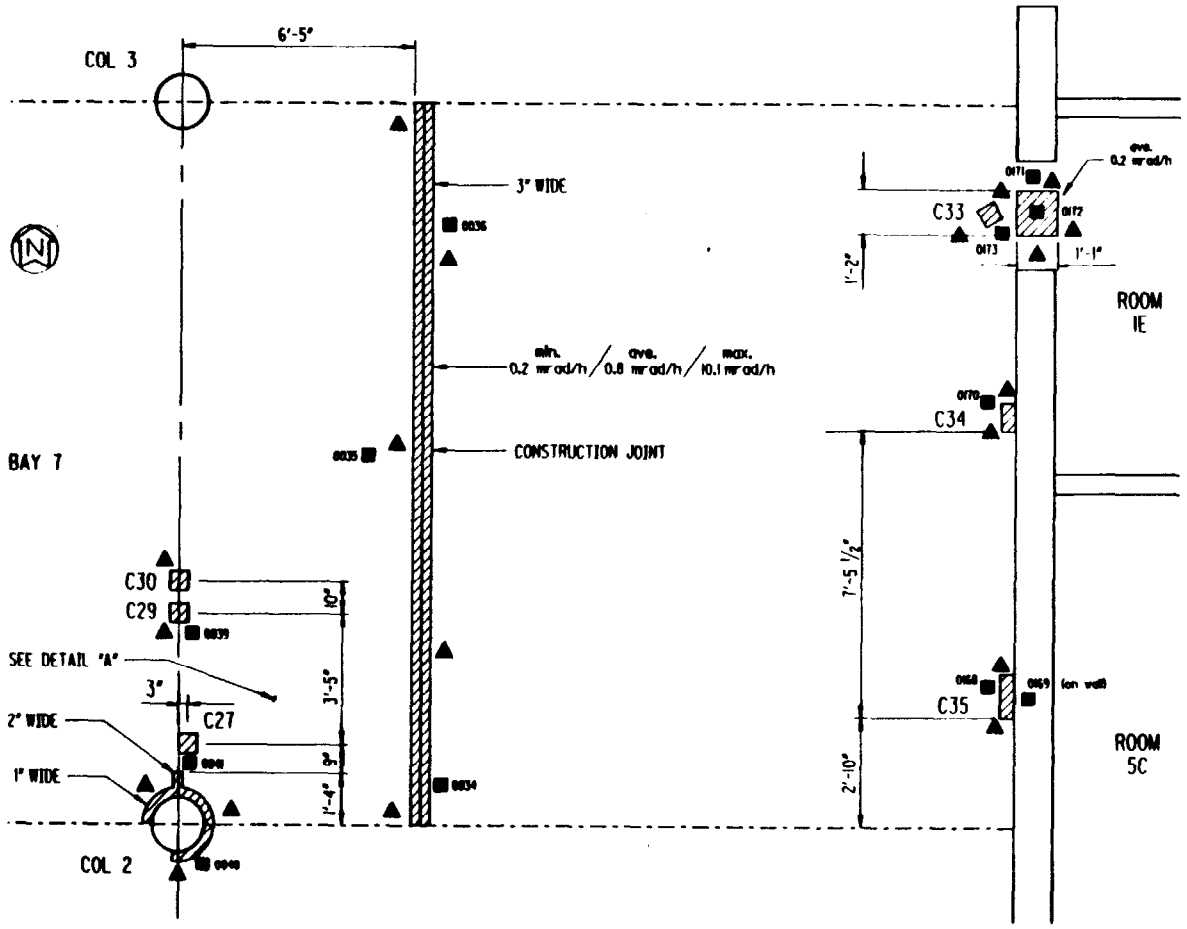
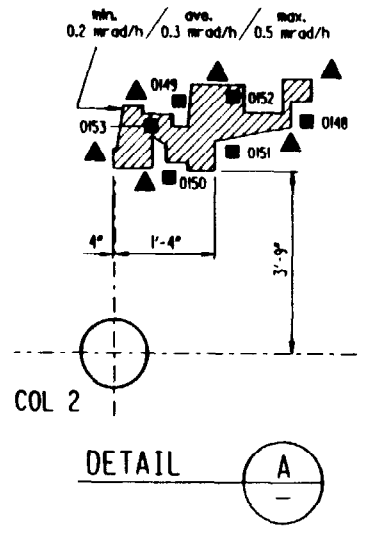


FIGURE 5-10 AREAS OF CONTAMINATION - COLUMN 2, NORTH FACE (ROOM 1, FIRST FLOOR)

GRB: [42,T] NSW980LDGN JKL



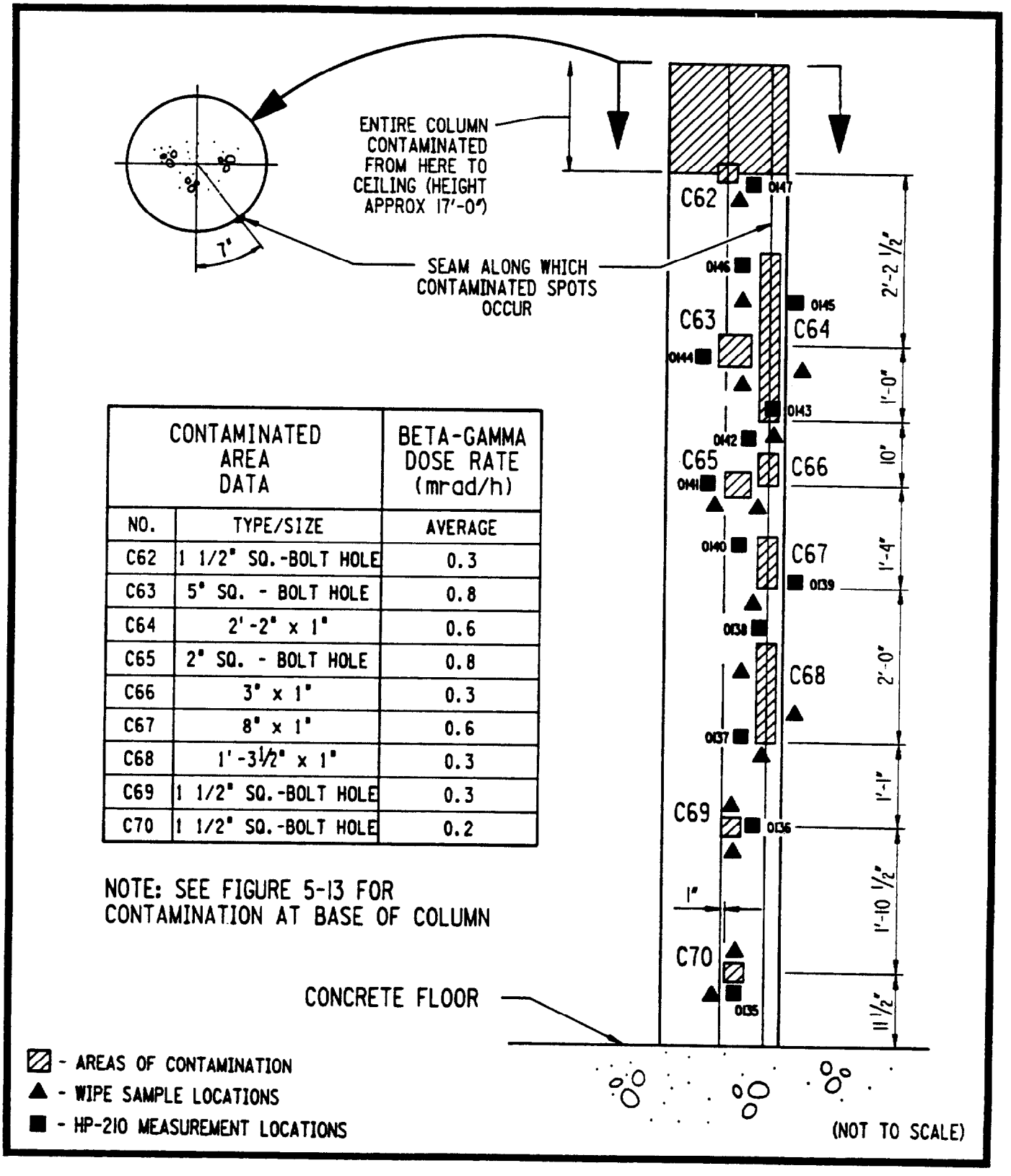


CONTAMINATED AREA DATA		BETA-GAMMA DOSE RATE RANGE (mrad/h)
NO.	TYPE/SIZE	AVERAGE
C27	1" SQ. - BOLT HOLE	0.3
C29	2 SMALL HOLES	0.3
C30	4" SQ. - BOLT HOLE	5.5
C33	4" SQUARE	0.2
C34	5" x 1 1/2"	0.2
C35	1'-2" x 1 1/2"	0.2

▨ - AREAS OF CONTAMINATION
▲ - WIPE SAMPLE LOCATIONS
■ - HP-210 MEASUREMENT LOCATIONS

(NOT TO SCALE)

FIGURE 5-11 AREAS OF CONTAMINATION - BAY 7 (ROOM 1, FIRST FLOOR)

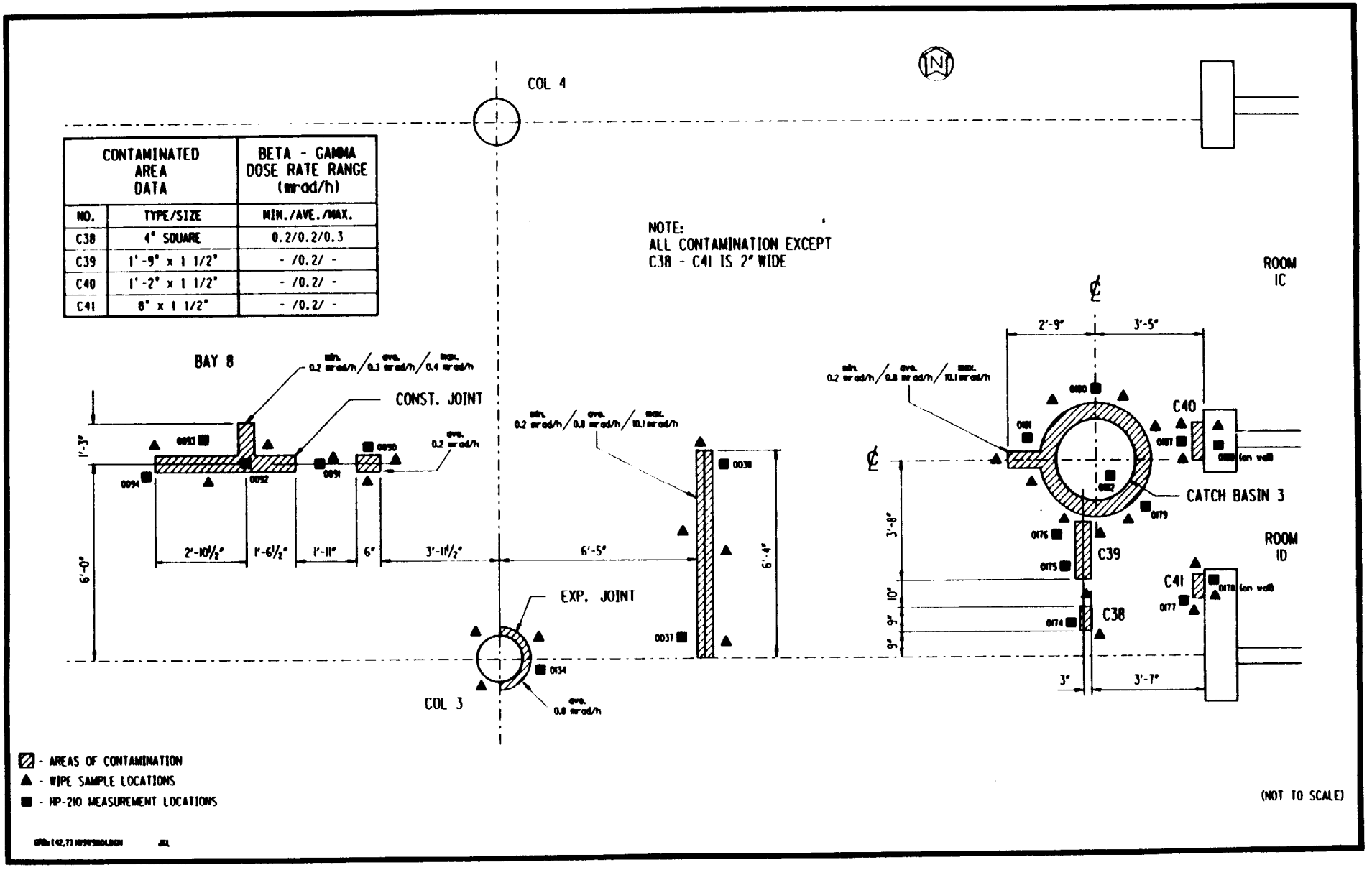


CONTAMINATED AREA DATA		BETA-GAMMA DOSE RATE (mrad/h)
NO.	TYPE/SIZE	AVERAGE
C62	1 1/2" SQ.-BOLT HOLE	0.3
C63	5" SQ. - BOLT HOLE	0.8
C64	2'-2" x 1"	0.6
C65	2" SQ. - BOLT HOLE	0.8
C66	3" x 1"	0.3
C67	8" x 1"	0.6
C68	1'-3½" x 1"	0.3
C69	1 1/2" SQ.-BOLT HOLE	0.3
C70	1 1/2" SQ.-BOLT HOLE	0.2

NOTE: SEE FIGURE 5-13 FOR CONTAMINATION AT BASE OF COLUMN

FIGURE 5-12 AREAS OF CONTAMINATION - COLUMN 3, SOUTH FACE (ROOM 1, FIRST FLOOR)

GRB: (42,7) N9W980LDGN JKL



CONTAMINATED AREA DATA		BETA - GAMMA DOSE RATE RANGE (mrad/h)
NO.	TYPE/SIZE	MIN./AVE./MAX.
C38	4" SQUARE	0.2/0.2/0.3
C39	1'-9" x 1 1/2"	- /0.2/ -
C40	1'-2" x 1 1/2"	- /0.2/ -
C41	8" x 1 1/2"	- /0.2/ -

FIGURE 5 13 AREAS OF CONTAMINATION - BAY 8 (ROOM 1, FIRST FLOOR)

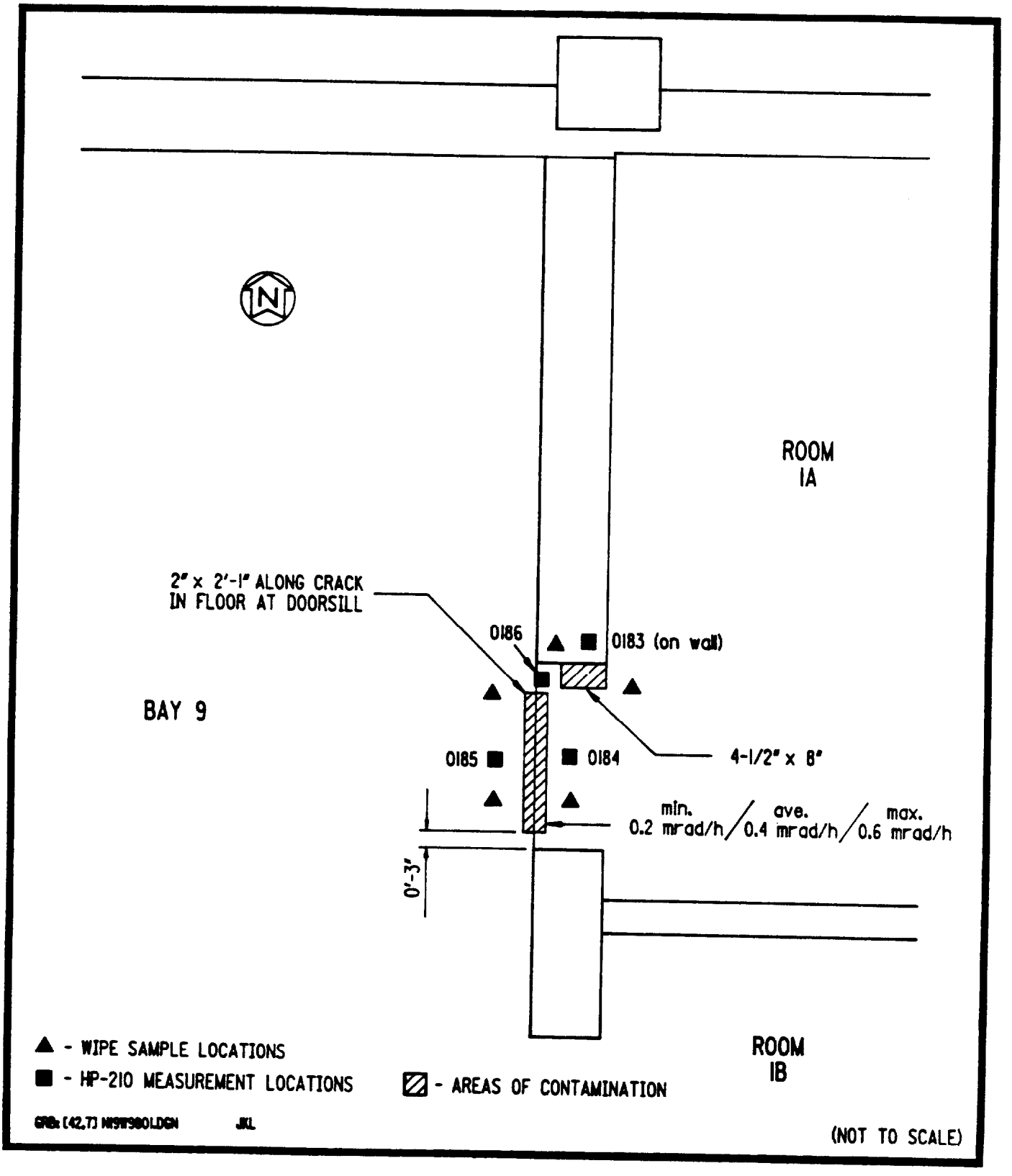


FIGURE 5-14 AREAS OF CONTAMINATION - BAY 9 / ROOM 1A

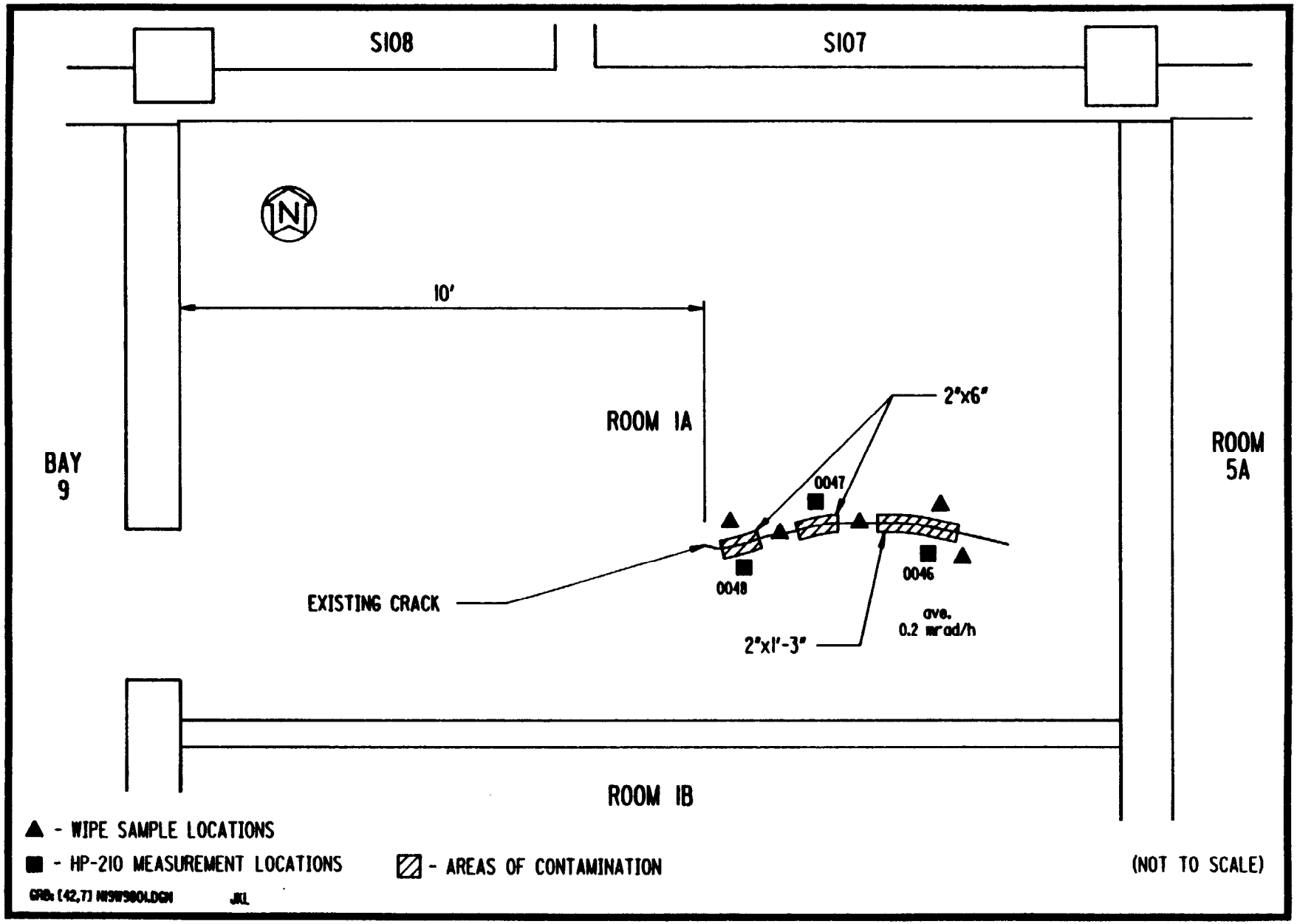


FIGURE 5-15 AREAS OF CONTAMINATION - ROOM 1A (FIRST FLOOR)

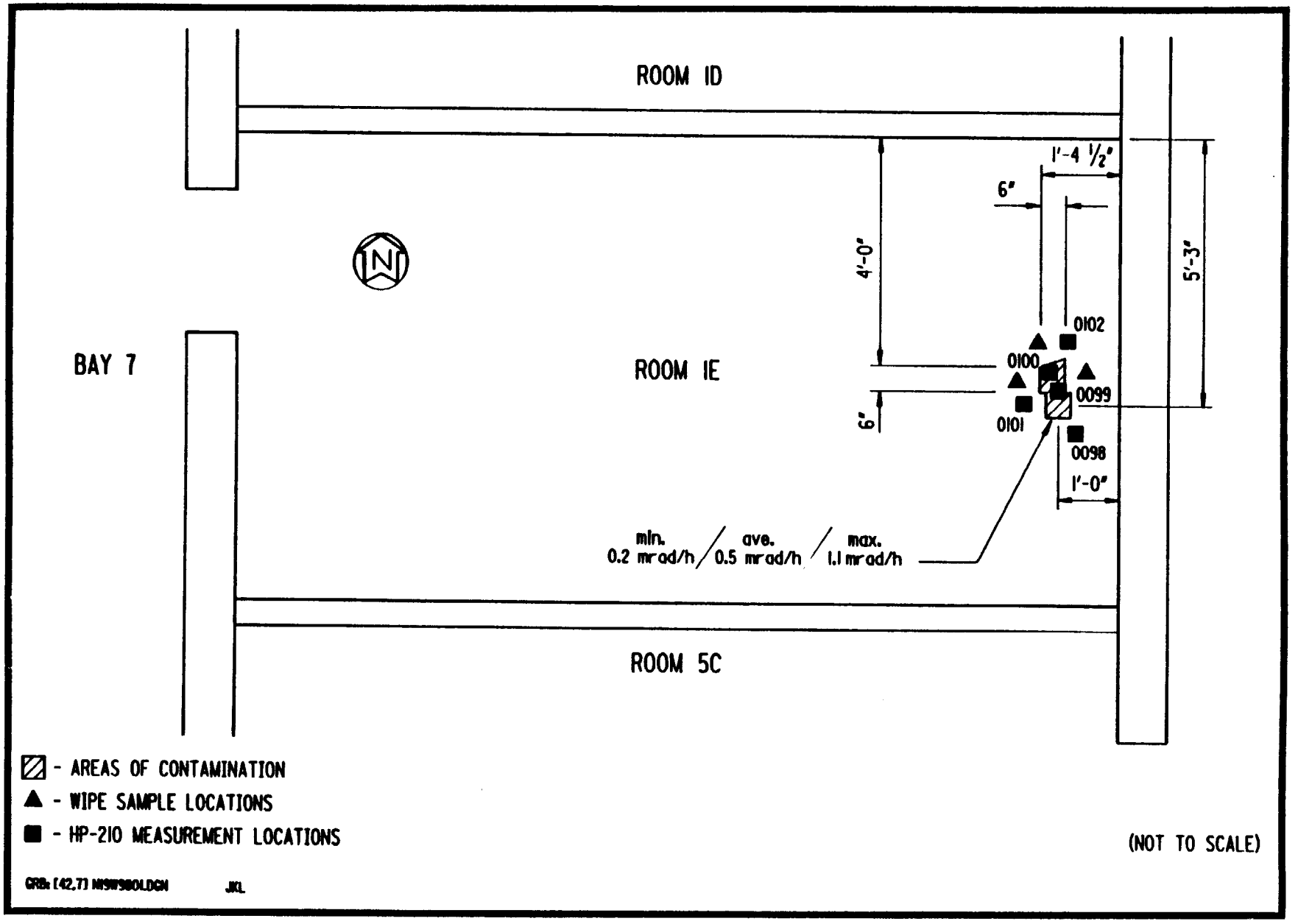


FIGURE 5-16 AREAS OF CONTAMINATION - ROOM 1E (FIRST FLOOR)

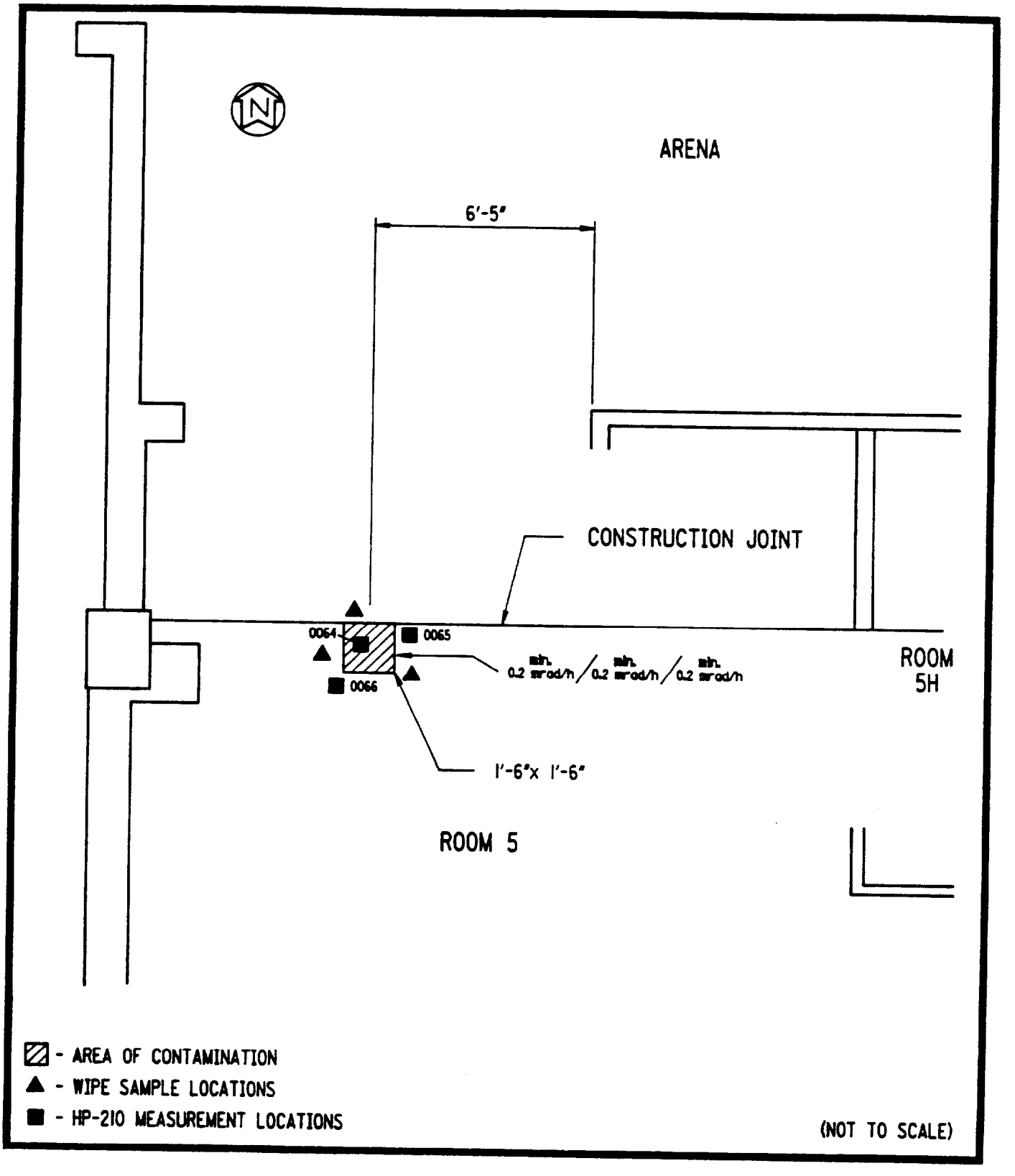


FIGURE 5-17 AREA OF CONTAMINATION - ROOM 5 (FIRST FLOOR)

GRB: [42,7] N9W980LDGN JKL

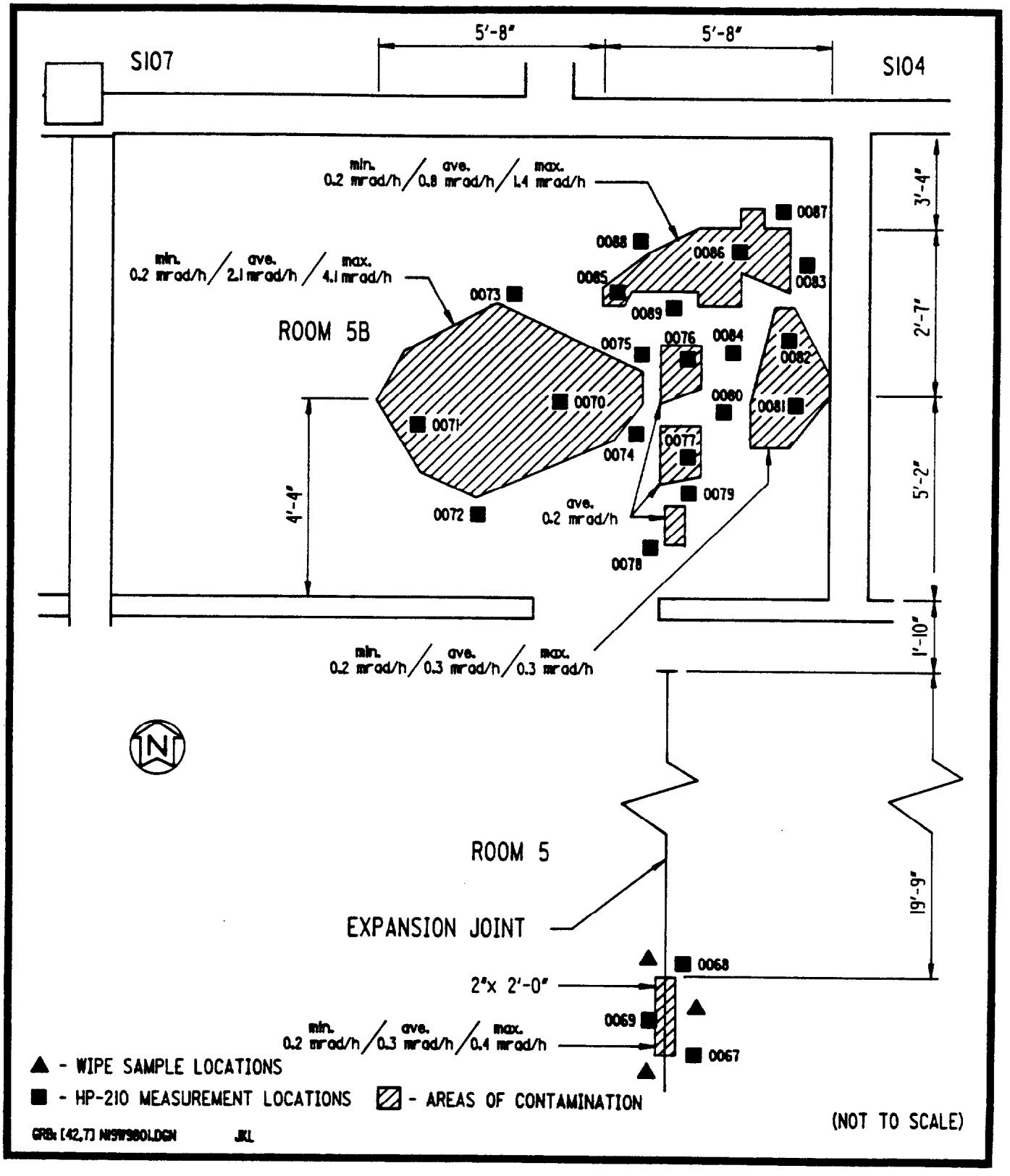


FIGURE 5-18 AREAS OF CONTAMINATION - ROOM 5B (FIRST FLOOR)

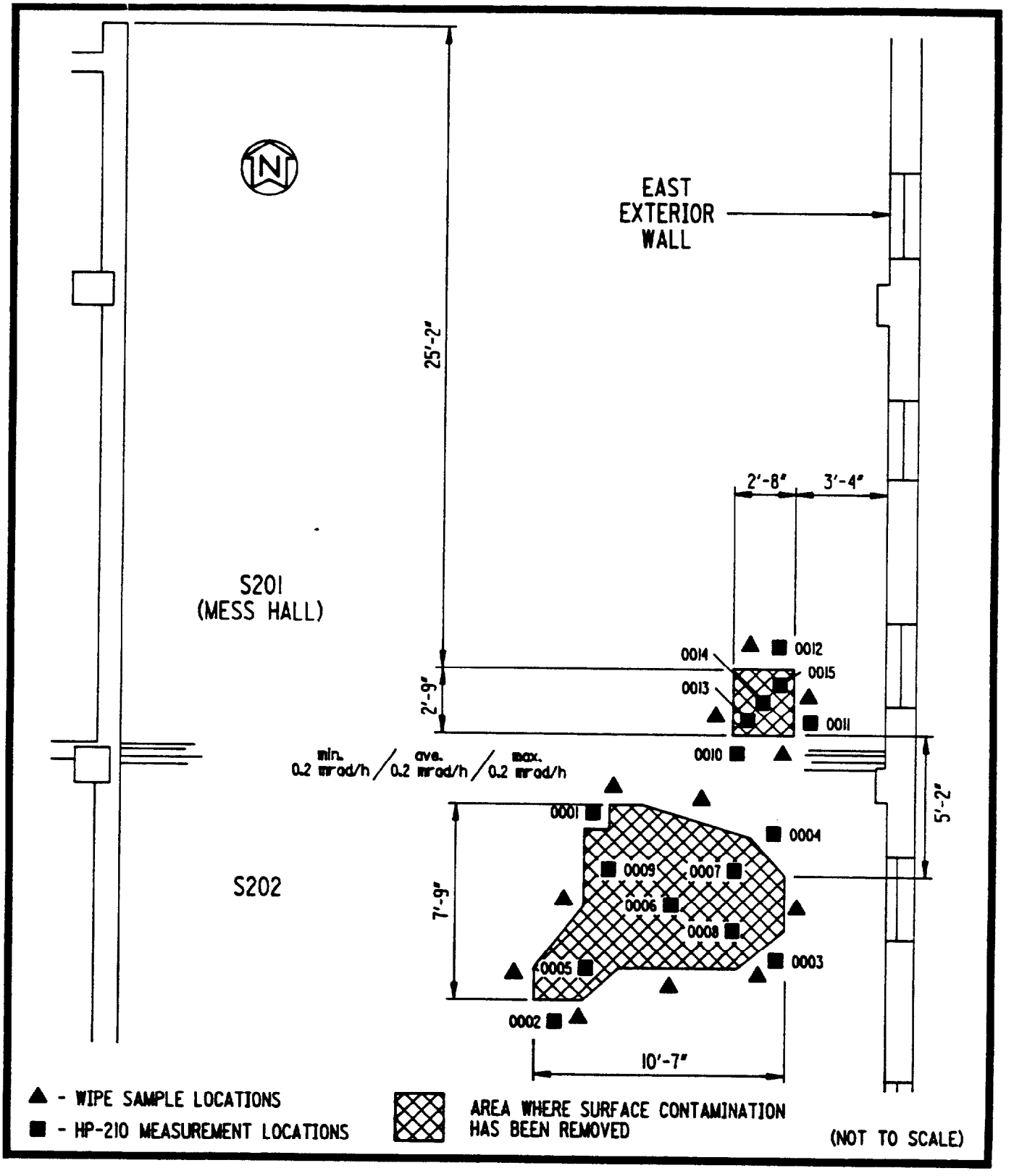


FIGURE 5-19 AREAS OF CONTAMINATION - ROOMS S201 / S202 (SECOND FLOOR)

GRA: [66,42] N9W9802.DGN JKL

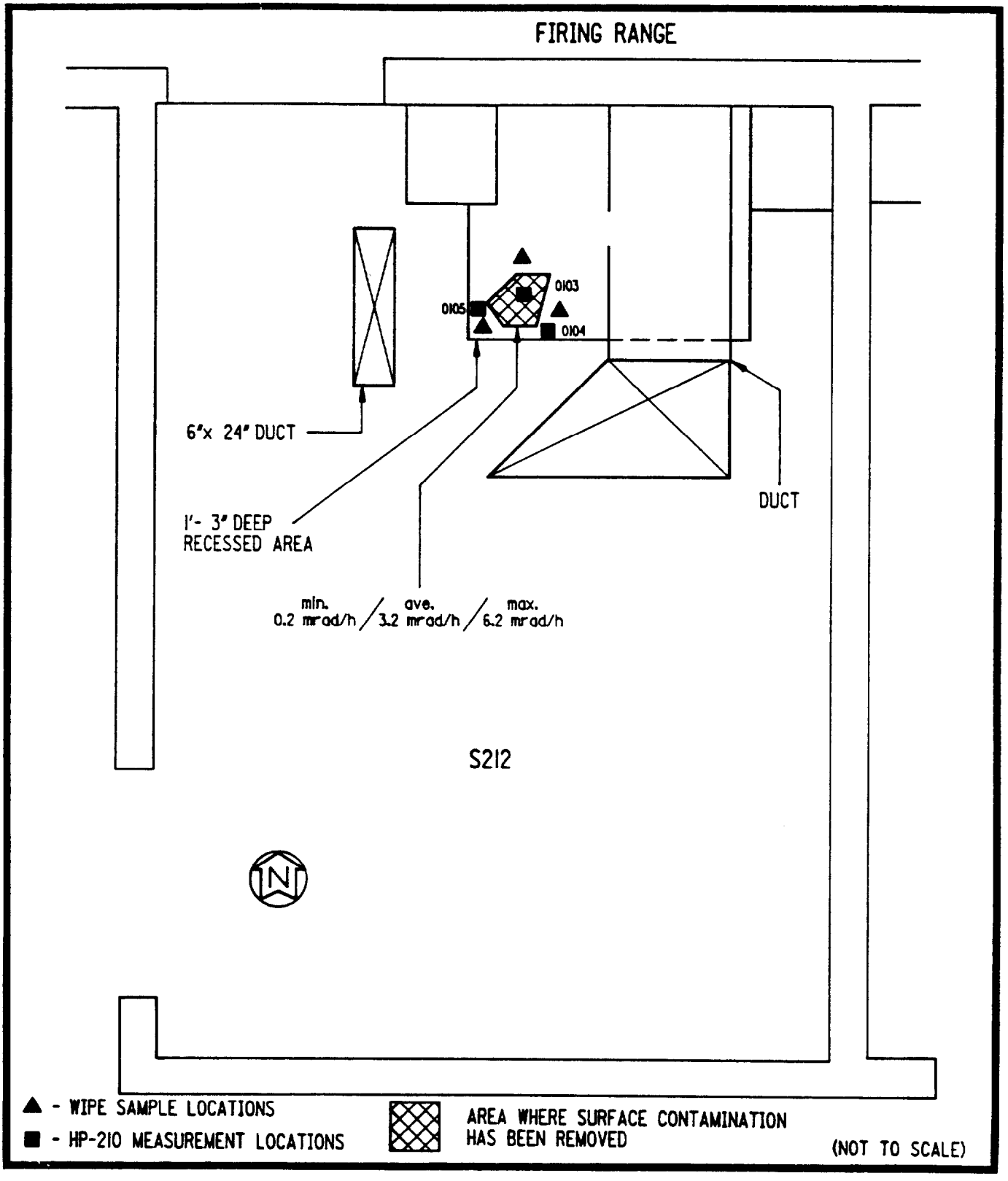


FIGURE 5-20 AREA OF CONTAMINATION - ROOM S212 (SECOND FLOOR)

GRB: [42,7] N9W9802.DGN JKL

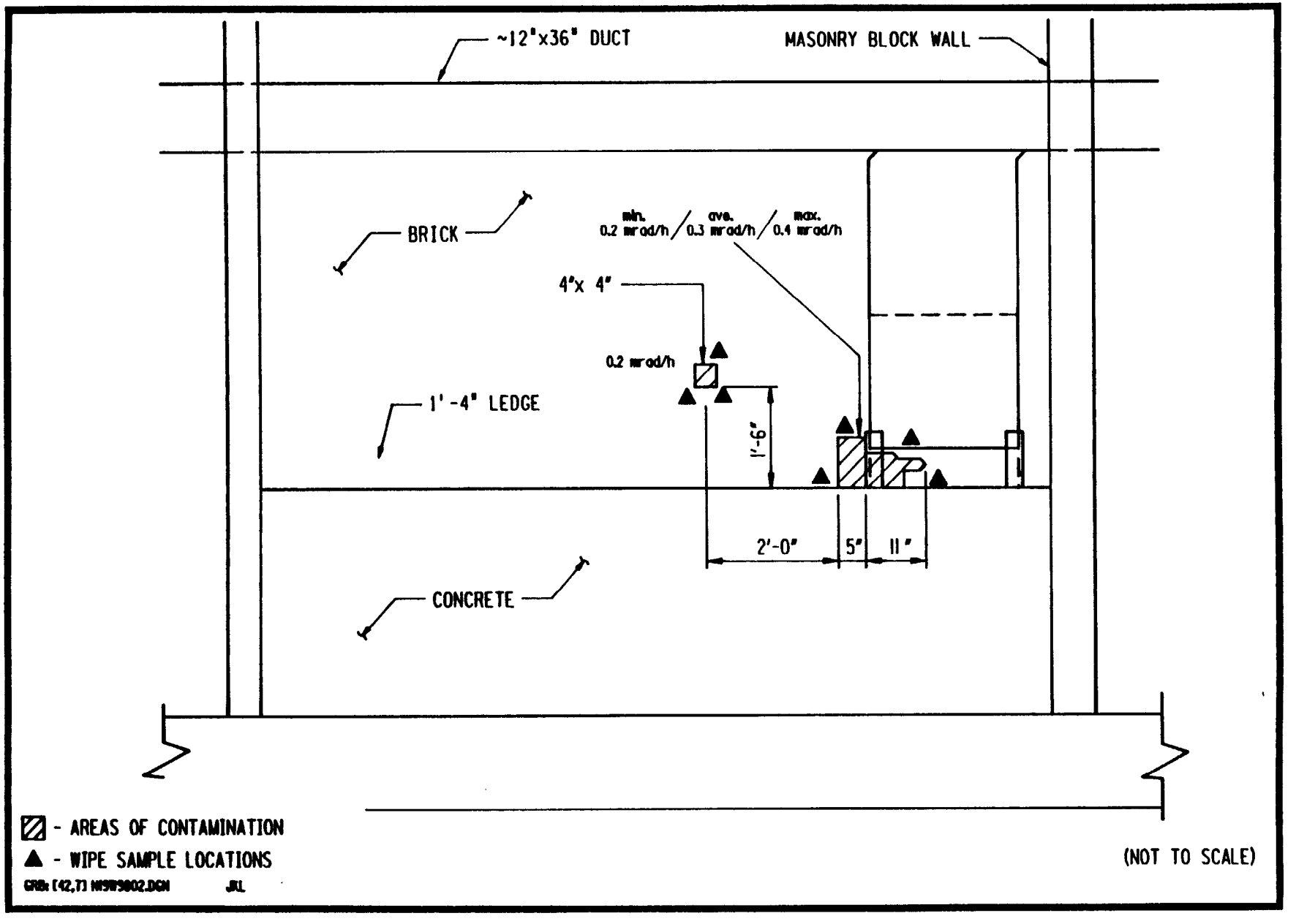


FIGURE 5-21 AREAS OF CONTAMINATION - ROOM S213, ELEVATION OF NORTH WALL (SECOND FLOOR)

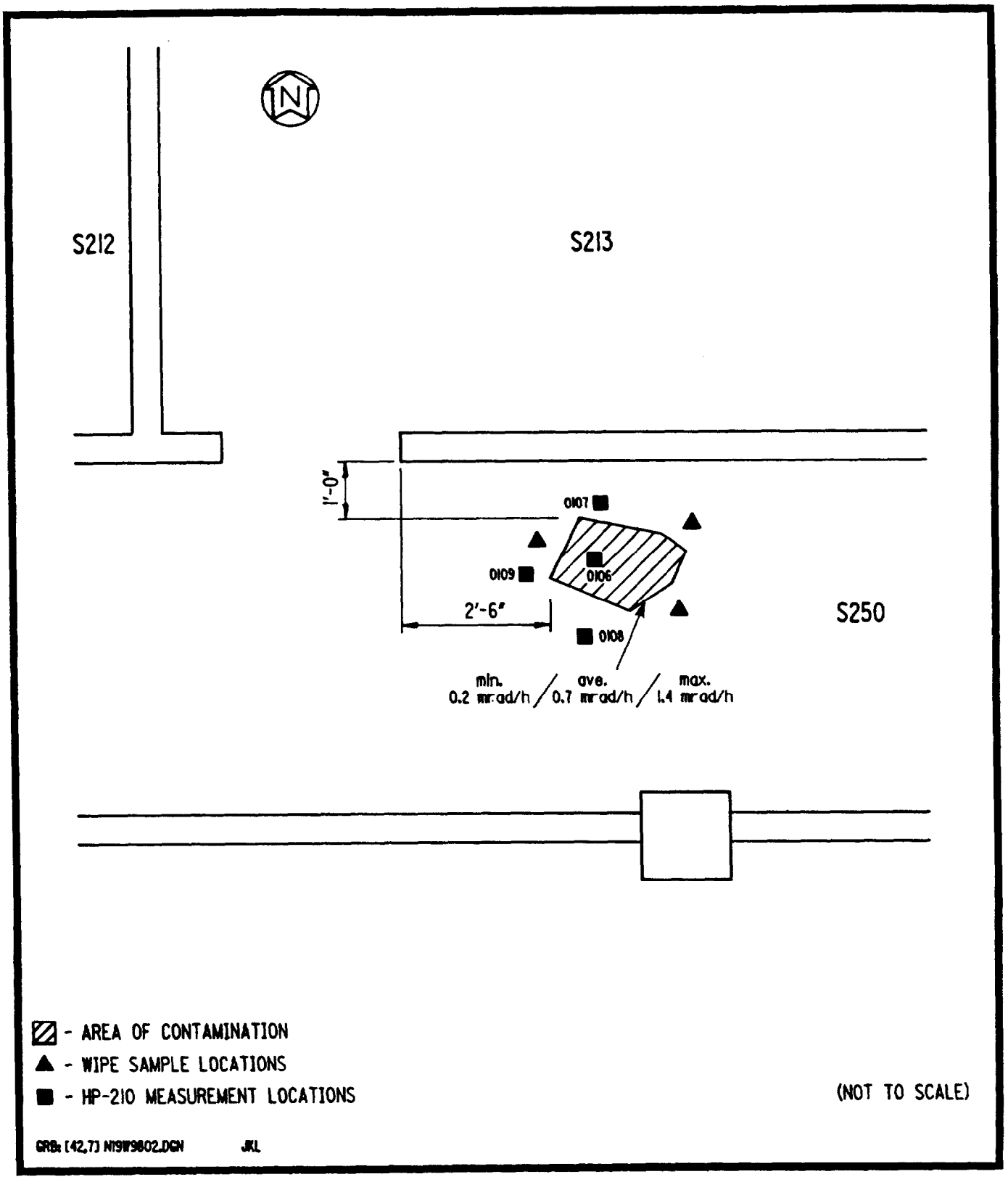


FIGURE 5-22 AREA OF CONTAMINATION - ROOM S250 (SECOND FLOOR)

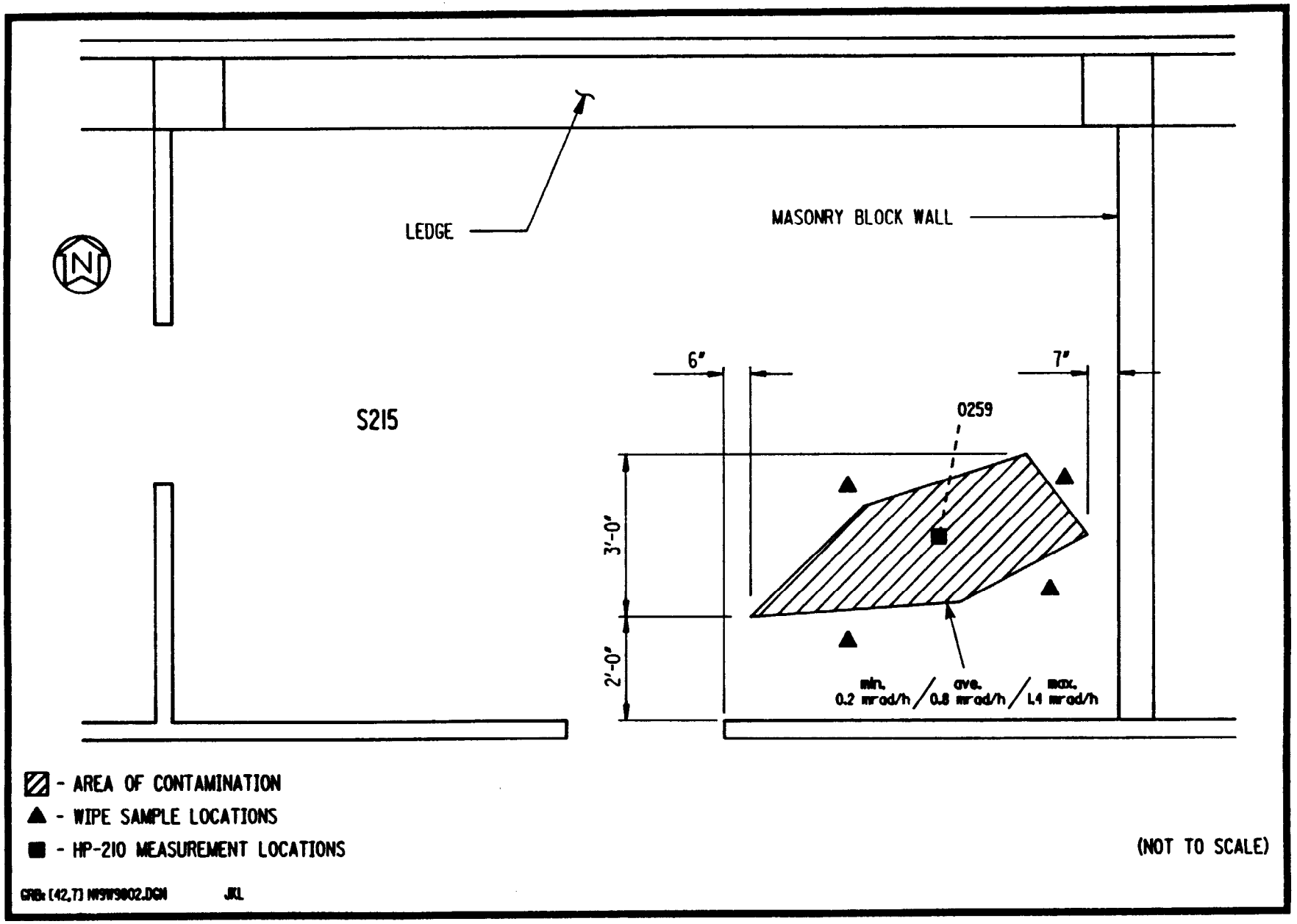


FIGURE 5-23 AREA OF CONTAMINATION - ROOM S215 (SECOND FLOOR)

TABLE 5-1

SUMMARY OF RESIDUAL CONTAMINATION GUIDELINES FOR THE NATIONAL GUARD ARMORY

BASIC DOSE LIMITS

The basic limit for the annual radiation dose received by an individual member of the general public is 100 mrem/yr.

SOIL (LAND) GUIDELINES (MAXIMUM LIMITS FOR UNRESTRICTED USE)

Radionuclide	Soil Concentration (pCi/g) above background[a,b,c]
Radium-226 Radium-228 Thorium-230 Thorium-232	5 pCi/g, averaged over the first 15 cm of soil below the surface; 15 pCi/g when averaged over any 15-cm-thick soil layer below the surface layer.
Uranium-238	150 pCi/g*
Other radionuclides	Soil guidelines will be calculated on a site-specific basis using the DOE manual developed for this use.

STRUCTURE GUIDELINES (MAXIMUM LIMITS FOR UNRESTRICTED USE)

Airborne Radon Decay Products

Generic guidelines for concentrations of airborne radon decay products shall apply to existing occupied or habitable structures on private property that are intended for unrestricted use; structures that will be demolished or buried are excluded. The applicable generic guideline (40 CFR 192) is: In any occupied or habitable building, the objective of remedial action shall be, and reasonable effort shall be made to achieve, an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 WL.[d] In any case, the radon decay product concentration (including background) shall not exceed 0.03 WL. Remedial actions are not required in order to comply with this guideline when there is reasonable assurance that residual radioactive materials are not the cause.

External Gamma Radiation

The average level of gamma radiation inside a building or habitable structure on a site to be released for unrestricted use shall not exceed the background level by more than 20 μR/h.

Indoor/Outdoor Structure Surface Contamination

Radionuclide[f]	Allowable Surface Residual Contamination[e] (dpm/100 cm^2) Average[g,h]	Maximum[h,i]	Removable[h,j]
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

*Argonne National Laboratory. Derivation of a Uranium Residual Radioactivity Guideline for the National Guard Armory in Chicago, Illinois, Chicago, IL, May 1987.

TABLE 5-1

(continued)

Indoor/Outdoor Structure Surface Contamination (continued)

Radionuclide[f]	Allowable Surface Residual Contamination[e] (dpm/100 cm^2) Average[g,h]	Maximum[h,i]	Removable[h,j]
U-Natural, U-235, U-238, and associated decay products	5,000 α	15,000 α	1,000 α
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above	5,000 β-γ	15,000 β-γ	1,000 β-γ

[a]These guidelines take into account ingrowth of radium-226 from thorium-230 and of radium-228 from thorium-232, and assume secular equilibrium. If either thorium-230 and radium-226 or thorium-232 and radium-228 are both present, not in secular equilibrium, the guidelines apply to the higher concentration. If other mixtures of radionuclides occur, the concentrations of individual radionuclides shall be reduced so that the dose for the mixtures will not exceed the basic dose limit.

[b]These guidelines represent unrestricted-use residual concentrations above background averaged across any 15-cm-thick layer to any depth and over any contiguous 100-m^2 surface area.

[c]Localized concentrations in excess of these limits are allowable provided that the average over a 100-m^2 area is not exceeded.

[d]A working level (WL) is any combination of short-lived radon decay products in 1 liter of air that will result in the ultimate emission of 1.3×10^5 MeV of potential alpha energy.

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

[f]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.

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

[h]The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h and 1.0 mrad/h, respectively, at 1 cm.

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

[j]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and 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.

TABLE 5-2
EXTERIOR BACKGROUND RADIONUCLIDE CONCENTRATIONS AND RADIATION LEVELS IN THE AREA OF THE NGA (MEASURED IN OUTSIDE AREAS)

Measurement Location[a]	Surface Gamma Radiation (cpm)	Surface Beta-Gamma Radiation (mrad/h)	Radionuclide Concentration (pCi/g ± 2 sigma)		
			Uranium-238	Radium-226	Thorium-232
1[b]	10000	0.03	<4.5	0.8 ± 0.6	1.5 ± 0.8
2[c]	7000	0.02	<5.0	1.1 ± 0.5	<1.0
3[d]	8000	0.03	<4.0	0.6 ± 0.5	1.1 ± 0.7
4[e]	8000	0.03	<5.5	1.0 ± 0.6	1.0 ± 0.7
5[f]	9000	0.03	<5.0	1.3 ± 0.5	1.5 ± 0.8
Average	8000	0.03	<4.8	1.0 ± 0.5	1.2 ± 0.8

[a]See Figure 5-1.
[b]Located at the University of Chicago, south of eastbound Midway Plaisance approximately 120 ft west of Kenwood Street, and 5 ft south of lightpole 13/7.
[c]Located west of the Museum of Science and Industry, east of northbound Stony Island Avenue approximately 5 ft east of the fourth lightpole south of 57th Street.
[d]Located east of northbound Shore Drive, directly across from Chicago Sinai Congregation Synagogue, approximately 10 ft east of the shoulder of the road.
[e]Located on the east side of northbound Lake Shore Drive, 5 ft east of lightpole 50/11.
[f]Located near the parking lot north of the intersection of 47th Street and Cornell, between the parking lot and 47th Street.

TABLE 5-3

EXTERIOR SUBSURFACE SOIL SAMPLING RESULTS

AT THE NATIONAL GUARD ARMORY

Coordinates E,W	Coordinates N,S	Depth (ft)	Concentrations (pCi/g +/- 2 sigma) Uranium-238	Radium-226	Thorium-232
Area 1*					
W115	S000	0.0-0.5	<11.0	0.8 ± 0.5	<1.0
W115	S000	0.5-1.0	<7.0	1.3 ± 0.7	1.1 ± 0.8
W115	S005	0.0-0.5	<11.0	1.3 ± 0.7	<1.0
W115	S005	0.5-1.0	<6.0	<1.0	<1.0
W115	S010	0.0-0.5	<5.0	1.6 ± 0.6	0.9 ± 0.6
W115	S010	0.5-1.0	<11.0	1.0 ± 0.6	0.9 ± 0.6
W115	S015	0.0-0.5	<8.0	1.3 ± 0.7	1.2 ± 0.8
W115	S015	0.5-1.0	<6.0	1.6 ± 0.7	1.8 ± 0.8
W115	S020	0.0-0.5	<12.0	1.5 ± 0.8	<1.0
W115	S020	0.5-1.0	<9.0	3.3 ± 0.9	2.0 ± 1.0
W115	S025	0.0-0.5	<14.0	1.5 ± 0.8	<1.0
W115	S025	0.5-1.0	<7.0	2.3 ± 0.8	1.2 ± 0.8
W115	S030	0.0-0.5	<13.0	2.4 ± 0.8	<1.0
W115	S030	0.5-1.0	<8.0	2.7 ± 0.8	2.0 ± 1.0
W120	S000	0.0-0.5	<8.0	1.0 ± 0.5	0.6 ± 0.6
W120	S000	0.5-1.0	<11.0	<1.0	<1.0
W120	S005	0.0-0.5	<6.0	<1.0	0.8 ± 0.6
W120	S005	0.5-1.0	<11.0	2.0 ± 0.7	2.0 ± 1.0
W120	S010	0.0-0.5	<12.0	0.9 ± 0.5	1.2 ± 0.8
W120	S010	0.5-1.0	<6.0	1.1 ± 0.5	0.9 ± 0.7
W120	S015	0.0-0.5	<6.0	2.4 ± 0.7	1.0 ± 0.7
W120	S015	0.5-1.0	<14.0	1.1 ± 0.5	<1.0
W120	S020	0.0-0.5	<7.0	2.2 ± 0.7	<1.0
W120	S020	0.5-1.0	<6.0	2.3 ± 0.7	1.1 ± 0.8
W120	S025	0.0-0.5	<13.0	2.7 ± 0.8	<1.0
W120	S025	0.5-1.0	<6.0	1.5 ± 0.6	<1.0
W120	S030	0.0-0.5	<15.0	2.6 ± 1.0	3.0 ± 1.0
W120	S030	0.5-1.0	<6.0	2.7 ± 0.8	<1.0
W125	S000	0.0-0.5	<7.0	2.1 ± 0.8	1.2 ± 1.0
W125	S000	0.5-1.0	<12.0	2.6 ± 0.9	1.3 ± 1.2
W125	S005	0.0-0.5	<7.0	1.5 ± 0.8	2.0 ± 1.0
W125	S005	0.5-1.0	<14.0	1.6 ± 0.7	<1.0
W125	S010	0.0-0.5	<9.0	3.1 ± 0.9	3.0 ± 1.0
W125	S010	0.5-1.0	<8.0	5.0 ± 1.0	2.0 ± 1.0
W125	S010	1.0-1.5	<11.0	1.7 ± 0.7	<1.0
W125	S010	1.5-2.0	<6.0	1.8 ± 0.6	1.3 ± 0.7
W125	S010	2.0-2.5	<6.0	1.3 ± 0.6	0.9 ± 0.8
W125	S010	2.5-3.0	<9.0	<1.0	<1.0
W125	S010	3.0-3.5	<5.0	0.5 ± 0.4	0.8 ± 0.6
W125	S010	3.5-4.0	<6.0	0.8 ± 0.4	0.7 ± 0.5
W125	S010	4.0-4.5	<4.0	0.7 ± 0.4	0.6 ± 0.4
W125	S010	4.5-5.0	<3.0	0.7 ± 0.4	0.7 ± 0.5
W125	S015	0.0-0.5	<8.0	2.4 ± 0.9	3.0 ± 1.0

TABLE 5-3

(Continued)

Coordinates E,W	Coordinates N,S	Depth (ft)	Concentrations (pCi/g +/- 2 sigma) Uranium-238	Radium-226	Thorium-232
W125	S015	0.5-1.0	<7.0	2.0 ± 0.8	2.0 ± 1.0
W125	S020	0.0-0.5	<12.0	5.0 ± 1.0	2.0 ± 1.0
W125	S020	0.5-1.0	<15.0	4.0 ± 1.0	3.0 ± 2.0
W125	S020	1.0-1.5	<8.0	3.8 ± 0.9	2.0 ± 1.0
W125	S020	1.5-2.0	<5.0	1.0 ± 0.5	1.2 ± 0.7
W125	S020	2.0-2.5	<10.0	0.8 ± 0.5	<1.0
W125	S020	2.5-3.0	<6.0	0.6 ± 0.5	1.0 ± 0.6
W125	S020	3.0-3.5	<10.0	0.6 ± 0.4	1.0 ± 0.6
W125	S020	3.5-4.0	<10.0	<1.0	<1.0
W125	S020	4.0-4.5	<9.0	0.6 ± 0.4	0.9 ± 0.5
W125	S020	4.5-5.0	<8.0	<1.0	<1.0
W125	S025	0.0-0.5	<8.0	1.1 ± 0.7	<1.0
W125	S025	0.5-1.0	<14.0	3.6 ± 0.9	2.0 ± 1.0
W125	S030	0.0-0.5	<8.0	2.1 ± 0.8	2.0 ± 1.0
W125	S030	0.5-1.0	<7.0	0.8 ± 0.5	1.4 ± 0.8
W130	S000	0.0-0.5	<11.0	1.4 ± 0.6	<1.0
W130	S000	0.5-1.0	<11.0	0.9 ± 0.6	0.8 ± 0.8
W130	S005	0.0-0.5	<14.0	4.0 ± 1.0	4.0 ± 2.0
W130	S005	0.5-1.0	<9.0	2.2 ± 0.8	2.0 ± 1.0
W130	S010	0.0-0.5	<7.0	2.1 ± 0.8	3.0 ± 1.0
W130	S010	0.5-1.0	<10.0	3.0 ± 1.0	2.0 ± 1.0
W130	S015	0.0-0.5	<14.0	3.1 ± 0.9	1.0
W130	S015	0.5-1.0	<15.0	4.0 ± 1.0	5.0 ± 2.0
W130	S020	0.0-0.5	<13.0	2.8 ± 0.9	2.0 ± 1.0
W130	S020	0.5-1.0	<10.0	4.0 ± 1.0	2.0 ± 1.0
W130	S025	0.0-0.5	<8.0	2.5 ± 0.9	2.0 ± 1.0
W130	S025	0.5-1.0	<13.0	2.2 ± 0.9	3.0 ± 1.0
W130	S030	0.0-0.5	<10.0	2.1 ± 0.8	2.0 ± 1.0
W130	S030	0.5-1.0	<7.0	1.3 ± 0.7	1.2 ± 0.9
W135	S000	0.0-0.5	<11.0	1.6 ± 0.8	<1.0
W135	S000	0.5-1.0	<10.0	<1.0	1.8 ± 0.7
W135	S005	0.0-0.5	<12.0	1.5 ± 0.7	1.6 ± 0.9
W135	S005	0.5-1.0	<13.0	1.2 ± 0.6	<1.0
W135	S010	0.0-0.5	<7.0	1.9 ± 0.7	1.6 ± 0.9
W135	S010	0.5-1.0	<13.0	1.8 ± 0.7	<1.0
W135	S015	0.0-0.5	<7.0	2.8 ± 0.9	1.1 ± 0.9
W135	S015	0.5-1.0	<13.0	3.0 ± 1.0	3.0 ± 1.0
W135	S020	0.0-0.5	<8.0	3.3 ± 0.9	<1.0
W135	S020	0.5-1.0	<14.0	3.0 ± 1.0	5.0 ± 2.0
W135	S025	0.0-0.5	<9.0	2.0 ± 1.0	<1.0
W135	S025	0.5-1.0	<14.0	3.0 ± 1.0	2.0 ± 1.0
W135	S030	0.0-0.5	<6.0	1.0 ± 0.7	<1.0
W135	S030	0.5-1.0	<14.0	4.0 ± 1.0	<1.0

TABLE 5-3

(Continued)

Coordinates E,W	Coordinates N,S	Depth (ft)	Concentrations (pCi/g +/- 2 sigma) Uranium-238	Radium-226	Thorium-232
Area 2*					
W263	N151	0.0-0.5	<7.0	1.0 ± 0.5	<1.0
W263	N151	0.5-1.0	<42.0	360.0 ±10.0	<4.0
Area 3*					
W295	N013	0.0-0.5	48.0 ±11.0	0.7 ± 0.5	1.6 ± 0.9
W297	N008	0.0-0.5	49.0 ±10.0	1.1 ± 0.7	<1.0

*See Figure 5-2.

TABLE 5-4

GROSS ALPHA CONTAMINATION FROM THE WIPE SAMPLES

AT THE NATIONAL GUARD ARMORY

Location	Sample	Corresponding Figure	Gross Alpha dpm/100 cm^2
Rooms S201/202	0001	5-19	<1
Rooms S201/202	0002	5-19	<1
Rooms S201/202	0003	5-19	<1
Rooms S201/202	0004	5-19	<1
Rooms S201/202	0005	5-19	<1
Rooms S201/202	0006	5-19	<1
Rooms S201/202	0007	5-19	<1
Rooms S201/202	0008	5-19	1 ± 1
Rooms S201/202	0009	5-19	1 ± 1
Rooms S201/202	0010	5-19	<1
Rooms S201/202	0011	5-19	<1
Rooms S201/202	0012	5-19	<1
Rooms S201/202	0013	5-19	<1
Rooms S201/202	0014	5-19	<1
Rooms S201/202	0015	5-19	<1
Room 1	0016	5-6	2 ± 1
Room 1	0017	5-6	8 ± 2
Room 1	0018	5-6	7 ± 2
Room 1	0019	5-6	2 ± 1
Room 1	0020	5-6	2 ± 1
Room 1	0021	5-6	7 ± 2
Room 1	0022	5-6	8 ± 2
Room 1	0023	5-6	43 ± 6
Room 1	0024	5-6	6 ± 2
Room 1	0025	5-6	2 ± 1
Room 1	0026	5-6	2 ± 1
Room 1	0027	5-6	1 ± 1
Room 1	0028	5-6	1 ± 1
Room 1	0029	5-8	1 ± 1
Room 1	0030	5-8	2 ± 1
Room 1	0031	5-8	2 ± 1
Room 1	0032	5-8	2 ± 1
Room 1	0033	5-8	3 ± 2
Room 1	0034	5-11	1 ± 1
Room 1	0035	5-11	<1
Room 1	0036	5-11	<1
Room 1	0037	5-13	2 ± 1
Room 1	0038	5-13	4 ± 2
Room 1	0039	5-11	3 ± 1
Room 1	0040	5-11	4 ± 2
Room 1	0041	5-11	2 ± 1
Room 1	0042	5-6	2 ± 1
Room 1	0043	5-6	7 ± 2

TABLE 5-4

(continued)

Location	Sample	Corresponding Figure*	Gross Alpha dpm/100 cm^2
Room 1	0044	5-6	2 ± 1
Room 1	0045	5-8	1 ± 1
Room 1A	0046	5-15	<1
Room 1A	0047	5-15	<1
Room 1A	0048	5-15	<1
Rooms S201/202	0049	B	1300 ± 30
Rooms S201/202	0050	B	4500 ± 50
Rooms S201/202	0051	B	4940 ± 60
Rooms S201/202	0052	B	656 ± 20
Rooms S201/202	0053	C	<1
Rooms S201/202	0054	C	<1
Rooms S201/202	0055	C	<1
Rooms S201/202	0056	C	1 ± 1
Rooms S201/202	0057	C	<1
Rooms S201/202	0058	C	<1
Rooms S201/202	0059	C	<1
Rooms S201/202	0060	C	1 ± 1
Rooms S201/202	0061	C	<1
Rooms S201/202	0062	C	<1
Rooms S201/202	0063	C	<1
Room 5	0064	5-17	<1
Room 5	0065	5-17	<1
Room 5	0066	5-17	<1
Room 5	0067	5-18	<1
Room 5	0068	5-18	<1
Room 5	0069	5-18	<1
Room 5B	0070	5-18	5 ± 2
Room 5B	0071	5-18	<1
Room 5B	0072	5-18	<1
Room 5B	0073	5-18	<1
Room 5B	0074	5-18	<1
Room 5B	0075	5-18	<1
Room 5B	0076	5-18	<1
Room 5B	0077	5-18	<1
Room 5B	0078	5-18	<1
Room 5B	0079	5-18	<1
Room 5B	0080	5-18	<1
Room 5B	0081	5-18	<1
Room 5B	0082	5-18	<1
Room 5B	0083	5-18	<1
Room 5B	0084	5-18	1 ± 1
Room 5B	0085	5-18	<1
Room 5B	0086	5-18	<1

TABLE 5-4

(continued)

Location	Sample	Corresponding Figure	Gross Alpha dpm/100 cm^2
Room 5B	0087	5-18	<1
Room 5B	0088	5-18	<1
Room 5B	0089	5-18	<1
Room 1	0090	5-13	1 ± 1
Room 1	0091	5-13	<1
Room 1	0092	5-13	3 ± 2
Room 1	0093	5-13	<1
Room 1	0094	5-13	<1
Room 1	0095	5-5	1 ± 1
Room 1	0096	5-5	2 ± 1
Room 1	0097	5-5	<1
Room 1E	0098	5-16	<1
Room 1E	0099	5-16	<1
Room 1E	0100	5-16	<1
Room 1E	0101	5-16	<1
Room 1E	0102	5-16	<1
Room S212	0103	5-20	18 ± 3
Room S212	0104	5-20	48 ± 6
Room S212	0105	5-20	57 ± 6
Room S250	0106	5-22	2 ± 1
Room S250	0107	5-22	<1
Room S250	0108	5-22	<1
Room S250	0109	5-22	<1
Room 1	0110	5-6	8 ± 2
Room 1	0111	5-6	4 ± 2
Room 1	0112	5-6	<1
Room 1	0113	5-6	1 ± 1
Room 1	0114	5-6	<1
Room 1	0115	5-6	3 ± 1
Room 1	0116	5-8	1 ± 1
Room 1	0117	5-8	1 ± 1
Room 1	0118	5-8	4 ± 2
Room 1	0119	5-8	<1
Room 1	0120	5-9	<1
Room 1	0121	5-9	3 ± 1
Room 1	0122	5-9	<1
Room 1	0123	5-10	<1
Room 1	0124	5-10	<1
Room 1	0125	5-10	2 ± 1
Room 1	0126	5-9	4 ± 2
Room 1	0127	5-9	4 ± 2
Room 1	0128	5-9	9 ± 3
Room 1	0129	5-10	30 ± 4

TABLE 5-4

(continued)

Location	Sample	Corresponding Figure	Gross Alpha dpm/100 cm^2
Room 1	0130	5-10	3 ± 1
Room 1	0131	5-10	28 ± 4
Room 1	0132	5-10	7 ± 2
Room 1	0133	5-10	1 ± 1
Room 1	0134	5-13	7 ± 2
Room 1	0135	5-12	<1
Room 1	0136	5-12	<1
Room 1	0137	5-12	<1
Room 1	0138	5-12	<1
Room 1	0139	5-12	<1
Room 1	0140	5-12	3 ± 1
Room 1	0141	5-12	3 ± 2
Room 1	0142	5-12	<1
Room 1	0143	5-12	<1
Room 1	0144	5-12	<1
Room 1	0145	5-12	<1
Room 1	0146	5-12	5 ± 2
Room 1	0147	5-12	97 ± 8
Room 1	0148	5-11	1 ± 1
Room 1	0149	5-11	3 ± 2
Room 1	0150	5-11	3 ± 2
Room 1	0151	5-11	2 ± 1
Room 1	0152	5-11	4 ± 2
Room 1	0153	5-11	8 ± 2
Room 1	0154	5-8	1 ± 1
Room 1	0155	5-8	1 ± 1
Room 1	0156	5-8	2 ± 1
Room 1	0157	5-8	<1
Room 1	0158	5-8	1 ± 1
Room 1	0159	5-8	<1
Room 1	0160	5-8	2 ± 1
Room 1	0161	5-8	<1
Room 1	0162	5-8	2 ± 1
Room 1	0163	5-8	<1
Room 1	0164	5-8	1 ± 1
Room 1	0165	5-8	1 ± 1
Room 1	0166	5-8	<1
Room 1	0167	5-8	1 ± 1
Room 1	0168	5-8, 5-11	5 ± 2
Room 1	0169	5-8, 5-11	<1
Room 1	0170	5-11	3 ± 1
Room 1	0171	5-11	<1
Room 1	0172	5-11	1 ± 1

TABLE 5-4

(continued)

Location	Sample	Corresponding Figure*	Gross Alpha dpm/100 cm^2
Room 1	0173	5-11	1 ± 1
Room 1	0174	5-13	2 ± 1
Room 1	0175	5-13	<1
Room 1	0176	5-13	1 ± 1
Room 1	0177	5-13	<1
Room 1	0178	5-13	<1
Room 1	0179	5-13	1 ± 1
Room 1	0180	5-13	1 ± 1
Room 1	0181	5-13	1 ± 1
Room 1	0182	5-13	3 ± 1
Room 1	0183	5-14	<1
Room 1	0184	5-14	<1
Room 1	0185	5-14	1 ± 1
Room 1	0186	5-14	1 ± 1
Room 1	0187	5-13	3 ± 1
Room 1	0188	5-13	<1
Room 1	0189	C	<1
Room 1	0190	C	<1
Room 1	0191	C	<1
Room 1	0192	C	<1
Room 1	0193	C	1 ± 1
Room 1	0194	C	<1
Room 1	0195	C	<1
Room 1	0196	C	<1
Room 1	0197	C	<1
Room 1	0198	C	<1
Room 1	0199	C	<1
Room 1	0200	C	25 ± 4
Room 1	0201	C	<1
Room 1	0202	C	<1
Room 1	0203	C	128 ± 9
Room 1	0204	C	27 ± 4
Room 1	0205	C	35 ± 5
Room 1	0206	C	41 ± 5
Room 1	0207	C	29 ± 4
Room 1	0208	C	86 ± 7
Room 1	0209	C	21 ± 4
Room 1	0210	C	35 ± 5
Room 1	0211	C	90 ± 8
Room 1	0212	C	33 ± 5
Room 1	0213	C	39 ± 5
Room 1	0214	C	65 ± 6
Room 1	0215	C	36 ± 5

TABLE 5-4
(continued)

Location	Sample	Corresponding Figure*	Gross Alpha dpm/100 cm^2
Room 1	0216	C	58 ± 6
Room 1	0217	C	33 ± 5
Room 1	0218	C	28 ± 4
Room 1	0219	C	43 ± 5
Room 1	0220	C	58 ± 6
Room 1	0221	C	111 ± 8
Room 1	0222	C	47 ± 6
Room 1	0223	C	34 ± 5
Room 1	0224	C	42 ± 5
Room 1	0225	C	30 ± 4
Room 1	0226	C	20 ± 4
Room 1	0227	C	46 ± 5
Room 1	0228	C	28 ± 4
Room 1	0229	C	50 ± 6
Room 1	0230	C	28 ± 4
Room 1	0231	C	23 ± 4
Room 1	0232	C	42 ± 5
Room 1	0233	C	56 ± 6
Room 1	0234	C	23 ± 4
Room 1	0235	C	24 ± 4
Room 1	0236	C	38 ± 5
Room 1	0237	C	83 ± 7
Room 1	0238	C	44 ± 5
Room 1	0239	C	<1
Room 1	0240	C	1 ± 1
Room 1	0241	C	<1
Room 1	0242	C	1 ± 1
Room 1	0243	C	<1
Room 1	0244	C	<1
Room 1	0245	C	1 ± 1
Room 1	0246	C	<1
Room 1	0247	C	<1
Room 1	0248	C	<1
Room 1	0249	C	<1
Room 1	0250	C	<1
Room 1	0251	C	192 ± 24
Room 1	0252	C	584 ± 19
Room 1	0253	C	4 ± 2
Room 1	0254	C	41 ± 5
Room S212	0256	C	<1
Room S250	0257	C	1 ± 1
Room S215	0258	C	<1
Room 1	0259	C	<1

TABLE 5-4

(continued)

Location	Sample	Corresponding Figure*	Gross Alpha dpm/100 cm^2
Room 1	0260	C	<1
Room 5B	0261	B	4 ± 2
Room 5B	0262	B	<1
Room 5	0263	B	<1
Room 5	0264	B	<1
Room S244	0265	B	12 ± 3
Room S212	0266	B	9 ± 2
Room S212	0267	B	<1
Arena Hall	0268	B	1 ± 1
Arena Hall	0269	B	<1
Arena Hall	0270	B	<1
Arena Hall	0271	B	<1
East Arena Hall	0272	B	1 ± 1
East Arena Hall	0273	B	<1
East Arena Hall	0274	B	<1
East Arena Hall	0275	B	1 ± 1
Room 5	0276	B	<1
Hall/Room S215	0277	B	<1
Hall/Room S213	0278	B	<1
South Headhouse	0279	B	<1
Hall/Room S231	0280	B	<1
Room S240	0281	B	1 ± 1
Room S212	0282	B	21 ± 4
Room S212	0283	B	5 ± 2
Room S212	0284	B	5 ± 2
Room 311	0285	B	<1
Hall/Room 311	0286	B	<1
Room 401	0287	B	3 ± 2
Room 401D	0288	B	<1
Room 401	0289	B	1 ± 1
North Headhouse	0290	B	<1
Bleacher	0291	B	<1
Room S203	0292	B	1 ± 1
North Headhouse	0293	B	<1
Room 5	0294	C	<1
Room 5	0295	C	<1
Room 5	0296	C	<1
Room 5	0297	C	<1
Room 5	0298	C	<1
Room 5	0299	C	<1
Room 5	0300	C	<1
Room 5	0301	C	<1
Room 5	0302	C	1 ± 1

TABLE 5-4
(continued)

Location	Sample	Corresponding Figure*	Gross Alpha dpm/100 cm^2
Room 5	0303	C	<1
Room 5	0304	C	<1
Room 5	0305	C	<1
Room 5	0306	C	<1
Room 5	0307	C	<1
Room 5	0308	C	<1
Room 5	0309	C	<1
Room 5	0310	C	<1
Room 5	0311	C	<1
Room 5	0312	C	<1
Room 5	0313	C	<1
Room 5	0314	C	<1
Room 5	0315	C	<1
Room 5	0316	C	<1
Room 5	0317	C	<1
Room 5	0318	C	<1
Room 5	0319	C	<1
Room 5	0320	C	<1
Room 5	0321	C	3 ± 2
Room 5	0322	C	4 ± 2
Room 5	0323	C	<1
Room 5	0324	C	<1
Room 5	0325	C	<1
Room 5	0326	C	4 ± 2
Room 5	0327	C	<1
Room 5	0328	C	<1
Room 5	0329	C	<1
Room 5	0330	C	<1
Room 5	0331	C	<1
Room 5	0332	C	<1
Room 5	0333	C	<1
Room 5	0334	C	<1
Room 5	0335	C	1 ± 1
Room 5	0336	C	<1
Room 5H	0337	B	5 ± 2
Room 5H	0338	B	<1
North Headhouse	0339	B	<1
North Headhouse	0340	B	1 ± 1
North Headhouse	0341	B	1 ± 1

*B indicates biased sample locations taken on horizontal surfaces suspected of being contaminated; C indicates samples taken from ceiling surfaces. The locations of these samples are not shown on figures.

TABLE 5-5

RADIONUCLIDE CONCENTRATION IN BRICK SAMPLES

Type of Brick	Concentration (pCi/g ± 2 sigma)		
	Uranium-238	Radium-226	Thorium-232
White	11 ± 7	8 ± 2	2 ± 1
Red	7 ± 4	4 ± 1	2 ± 1
Yellow	<11	2 ± 1	5 ± 2

As the data in Table 5-5 indicates, the radium-226 and thorium-232 concentrations are elevated and even exceed guidelines when all radionuclides are considered. However, due to the ratio of the isotopes (elevated radium-226 and thorium-232, but only slightly elevated uranium-238), the elevated concentrations appear to arise from natural sources and are not characteristic of contamination which may have occurred during MED activities.

TABLE 5-6

INTERIOR SUBSURFACE SOIL SAMPLING RESULTS

AT THE NATIONAL GUARD ARMORY

Location	Depth (ft)	Concentrations (pCi/g ± 2 sigma) Uranium-238	Radium-226	Thorium-232
Arena+				
1	0.0-0.5	<4.0	<0.4	1.0 ± 0.5
1	0.5-1.0	<6.0	1.0 ± 0.5	0.6 ± 0.5
1	1.0-1.5	<10.0	<0.5	<0.8
1	1.5-2.0	<5.0	<0.5	0.6 ± 0.5
1	2.0-2.5	<11.0	<0.5	<0.8
1	2.5-3.0	<9.0	<0.4	<0.7
1	3.0-3.5	<4.0	<0.4	0.9 ± 0.6
1	3.5-4.0	<4.0	<0.4	0.7 ± 0.6
1	4.0-4.5	<9.0	<0.4	<0.7
1	4.5-5.0	<4.0	0.8 ± 0.3	<0.4
1	5.0-5.5	<4.0	0.7 ± 0.4	0.9 ± 0.5
1	5.5-6.0	<4.0	1.2 ± 0.4	1.0 ± 0.6
1	6.0-6.5	<5.0	<0.4	<0.5
1	6.5-7.0	<4.0	0.6 ± 0.5	0.8 ± 0.6
1	7.0-7.5	<6.0	1.7 ± 0.6	0.8 ± 0.7
1	7.5-8.0	<5.0	0.9 ± 0.5	<0.9
2	0.0-0.5	<11.0	0.5 ± 0.3	<0.7
2	0.5-1.0	<9.0	1.5 ± 0.6	<0.7
2	1.0-1.5	<10.0	1.4 ± 0.5	<0.8
2	1.5-2.0	<6.0	0.4 ± 0.4	1.2 ± 0.7
2	2.0-2.5	<11.0	<0.5	<0.9
2	2.5-3.0	<5.0	0.9 ± 0.4	0.8 ± 0.6
2	3.0-3.5	<5.0	<0.4	0.8 ± 0.5
2	3.5-4.0	<10.0	<0.5	1.6 ± 0.9
2	4.0-4.5	<3.0	1.0 ± 0.4	0.9 ± 0.7
2	4.5-5.0	<5.0	<0.3	0.7 ± 0.5
2	5.0-5.5	<9.0	0.8 ± 0.4	<0.7
3	0.0-0.5	<4.0	1.4 ± 0.4	0.9 ± 0.6
3	0.5-1.0	<5.0	1.1 ± 0.5	0.9 ± 0.6
3	1.0-1.5	<10.0	0.8 ± 0.4	<0.8
3	1.5-2.0	<4.0	0.5 ± 0.4	<0.5
3	2.0-2.5	<4.0	0.5 ± 0.4	<0.5
3	2.5-3.0	<10.0	<0.4	<0.7
3	3.0-3.5	<5.0	0.5 ± 0.4	0.8 ± 0.6
3	3.5-4.0	<4.0	1.0 ± 0.4	0.7 ± 0.5
3	4.0-4.5	<10.0	<0.5	<0.8
3	4.5-5.0	<5.0	0.7 ± 0.4	<0.5
3	5.0-5.5	<4.0	0.5 ± 0.4	0.7 ± 0.4
4	0.0-0.5	<10.0	1.3 ± 0.6	<0.7
4	0.5-1.0	<5.0	1.2 ± 0.5	1.3 ± 0.6
4	1.0-1.5	<4.0	0.6 ± 0.5	1.1 ± 0.6

TABLE 5-6

(continued)

Location	Depth (ft)	Concentrations (pCi/g ± 2 sigma) Uranium-238	Radium-226	Thorium-232
4	1.5-2.0	<11.0	1.0 ± 0.5	<0.9
4	2.0-2.5	<12.0	0.9 ± 0.4	<0.9
4	2.5-3.0	<4.0	0.7 ± 0.5	0.7 ± 0.5
4	3.0-3.5	<10.0	0.8 ± 0.4	1.0 ± 0.7
4	3.5-4.0	<4.0	0.8 ± 0.3	0.8 ± 0.5
4	4.0-4.5	<11.0	<0.5	<0.8
4	4.5-5.0	<4.0	<0.5	<0.7
4	5.0-5.5	<4.0	0.8 ± 0.3	0.8 ± 0.5
5	0.0-0.5	<4.0	<0.4	<0.7
5	0.5-1.0	<4.0	<0.4	1.0 ± 0.5
5	1.0-1.5	<4.0	0.7 ± 0.5	<0.5
6	0.0-0.5	<11.0	<0.6	<0.8
6	0.5-1.0	<5.0	0.6 ± 0.5	<0.6
6	1.0-1.5	<11.0	<0.5	<0.8
6	1.5-2.0	<5.0	0.5 ± 0.5	<0.7
6	2.0-2.5	<10.0	<0.5	<0.8
6	2.5-3.0	<5.0	0.6 ± 0.4	<0.6
6	3.0-3.5	<9.0	0.6 ± 0.3	<0.7
6	3.5-4.0	<4.0	<0.4	0.8 ± 0.6
6	4.0-4.5	<4.0	<0.4	1.0 ± 0.7
6	4.5-5.0	<10.0	<0.5	<0.8
6	5.0-5.5	<9.0	<0.4	<0.7
7	0.0-0.5	<4.0	1.0 ± 0.4	1.1 ± 0.6
7	0.5-1.0	<6.0	1.1 ± 0.5	<0.6
7	1.0-1.5	<9.0	0.7 ± 0.3	<0.7
7	1.5-2.0	<4.0	1.1 ± 0.5	1.3 ± 0.7
7	2.0-2.5	<4.0	0.9 ± 0.4	<0.6
7	2.5-3.0	<10.0	<0.5	<0.8
7	3.0-3.5	<4.0	<0.4	<0.5
7	3.5-4.0	<4.0	<0.4	<0.5
7	4.0-4.5	<10.0	<0.5	<0.8
7	4.5-5.0	<4.0	0.5 ± 0.4	1.0 ± 0.5
7	5.0-5.5	<9.0	<0.4	<0.7
8	0.0-0.5	<4.0	1.0 ± 0.5	1.1 ± 0.6
8	0.5-1.0	<9.0	0.7 ± 0.5	<0.7
8	1.0-1.5	<4.0	0.7 ± 0.4	1.0 ± 0.7
8	1.5-2.0	<9.0	<0.6	<0.8
8	2.0-2.5	<4.0	0.9 ± 0.5	1.1 ± 0.7
8	2.5-3.0	<4.0	<0.5	<0.5
8	3.0-3.5	<10.0	0.6 ± 0.5	<0.8
8	3.5-4.0	<10.0	0.8 ± 0.5	1.2 ± 0.6
8	4.0-4.5	<5.0	1.2 ± 0.5	1.0 ± 0.7
8	4.5-5.0	<6.0	<0.4	<0.7
8	5.0-5.5	<9.0	<0.5	<0.7

TABLE 5-6

(continued)

Location	Depth (ft)	Concentrations (pCi/g ± 2 sigma) Uranium-238	Radium-226	Thorium-232
Southeast Corner of Room 1*				
9	0.0-0.5	<4.0	0.8 ± 0.6	<0.6
9	0.5-1.0	<5.0	0.9 ± 0.5	1.6 ± 0.8
9	1.0-2.0	<10.0	1.1 ± 0.5	<0.7
9	2.0-2.5	<4.0	0.7 ± 0.4	1.5 ± 0.8
9	2.5-3.0	<11.0	0.9 ± 0.4	<0.9
9	3.0-3.5	<4.0	0.7 ± 0.4	<0.7
9	3.5-4.0	<9.0	0.9 ± 0.4	<0.7
9	4.0-4.5	<4.0	0.5 ± 0.4	1.1 ± 0.6
9	4.5-5.0	<4.0	0.4 ± 0.3	0.5 ± 0.5
9	5.0-5.5	<3.0	1.0 ± 0.4	0.7 ± 0.4
10	0.0-0.5	9.0 ± 5.0	0.8 ± 0.4	<1.0
10	0.5-1.0	<5.0	0.5 ± 0.5	<1.0

+See Figure 4-1.
*See Figure 5-6.

TABLE 5-7

RADIONUCLIDE CONCENTRATIONS IN SAMPLES TAKEN FROM CATCH BASINS

Catch Basin Number	Depth (ft)	Concentration (pCi/g ± 2 sigma) Uranium-238	Radium-226	Thorium-232
1	Composite	<7	<1	<1
2	Composite	9 ± 4	0.9 ± 0.5	<1
3	0.0 - 0.5	15 ± 3	0.3 ± 0.2	<1
3	0.5 - 1.0	62 ± 6	0.4 ± 0.2	<1
3	1.0 - 1.5	220 ± 10	0.6 ± 0.4	0.4 ± 0.3
4	Composite	42 ± 11	1.0 ± 0.6	1.1 ± 0.8
6	Composite	35 ± 9	1.5 ± 0.6	<1
7	Composite	<6	<0.5	<0.7
Grease Traps (Room 5)				
Center	Composite	21 ± 9	<0.4	0.9 ± 0.6
North	Composite	20 ± 8	<0.5	<0.8

See Figure 4-2.

TABLE 5-8

RADIONUCLIDE CONCENTRATIONS IN SCRAPINGS

FROM CATCH BASIN WALLS

Catch Basin Number	Concentration (pCi/g ± 2 sigma)		
	Uranium-238	Radium-226	Thorium-232
1	<27	4 ± 2	<3
2	310 ± 30	2 ± 2	<2
3	16000 ± 1000	3 ± 2	<1
4	290 ± 50	<6	<3
6	<22	3 ± 2	5 ± 3

REFERENCES

1. Argonne National Laboratory. Radiological Survey of the National Guard Armory at Washington Park, 52nd Street and Cottage Grove Avenue, Chicago, IL, January 1983.

2. Memorandum, P.A. Williams, Industrial Safety Supervisor, Bechtel National, Inc., to C.A. Knoke, Construction Superintendent, Bechtel National, Inc. "Revised NGA Health and Safety Requirements," CCN 042584, January 13, 1987.

3. U.S. Department of Energy. Radiological Guidelines for Application to DOE's Formerly Utilized Sites Remedial Action Program, ORO-831, Oak Ridge, TN, March 1983 (reprinted with corrections, January 1984).

4. Argonne National Laboratory. Derivation of a Uranium Residual Radioactivity Guideline for the National Guard Armory in Chicago, Illinois, Chicago, IL, May 1987.

5. Letter, G.P. Crotwell, Bechtel National, Inc., to R.G. Bowles, Department of Energy, Oak Ridge Operations. "Chemical Status of NGA Basins," CCN 044077, April 1, 1987.

APPENDIX A

SUMMARY OF THE PROCEDURES AND RESULTS OF THE LIMITED CHEMICAL CHARACTERIZATION AT THE NGA

APPENDIX A

SUMMARY OF THE PROCEDURES AND RESULTS OF THE LIMITED CHEMICAL CHARACTERIZATION AT THE NGA

A.1 PURPOSE

The limited chemical characterization was performed to determine personnel safety requirements during the characterization and disposal restrictions for the chemical contamination identified.

A.2 PROCEDURE

A representative sample was obtained from each catch basin for analysis. The sample consisted of four aliquots of the material in the catch basin, which then provided a profile of the material. The volume of each catch basin was noted, as well as the type of material, i.e., solid or liquid. Samples of the material were then sent to the laboratory and analyzed for hazardous waste constituents.

A.3 RESULTS

The results of the analysis are provided in Table A-1. Results of the analysis showed elevated levels of volatile and semi-volatile organic compounds as well as some metals such as lead and chromium. After reviewing the Resource Conservation and Recovery Act characteristics of the samples, it was determined that the waste is defined as hazardous because the flashpoint is less than 70°F which meets the criteria under the definition of ignitability in 40 CFR Part 261.21.

TABLE A-1

SUMMARY OF CHEMICAL ANALYSIS AT NGA

	Concentrations in Catch Basins				
	1	2	3	4	6
Organic Volatiles (μg/kg)					
Methylene chloride	--	40,000	--	--	--
Acetone	--	43,000	--	--	--
1,1-Dichloroethane	--	34,000	--	--	--
1,1-Dichloroethene	--	71,000	--	--	--
1,1,1-Trichloroethane	--	410,000	--	--	--
Trichloroethane	--	25,000	--	--	--
Toluene	43,000	230,000	270,000	230,000	51,000
Ethylbenzene	31,000	140,000	110,000	120,000	37,000
Total xylenes	160,000	730,000	620,000	1,000,000	200,000
Chloroform	--	--	23,000	--	--
Benzene	--	--	20,000	<56,000	--
Organic Semi-volatiles (μg/kg)					
1,3-Dichlorobenzene	--	<50,000	--	--	--
1,4-Dichlorobenzene	--	64,000	200,000	--	--
Naphthalene	--	150,000	97,000	740,000	--
2-Methylnaphthalene	--	210,000	140,000	1,300,000	<41,000
Acenaphthene	--	<50,000	--	--	--
Di-n-butylphthalate	--	<50,000	--	--	--
Bis (2-ethylhexyl) phthalate	--	110,000	54,000	130,000	70,000
Phenanthrene	--	43,000	<54,000	--	--
Fluorene	--	--	--	<110,000	--
Acid Extractible (μg/kg)					
Phenol	1,800	5,500	--	1,800	1,000
Metals (mg/kg)					
Lead	440	1,500	2,300	750	1,300
Chromium	23	200	230	55	150
Flashpoint (°F)	<70	<70	<70	<70	<70

Exhibit II (4) - NEPA Documents

The documents listed below fulfill NEPA requirements for the subject site and are included in this exhibit.

	Page
Argonne National Laboratory. Action Description Memorandum, Proposed Decontamination of the National Guard Armory in Chicago, IL, Argonne, IL, March 1987.	II-287
Memorandum, J.E. Baublitz for W.R. Voigt, Jr., Director, Office of Remedial Action and Waste Technology, Office of Nuclear Energy, Department of Energy Headquarters, to J. LaGrone, Manager, Oak Ridge Operations Office. "Review of Remedial Actions at the National Guard Armory, Chicago, Illinois," Washington, D.C., July 27, 1987.	II-307