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U.S. Department of Energy
Grand Junction Office Remedial Action Project

Final Report of the Radiological Release Survey of Building 11 at the Grand Junction Office Facility

September 1997

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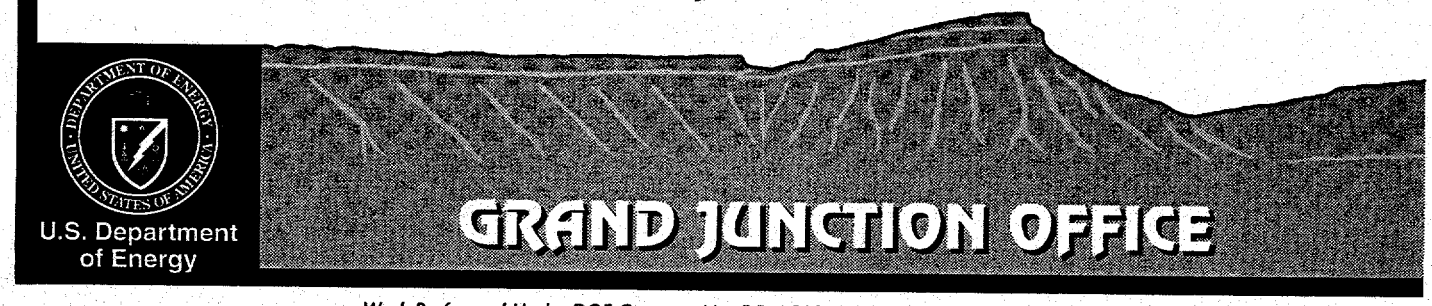

Work Performed Under DOE Contract No. DE-AC13-96GJ87460 for the U.S. Department of Energy

GJO–97–15–FOS
GJO–GJ–46

Grand Junction Office Remedial Action Project

Final Report of the Radiological Release Survey of Building 11 at the Grand Junction Office Facility

September 1997

Prepared for
U.S. Department of Energy
Albuquerque Operations Office
Grand Junction Office

Prepared by
WASTREN-Grand Junction
Grand Junction, Colorado

WASTREN-Grand Junction has been granted authorization to conduct remedial action under the Decontamination and Decommissioning Program. Remedial action was conducted at the DOE–GJO facility in accordance with all applicable or relevant and appropriate requirements.

Work Performed Under DOE Contract No. DE–AC13–96GJ87460
Approved for public release; distribution is unlimited.

Signature Page

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Abstract

The U.S. Department of Energy (DOE) Grand Junction Office (GJO) occupies a 61.7-acre facility along the Gunnison River near Grand Junction, Colorado. This site was contaminated with uranium ore concentrates and mill tailings during vanadium refining activities of the Manhattan Engineer District, and during sampling, assaying, pilot milling, storage, and brokerage activities conducted for the U.S. Atomic Energy Commission's domestic uranium procurement program. The DOE Defense Decontamination and Decommissioning Program established the GJO Remedial Action Project (GJORAP) to clean up and restore the facility lands, improvements, and underlying aquifer. *WASTREN-Grand Junction* is the site contractor for the facility and the remedial action contractor for GJORAP.

Building 11 and the underlying soil were found not to be radiologically contaminated; therefore, the building can be released for unrestricted use. Placards have been placed at the building entrances indicating the completion of the radiological release survey and prohibiting the introduction of any radioactive materials within the building without written approvals from the GJO Facilities Operations Manager. This document was prepared in response to a DOE–GJO request for an individual final release report for each GJO building.

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Acronyms

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*U.S. Code of Federal Regulations*
D&D	Decontamination and Decommissioning
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FOS	Facilities Operations & Support contractor (*WASTREN-Grand Junction*)
FUSRAP	Formerly Utilized Sites Remedial Action Program
GJO	Grand Junction Office
GJORAP	Grand Junction Office Remedial Action Project
GJPORAP	Grand Junction Projects Office Remedial Action Project
ICRP	International Commission on Radiological Protection
IVC	independent verification contractor (Oak Ridge National Laboratory)
LTSM	long-term surveillance and maintenance
MDC	minimum detectable concentration
ORNL	Oak Ridge National Laboratory
RDC	radon decay-product concentration
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SFMP	Surplus Facilities Management Program
TAR	Technical Assistance & Remediation contractor (MACTEC-ERS)
U.S.C.	United States Code
WL	working level

I. Introduction and Background

This report summarizes the results of the radiological release survey for Building 11 at the U.S. Department of Energy Grand Junction Office (DOE–GJO) facility. After all Grand Junction Office Remedial Action Project (GJORAP) remedial action is completed, the DOE–GJO facility will be transferred to the Long-Term Surveillance and Maintenance (LTSM) Program to monitor the passive restoration of the underlying aquifer. Additional reports summarize the remediation and release surveys of the exterior land areas, the other buildings, and associated utilities on the DOE–GJO facility.

Description of Facility

The DOE–GJO facility (Figure 1) is located approximately 0.6 mile (1 kilometer) south and west of populated areas of the city of Grand Junction in Sections 26 and 27, Township 1 South, Range 1 West, Ute Principal Meridian, Mesa County, Colorado. The facility occupies 61.7 acres (25 hectares) of floodplain within an accretionary bend along the east bank of the Gunnison River.

The elevation of the DOE–GJO facility is approximately 4,560 feet, or 1,390 meters (m). The facility is situated on silty sandy gravel underlain by mudstone bedrock. Two bodies of water with associated wetlands are located on the DOE–GJO facility: the North Pond and the South Pond. A freshwater alluvial aquifer underlying the facility is in direct hydraulic contact with the ponds and the Gunnison River. A semiarid climate prevails.

Access to the occupied portion of the facility currently is restricted by security personnel and a fence. There are approximately 36 structures on the facility. Beyond the fence are vehicle parking lots to the east and an earthen dike along the Gunnison River to the west and north. The area adjacent to the facility to the north was formerly Black Bridge Park, now owned by DOE. The facility is bordered on the east by the Union Pacific Railroad right-of-way.

DOE–GJO facility lands were acquired by the U.S. War Department in 1943 for the Manhattan Engineer District. A vanadium refinery was operated on the site from 1943 to 1946 to treat and concentrate uranium oxide. The U.S. Atomic Energy Commission operated a uranium-concentrate sampling plant and assay laboratory on the site until 1974. Pilot-scale uranium ore mills were operated from 1953 to 1958, processing 30,000 tons (27,200 metric tons) of ore (DOE 1987a). Mill operations were the primary source of contaminated materials at the DOE–GJO facility, resulting in the on-site burial of approximately 247,000 cubic yards (189,000 cubic meters) of uranium mill products. Other potential sources of contamination included laboratory and vehicle-maintenance wastes and byproducts, and activities related to sampling and stockpiling uranium concentrates (including yellowcake—U_3O_8). Approximately 22 acres (8.9 hectares) of open land and 19 buildings were contaminated.

Description of Project

In 1984, the DOE–GJO facility was accepted into the DOE Surplus Facilities Management Program (SFMP) for the purpose of eliminating health hazards resulting from uranium mill tailings and associated contaminated materials at the facility; and to bring contaminated portions of the facility, including the underlying aquifer, into compliance with applicable environmental regulations (DOE 1989a).

The facility was transferred to the DOE Decontamination and Decommissioning (D&D) Program in 1988. The D&D Program is responsible for the surveillance and maintenance of surplus DOE facilities, and performing any necessary decontamination and decommissioning activities. DOE–GJO has specific responsibility for GJORAP under the D&D Program.

WASTREN-Grand Junction (*WASTREN*) is the Facilities Operations & Support (FOS) contractor for DOE–GJO, and is the remedial action contractor for GJORAP. The GJORAP

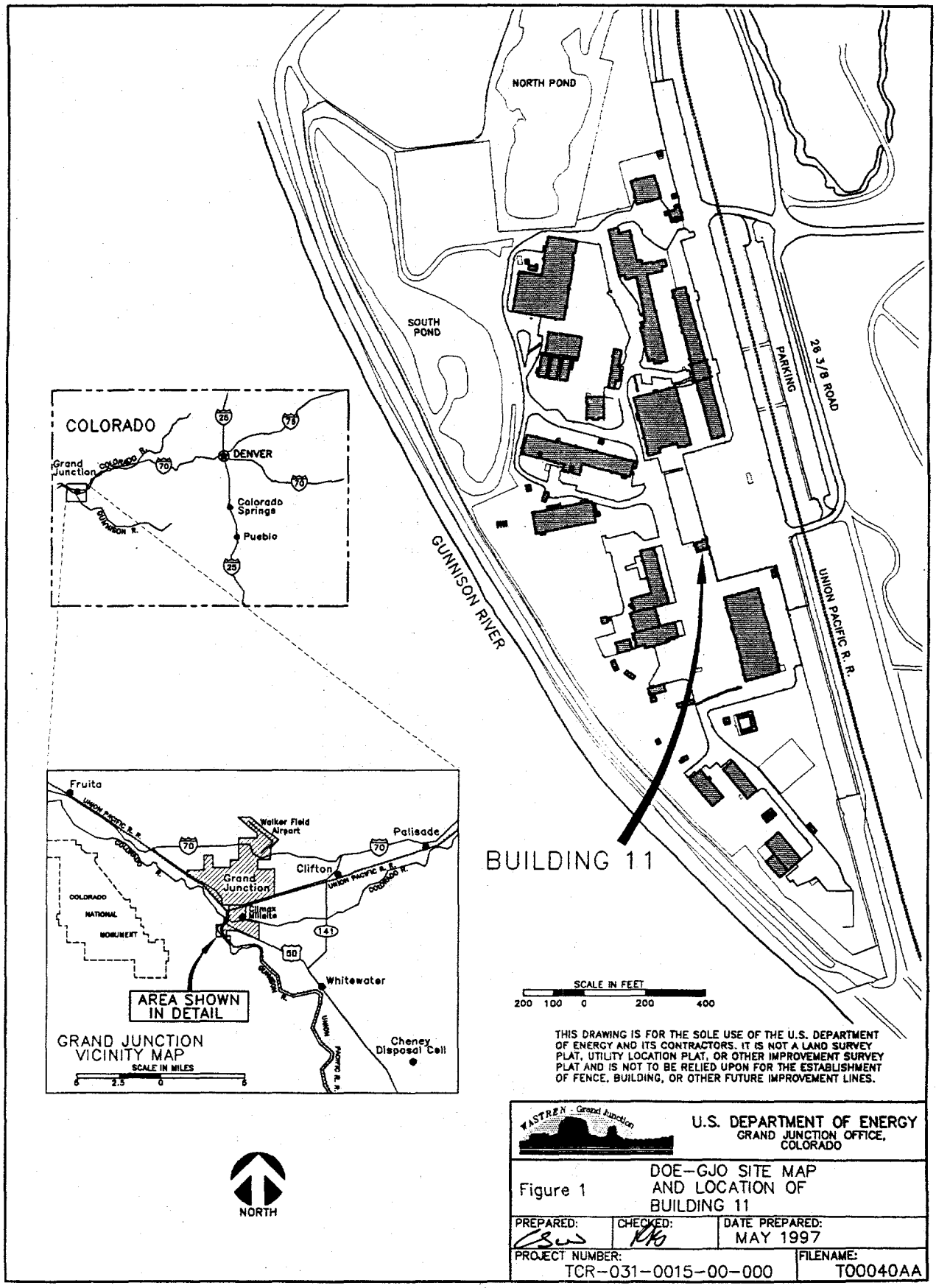

Figure 1. DOE– GJO Site Map and Location of Building 11

organization and implementation strategy was defined in the *Grand Junction Projects Office Remedial Action Project Remedial Action Plan* (DOE 1990d). The project originally was administered as the Grand Junction Projects Office Remedial Action Project (GJPORAP).

Description of Building 11

Building 11 was constructed on the DOE–GJO facility in 1955. It was built as the primary guardhouse (South Gate), and continues to serve this function. The building has a footprint of approximately 796 square feet, or 74.0 square meters (m^2). It is constructed of a wood frame on a concrete slab, with sheet steel siding and a flat built-up roof. The interior walls are constructed of wood framing and sheetrock.

Basis for Remedial Action

In 1980, the U.S. Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 *United States Code* [U.S.C.] 9601). In 1986, Congress amended CERCLA with the Superfund Amendments and Reauthorization Act (SARA). Section 120 of SARA and Executive Order 12580, *Superfund Implementation*, directed DOE to coordinate with the U.S. Environmental Protection Agency (EPA) to respond to actual or potentially imminent releases of hazardous substances into the environment at federally-owned DOE facilities. D&D Program policy specifies that remedial action will be conducted in accordance with DOE Order O 440.1, *Worker Protection Management for DOE Federal and Contractor Employees*, and all other applicable environmental regulations.

The DOE–GJO facility was evaluated using the CERCLA Hazard Ranking System. Although the resulting score of 14.6 (DOE 1989b) did not qualify the facility for placement on the National Priorities List, remedial action under GJORAP conformed to the applicable provisions of CERCLA, as amended by SARA, the Uranium Mill Tailings Radiation Control Act (42 U.S.C. 7901), the National Environmental Policy Act (42 U.S.C. 4321), and other applicable Federal and State regulations. Remedial action has been conducted with an emphasis on maintaining all health and safety risks as low as reasonably achievable.

II. Decommissioning Criteria, Objectives, and Work Scope

Applicable Guidelines and Standards

Table 1 presents the guideline documents that specify the authorized limits for releasing GJORAP buildings and open land (the applicable authorized limits are provided in Table 3). Remedial action activities on the facility have been conducted in accordance with approved plans and procedures (Appendix A) which incorporate the applicable provisions of Title 10, *U. S. Code of Federal Regulations*, Part 830 (10 CFR 830), Section 120, "Quality Assurance Requirements."

III. Work Performed

Remedial Investigation/Feasibility Study and Record of Decision

The Remedial Investigation/Feasibility Study—Environmental Assessment for GJPORAP was released in 1989 (DOE 1989a). Building 11 was not included in this study because it was outside the original scope of GJPORAP. Consequently, the release survey of this building was not addressed in the Record of Decision (ROD) (DOE 1990a).

Post-ROD Changes—An Explanation of Significant Differences will be prepared at the conclusion of GJORAP remedial action activities to address departures from the ROD, including the release survey of Building 11.

Characterization

A three-month-long radon decay-product concentration (RDC) measurement, completed in February 1990, and was 0.008 working level (WL) (DOE 1990c).

Table 1. Applicable or Relevant and Appropriate Standards

Type of Occurrence	Standard
Contamination in Soil	40 CFR 192[a] FUSRAP/SFMP Guidelines[b] DOE Order 5400.5[c]
Surface Activity (building surfaces)	FUSRAP/SFMP Guidelines[b] DOE Order 5400.5[c]
Gamma Exposure Rate (interior areas only)	40 CFR 192[a] FUSRAP/SFMP Guidelines[b] DOE Order 5400.5[c]
Radon Decay-Product Concentration (interior areas only)	40 CFR 192[a] FUSRAP/SFMP Guidelines[b] DOE Order 5400.5[c]

[a]40 CFR 192, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings."
[b]*Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program and Remote Surplus Facilities Management Program Sites* (DOE 1987b).
[c]DOE Order 5400.5, *Radiation Protection of the Public and the Environment.*

Building 11 was included in the 1993 comprehensive survey of the structures at the DOE–GJO facility. No radiological contamination was identified (Chem-Nuclear Geotech, Inc. 1993).

Three deposits of contaminated soil, parts of which were located within 3 m of the building, were assessed and remediated as verification areas V–453 and V–455 during the decontamination and decommissioning of the exterior land areas (DOE 1995a). Excavations ranged from 6 to 8 inches (15 to 20 centimeters) deep. Radionuclide concentrations (including background) in the composite samples collected at the bottom of the excavations were 1.4 picocuries per gram (pCi/g) for radium-226 (Ra-226) for both samples, and 1.8 and 2.2 pCi/g for thorium-230 (Th-230). The samples were not analyzed for total uranium. Gamma exposure rates at the bottom of the excavations ranged from 13 to 20 microroentgens per hour (μR/h).

Identification and removal of nonradiological hazardous materials is not required for radiological release of DOE–GJO buildings; however, when these materials are identified they are managed as required by appropriate regulations. Building 11 was surveyed for nonradiological hazardous materials in 1994. An asbestos-insulated pipe was identified and later removed to the county landfill (DOE 1995b). Other asbestos debris identified in a steam trench adjacent to the building was removed in 1997 after release-survey activities were completed.

Remedial Design

A remedial design was not required because no radioactive contamination was identified with Building 11.

IV. Final Release Survey

Building 11 was surveyed in February and May 1997 in accordance with the *Survey Plan for Releasing the Buildings at the Grand Junction Projects Office for Unrestricted Use* (DOE 1995c).

The soil areas adjacent to and beneath Building 11 were classified as unaffected because the associated exterior land area had been assessed and remediated and no contamination was found to extend beneath the

building (DOE 1995a). One exterior soil survey unit was established: Survey Unit 1 (141 m^2) consisting of exterior ground surfaces within 3 m of the building foundation.

The building surfaces were also classified as unaffected because existing survey data and the history of the building indicated low potential for contamination. Two survey units were established: Survey Unit 2 (241 m^2) consisting of the exterior walls, roof, and underside of the roof overhang; and Survey Unit 3 (311 m^2) consisting of the interior walls, floor, and ceiling.

Oak Ridge National Laboratory (ORNL) at Grand Junction was the independent verification contractor (IVC) for GJORAP. Oversight activities were conducted by representatives of the FOS Safety & Health Group and GJORAP Project Management.

Instrumentation

Radiation detection instruments were calibrated and used in accordance with the FOS *Calibration and Control Program Manual*. The instruments were checked daily for current calibration and proper operation. Calibrations used traceable standards and complied with 10 CFR 835, "Occupational Radiation Protection," DOE Order O 420.1, *Facility Safety,* and DOE Order O 440.1 *Worker Protection Management for DOE Federal and Contractor Employees*. Minimum detectable concentrations (MDCs) were calculated to ensure sufficient instrument sensitivity for measuring beta-gamma activity and gamma exposure rates at or below the authorized limits (*WASTREN* 1997b). MDCs are provided in Appendix B, Table B–1.

Background Determinations

Gamma-exposure-rate and radionuclide-concentration background values, determined for the DOE–GJO facility during previous investigations, are summarized in Table 2. Beta-gamma background activities used for this release survey were based on an average ambient air activity of 1500 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) plus material-specific activities determined from measurements collected on construction materials similar to those used on the DOE–GJO facility (*WASTREN* 1997a, DOE 1997). The applicable beta-gamma background activities are listed in Appendix B, Tables B–2 through B–4.

Reference Grids

A 1-m by 1-m survey grid, tied to the southwest corner of the building and the DOE–GJO facility survey grid, was established for the building-surface survey units. Survey Unit 1 (exterior ground surfaces) was divided into six approximately equal verification cells of 25 m^2 or less.

Scanning Results

One hundred percent of the exposed ground surface and the floor were scanned for gamma activity. Gross gamma exposure rates for the exterior ground surfaces and the floor are shown

Table 2. Gamma Exposure Rate and Soil Concentration Background Values for the DOE–GJO Facility

Criterion	Background Value	Source of Data
Gamma Exposure Rate	14 μR/h	DOE 1986
Radium-226 Concentration in Soil	1.0 pCi/g	DOE 1990b
Thorium-230 Concentration in Soil	2.0 pCi/g	DOE 1990b
Total Uranium Concentration in Soil	2.0 pCi/g	DOE 1990b

Key: μR/h = microroentgens per hour; pCi/g = picocuries per gram

in Appendix B, Figures B–1 and B–2, respectively.

One-square-meter grid blocks were scanned for beta-gamma activity at randomly-selected locations on the building surfaces. Measured activities are listed in Appendix B, Tables B–2 and B–3.

Direct Measurements

Direct beta-gamma measurements were taken within the scanned grid blocks for statistical analysis. These measurement results are provided in Appendix B, Tables B–2 and B–3. Results of additional measurements taken at selected locations and behind building surfaces are included in Appendix B, Table B–4. Measurement locations are shown in Appendix B, Figures B–1 through B–7. The projected upper limits of the mean activities, calculated at the 95 percent confidence level, indicate that the surface activities on the building surfaces do not exceed the authorized limits (Appendix B, Table B–7). The additional measurements indicated no significantly elevated activities, also.

In addition to measurements on building surfaces, direct measurements were taken on the exterior soil surfaces (beneath pavement) within 3 m of the building to screen for uranium. No significantly elevated activities were measured (Appendix B, Table B–4).

Alpha activity was not measured because any alpha-emitting contaminant at this site would also emit a detectable beta particle. For surfaces, uranium is the alpha-emitting contaminant of concern. Since uranium emits beta and alpha particles in a ratio nearly 1:1, compliance with authorized limits for beta-gamma activity demonstrates compliance with authorized limits for alpha activity.

Interior and exterior gamma exposure rates were measured 1 m above the floor or ground. Measurement locations are shown in Appendix B, Figures B–1 and B–2, and results are provided in Appendix B, Table B–5. The projected upper limits of the mean exposure rates, calculated at the 95 percent confidence level, indicate that the gamma exposure rates do not exceed the interior authorized limit or exterior guideline (Appendix B, Table B–7).

RDC Results

The average of three RDC measurements taken in Building 11 during a three-month-long period in 1997 was 0.0021 WL, which indicates that the working level is below the authorized limit.

Sample Results

Soil samples were collected at the location of highest surface gamma exposure rate within each verification cell. The samples were analyzed for Ra-226, Th-230, and total uranium. The results demonstrate that the radionuclide concentrations do not exceed the authorized limits for radionuclide concentrations in hot spots or averaged over 100 m^2 (Appendix B, Table B–6). The projected upper limits of the mean concentrations, calculated at the 95 percent confidence level, indicate that the radionuclide concentrations do not exceed the authorized limits.

V. Cost and Schedule

Project costs and the schedule for the release survey of Building 11 will be presented in a summary final report addressing all GJORAP buildings.

VI. Occupational Exposure

Health and safety procedures were followed in accordance with *The GJO Health and Safety Standards* and *The GJO Site Radiological Control Manual* to ensure personnel associated with the release survey activities were protected from radiological and nonradiological hazards.

VII. Waste Volumes

Building 11 did not require remediation; therefore, no radiologically-contaminated materials were generated.

VIII. Final Condition

All release requirements identified for GJORAP have been met for Building 11 (Table 3). The IVC will issue a Statement of Verification to signify concurrence that the release survey has achieved program objectives.

Building 11 can be released for unrestricted use. Placards have been placed at the building entrances indicating the completion of the radiological release survey and prohibiting the introduction of any radioactive materials within the building without written approvals from the GJO Facilities Operations Manager.

Because of the limitations of current technology and procedures for identifying and remediating radiologically-contaminated materials, unknown deposits of contamination may be found in the future. The potential for encountering contamination during future construction activities will be determined and at-risk activities will be monitored for radiological and nonradiological contamination. The DOE–GJO facility is routinely surveyed for radiation and other hazards.

At the time of this report, contamination is still present in other buildings located on the DOE–GJO facility; access to these areas is controlled and will be addressed by future GJORAP remedial actions. After the interior remedial actions are completed, the DOE–GJO facility will be managed as an LTSM site by DOE until the alluvial aquifer is restored by natural flushing.

IX. Lessons Learned

Several lessons were learned during release survey activities involving the DOE–GJO buildings in FY 1997. The experience gained has been applied to subsequent surveys, and should be considered for use on other DOE projects. The following lessons have been learned:

- Radiological protection managers should ensure that survey technicians and their trainers are fully trained and tested on every type of equipment that will be used for performing release surveys. A small quantity of unusable data were collected because survey crew members misinterpreted the display on a new type of survey instrument. Although the problem was caught early, it could have resulted in a large quantity of useless and expensive data. Special care is required when new types of equipment are introduced into the field. Furthermore, it may be desirable to involve manufacturers' technical representatives in the initial training and testing of personnel who will use the equipment.

- Project team members should be encouraged to think critically about all project activities so that wasteful or otherwise inappropriate practices are recognized and eliminated as soon as possible. An example of this process occurred when personnel not directly involved in the release surveys questioned the practice of measuring beta-gamma background activity on surfaces in the same buildings being surveyed for release. This practice could mask contamination by incorporating its activity in the background measurement, thus compromising the validity of release survey results. A subsequent study of beta-gamma activities contributed by common building materials indicated that most background measurements for beta-gamma activity in the DOE-GJO buildings can be performed by measuring ambient background activity in air.

- Good communication and coordination of activities is essential for limiting unnecessary delays and costs. For example,

Table 3. Certification Summary for All Survey Units

Certification Criteria	Number of Observations	Authorized Limit	Results[a]
Surface Activity (building surfaces only)	64 direct beta-gamma measurements	Alpha or beta-gamma activity shall not exceed 5,000 dpm/100 cm^2 fixed averaged over 1 m^2.	Maximum beta-gamma = 342 dpm/100 cm^2 $\mu_{95\%}$ = 100 dpm/100 cm^2 for Survey Unit 2 $\mu_{95\%}$ = 28 dpm/100 cm^2 for Survey Unit 3
	0 smears[b]	Alpha or beta-gamma activity shall not exceed 1,000 dpm/100 cm^2 removable.	Maximum direct beta-gamma = 342 dpm/100 cm^2
	64 scan beta-gamma measurements[b]	Alpha or beta-gamma activity shall not exceed 15,000 dpm/100 cm^2 maximum averaged over 100 cm^2.	Maximum direct beta-gamma = 342 dpm/100 cm^2
Gamma Exposure Rate (habitable areas only)	21 static measurements[c]	≤ 20 μR/h above background[d]	Maximum rate = -1.2 μR/h $\mu_{95\%}$ = -1.8 μR/h
	100% floor scan	≤ 20 μR/h above background[d]	Ranged from -1.9 to 0.3 μR/h
Radon Decay-Product Concentration (habitable areas only)	3 three-month measurements	Annual average shall not exceed 0.02 WL, to the extent practicable, and in no case shall exceed 0.03 WL.	$\bar{x}$ = 0.0021 WL
Radionuclide Concentrations in Soil		Ra-226 and Th-230:	
	6 individual samples	Shall not exceed 5 pCi/g above background[d] in the 15-cm surface layer, averaged over 100 m^2.	Ra-226: $\bar{x}_{max}$ = 0.9 pCi/g $\bar{x}$ = 0.8 pCi/g $\mu_{95\%}$ = 0.9 pCi/g Th-230: $\bar{x}_{max}$ = -1.0 pCi/g $\bar{x}$ = -1.0 pCi/g $\mu_{95\%}$ = -0.9 pCi/g
	None	Shall not exceed 15 pCi/g above background[d] in any 15-cm-thick soil layer more than 15 cm below the surface, averaged over 100 m^2.	Not applicable
		Total uranium:	
	6 individual samples	Shall not exceed 106 pCi/g above background[d] in any 15-cm–thick layer, averaged over 100 m^2.	$\bar{x}_{max}$ = 0.6 pCi/g $\bar{x}$ = 0.3 pCi/g $\mu_{95\%}$ = 0.7 pCi/g
Soil Hot-Spot Criteria	As required for samples exceeding authorized limits	Limit = (authorized limit) x $(100/area)^{0.5}$	Not applicable: maximum concentrations are below authorized limits.

[a]Net results (background subtracted).

[b]Compliance was demonstrated by a combination of scans and direct measurements. Direct measurements were made at locations of highest elevated activity if elevated activity was present. Otherwise, direct measurements were made at the centers of the 1-m^2 grid blocks.

[c]Gamma exposure rates were measured 1 m above the floor.

[d]Background values are summarized in Table 2.

Table 3 (continued). Certification Summary for All Survey Units

Key for Table 3:

dpm/100 cm^2	=	disintegrations per minute per 100 square centimeters
cm	=	centimeter(s)
m^2	=	square meter(s)
$\mu_{95\%}$	=	upper limit of the true population mean at the 95 percent confidence level
μR/h	=	microroentgens per hour
WL	=	working level
Ra-226	=	radium-226
Th-230	=	thorium-230
pCi/g	=	picocuries per gram
$\bar{x}$	=	mean of all sample concentrations
$\bar{x}_{max}$	=	maximum concentration averaged over a contiguous 100 m^2 area

organizations that prepare survey plans should also be involved in the release surveys. A staff member from the organization that prepared the GJORAP survey plan met with the survey crews each morning and occasionally during each day to answer survey crews' questions and observe the work. As a result, problems related to staffing, recording data, reading survey instruments, and interpreting the plan were identified and corrected before they resulted in delays to the project or significantly increased costs.

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Appendix A

Applicable Program and Quality Assurance Requirements and Procedures

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The following manuals and guidance documents were used as applicable for conducting GJORAP administrative and performance activities. The specific manuals and documents pertinent to the activities associated with the release survey of this building are noted in the text of this report.

Joint Contractor Manuals

The GJO Quality Assurance Manual (GJO 1)

The GJO Health and Safety Standards (GJO 2)

The GJO Site Radiological Control Manual (GJO 3)

The GJO Training Manual (GJO 4)

The GJO Construction Procedures Manual (GJO 5)

The GJO Environmental Procedures Catalog (GJO 6)

The GJO Formality of Operations Manual (GJO 7)

The GJO Emergency Preparedness & Response Plan (GJO 8)

FOS Contractor Manuals

Safety and Health Manual

Environmental Compliance Manual

Operations Management Manual

Information Services Manual

Project Management Controls System Description

Budget Manual

Site Management Manual

Calibration and Control Program Manual

Information Management Support Manual

Grand Junction Projects Office Remedial Action Project Quality Assurance Program Plan (P–GJPO–141, Rev. 6)

Grand Junction Projects Office Remedial Action Project Records Management Plan (P–GJPO–143)

Grand Junction Projects Office Remedial Action Project Health and Safety Plan (P–GJPO–144, Rev. 7)

Engineering Support Procedures Manual

AutoCAD Standards Manual

Analytical Chemistry Laboratory Administrative Plan and Quality Control Procedures

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Appendix B

Final Radiological Conditions

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Appendix B Table Summary

Table B–1 provides MDC calculation results for the instruments used for beta-gamma activity and gamma exposure rate measurements. Beta-gamma scan and direct-measurement survey data for the building surfaces are listed in Tables B–2 and B–3. Table B–4 presents the results of additional measurements made during the release survey. Interior and exterior static gamma exposure rate measurement data are provided in Table B–5. Listed in Table B–6 are the soil sample results for the exterior ground area located within 3 meters of Building 11. Table B–7 presents the statistical summary of the measurement results.

Appendix B Figure Summary

The verification cells and sample and measurement locations for the exterior ground area are shown on Figure B–1. Figures B–2 through B–7 show the locations where beta-gamma scans were performed and direct measurements were made on the surfaces of the building. Interior gamma scans of the floor surface and static gamma measurement locations (1 m above the floor) are shown on Figure B–2.

Table B–1. Survey Instrumentation Sensitivities

Type of Measurement	Instrumentation		MDC[a]	
	Detector	Meter	Static	Scan
Beta-Gamma	Eberline SHP–340 Gas Proportional	Eberline E–600	530 dpm/100 cm^2	1700 dpm/100 cm^2
Gamma	Same as meter	Mount Sopris SC–132 Portable Scintillometer[b]	Not calculated[c]	3.4 μR/h

[a]Calculations include background counts for a specified time period. Equations and calculations are provided in *MDC Calculations for GJORAP* (*WASTREN* 1997b).

[b]The instrument has a 1.5 x 1.5-inch sodium iodide detector.

[c]The calculation of MDC for static gamma measurements is not appropriate due to empirical characteristics of the measurement method and associated variables. However, instrument detection is expected to be at least as sensitive as the scan MDC.

Key for Table B–1:

MDC	=	minimum detectable concentration
dpm/100 cm^2	=	disintegrations per minute per 100 square centimeters
μR/h	=	microroentgens per hour

The following equations and factors were used to calculate instrument sensitivities (from *WASTREN* 1997b):

$$Static\ MDC_{\beta\text{-}\gamma} = \frac{3 + 4.65 * \sqrt{C_b}}{T * \epsilon_T * A * K} = \frac{3 + 4.65 * \sqrt{230}}{1 * 0.19 * 73 * 0.01} = 530\ dpm/100\ cm^2$$

$$Scan\ MDC_{\beta\text{-}\gamma} = \frac{\frac{d' * \sqrt{B_r * T}}{T}}{\sqrt{E_{hf}} * \epsilon_T * A * K} = \frac{\frac{2 * \sqrt{230 * 1/60}}{1/60}}{\sqrt{1} * 0.19 * 73 * 0.01} = 1700\ dpm/100\ cm^2$$

$$Scan\ MDC_{\gamma} = \frac{\frac{d' * \sqrt{B_r * T}}{T}}{\sqrt{E_{hf}} * \epsilon_i * K} = \frac{\frac{2 * \sqrt{6300 * 1/60}}{1/60}}{\sqrt{0.65} * 450 * 1} = 3.4\ \mu R/h$$

Where:

$MDC_{\beta\text{-}\gamma}$	=	minimum detectable concentration for measuring beta-gamma activities
MDC_{γ}	=	mimimum detectable concentration for measuring gamma exposure rates
C_b	=	background counts for a count time T
T	=	count time or observational interval in minutes
ϵ_T	=	total detector efficiency in counts per disintegration (based on 1997 calibration)
A	=	probe area in square centimeters
K	=	unit or time conversion factors
d'	=	index of sensivity
B_r	=	applicable background count rate in counts per minute
E_{hf}	=	human factors efficiency
ϵ_i	=	instrument efficiency in counts per minute per μR/h (based on 1997 calibration where exposure rate (μR/h) = cps x 0.0748 + 6.03; therefore 105 cps = 13.9 μR/h, and 1 μR/h = 450 cpm)

Table B–2. Survey Unit 2 Surface Measurement Data

Loc. No.	Surface	Media	Background Activity[a]	Scan Beta-Gamma Activity				Direct Beta-Gamma Activity	
				Gross Max.	Gross Min.	Net Max.	Net Min.	Gross	Net
37	Exterior Wall	Steel	1500	1630	1183	130	-317	1502	2
38	Exterior Wall	Steel	1500	1787	1307	287	-193	1491	-9
39	Exterior Wall	Steel	1500	1814	1281	314	-219	1344	-156
40	Exterior Wall	Steel	1500	2050	1270	550	-230	1417	-83
41	Exterior Wall	Steel	1500	1784	1087	284	-413	1365	-135
42	Exterior Wall	Steel	1500	2109	1162	609	-338	1290	-210
43	Exterior Wall	Steel	1500	2080	1280	580	-220	1650	150
44	Exterior Wall	Steel	1500	1712	1134	212	-366	1444	-56
45	Exterior Wall	Steel	1500	1911	1092	411	-408	1478	-22
46	Exterior Wall	Steel	1500	1960	1264	460	-236	1348	-152
47	Exterior Wall	Steel	1500	1868	1248	368	-252	1601	101
69	Roof Overhang	Steel	1500	1892	1422	392	-78	1704	204
70	Roof Overhang	Steel	1500	1952	1244	452	-256	1605	105
71	Roof Overhang	Steel	1500	1999	1214	499	-286	1671	171
72	Roof Overhang	Steel	1500	2030	1170	530	-330	1704	204
73	Roof Overhang	Steel	1500	1992	1203	492	-297	1612	112
48	Roof	Vinyl	1500	2103	1352	603	-148	1688	188
49	Roof	Vinyl	1500	1930	1346	430	-154	1722	222
50	Roof	Vinyl	1500	1987	1141	487	-359	1842	342
51	Roof	Vinyl	1500	2002	1274	502	-226	1590	90
52	Roof	Vinyl	1500	1932	1148	432	-352	1496	-4
53	Roof	Vinyl	1500	2013	1346	513	-154	1586	86
54	Roof	Vinyl	1500	2080	1117	580	-383	1693	193
55	Roof	Vinyl	1500	1861	1063	361	-437	1717	217
57	Roof	Vinyl	1500	1950	861	450	-639	1531	31
58	Roof	Vinyl	1500	1854	804	354	-696	1527	27
59	Roof	Vinyl	1500	1998	831	498	-669	1489	-11
60	Roof	Vinyl	1500	2110	791	610	-709	1454	-46
61	Roof	Vinyl	1500	2080	871	580	-629	1419	-81
62	Roof	Vinyl	1500	2060	804	560	-696	1803	303

[a]Background activity includes average background ambient air and average material-specific activities (DOE 1997, *WASTREN* 1997a).

Note: All measurements were read in dpm/100 cm^2 and were collected with an Eberline E–600 meter with an Eberline SHP–340 probe to measure gross beta-gamma activity.

Table B–3. Survey Unit 3 Surface Measurement Data

Loc. No.	Surface	Media	Background Activity[a]	Scan Beta-Gamma Activity				Direct Beta-Gamma Activity	
				Gross Max.	Gross Min.	Net Max.	Net Min.	Gross	Net
5	Interior Wall	Sheetrock	1500	1840	1137	340	-363	1435	-65
6	Interior Wall	Sheetrock	1500	1805	1339	305	-161	1444	-56
7	Interior Wall	Sheetrock	1500	1897	1042	397	-458	1612	112
8	Interior Wall	Sheetrock	1500	1979	1390	479	-110	1462	-38
9	Interior Wall	Sheetrock	1500	1940	1191	440	-309	1389	-111
10	Interior Wall	Sheetrock	1500	1912	1322	412	-178	1460	-40
11	Interior Wall	Sheetrock	1500	1954	1390	454	-110	1317	-183
12	Interior Wall	Sheetrock	1500	1752	1122	252	-378	1284	-216
13	Interior Wall	Sheetrock	1500	1917	1211	417	-289	1397	-103
14	Interior Wall	Sheetrock	1500	1939	1122	439	-378	1314	-186
15	Interior Wall	Sheetrock	1500	1781	1147	281	-353	1360	-140
16	Interior Wall	Sheetrock	1500	1840	1144	340	-356	1482	-18
17	Interior Wall	Sheetrock	1500	1950	1082	450	-418	1732	232
18	Interior Wall	Sheetrock	1500	1915	1182	415	-318	1561	61
19	Floor	Linoleum Tile	1700	2210	1540	510	-160	1750	50
20	Floor	Linoleum Tile	1700	2240	1518	540	-182	1874	174
21	Floor	Linoleum Tile	1700	2240	1660	540	-40	1846	146
22	Floor	Linoleum Tile	1700	2215	1413	515	-287	1704	4
23	Floor	Linoleum Tile	1700	2300	1360	600	-340	1848	148
24	Floor	Linoleum Tile	1700	1920	1230	220	-470	1796	96
25	Floor	Linoleum Tile	1700	2190	1224	490	-476	1818	118
26	Floor	Linoleum Tile	1700	2139	1395	439	-305	1732	32
27	Ceiling	Accoustic Tile	1500	2100	1480	600	-20	1396	-104
28	Ceiling	Accoustic Tile	1500	1885	1445	385	-55	1681	181
29	Ceiling	Accoustic Tile	1500	1841	1232	341	-268	1681	181
30	Ceiling	Accoustic Tile	1500	1813	1176	313	-324	1556	56
31	Ceiling	Accoustic Tile	1500	1917	1014	417	-486	1528	28
32	Ceiling	Accoustic Tile	1500	1906	1189	406	-311	1513	13
33	Ceiling	Accoustic Tile	1500	1793	1124	293	-376	1486	-14
34	Ceiling	Accoustic Tile	1500	1812	1215	312	-285	1490	-10
76	Interior Wall	Sheetrock	1500	1626	1306	126	-194	1399	-101
77	Interior Wall	Sheetrock	1500	1470	1297	-30	-203	1342	-158
78	Interior Wall	Sheetrock	1500	1526	1277	26	-223	1299	-201
79	Interior Wall	Sheetrock	1500	1578	1279	78	-221	1389	-111

[a]Background activity includes average background ambient air and average material-specific activities (DOE 1997, *WASTREN* 1997a).

Note: All measurements were read in dpm/100 cm^2 and were collected with an Eberline E–600 meter with an Eberline SHP–340 probe to measure gross beta-gamma activity.

Table B–4. Additional Measurement Data

Loc. No.[a]	Surface	Media	Background Activity[b]	Scan Beta-Gamma Activity				Direct Beta-Gamma Activity	
				Gross Max.	Gross Min.	Net Max.	Net Min.	Gross	Net
Survey Unit 1									
74	Exterior Soil	Concrete	1900	3000	1900	1100	0	2270	370
75	Exterior Soil	Concrete	1900	NM	NM	N/A	N/A	2960	1060
11-V-2	Exterior Soil	Soil	1900	NM	NM	N/A	N/A	2600	700
11-V-3	Exterior Soil	Soil	1900	NM	NM	N/A	N/A	2560	660
11-V-4	Exterior Soil	Soil	1900	NM	NM	N/A	N/A	3010	1110
11-V-5	Exterior Soil	Soil	1900	NM	NM	N/A	N/A	2190	290
11-V-6	Exterior Soil	Soil	1900	NM	NM	N/A	N/A	2440	540
Survey Unit 2									
48 a	Roof Overhang	Plywood	1500	NM	NM	N/A	N/A	2070	570
48 b	Roof Overhang	Styrofoam	1500	NM	NM	N/A	N/A	1813	313
48 c	Roof Overhang	Tar/Rock	1500	NM	NM	N/A	N/A	2150	650
48 d	Roof Overhang	Wood	1500	NM	NM	N/A	N/A	1883	383
48 e	Roof Overhang	Insulation	1500	NM	NM	N/A	N/A	1989	489
48 f	Roof Overhang	Wood	1500	NM	NM	N/A	N/A	1544	44
58 a	Roof Overhang	Plywood	1500	NM	NM	N/A	N/A	1657	157
58 b	Roof Overhang	Styrofoam	1500	NM	NM	N/A	N/A	1883	383
58 c	Roof Overhang	Tar/Rock	1500	NM	NM	N/A	N/A	1728	228
58 d	Roof Overhang	Wood	1500	NM	NM	N/A	N/A	1432	-68
58 e	Roof Overhang	Insulation	1500	NM	NM	N/A	N/A	2010	510
58 f	Roof Overhang	Wood	1500	NM	NM	N/A	N/A	2220	720
37 a	Exterior Wall	Wood	1500	2105	1410	605	-90	1671	171
38 a	Exterior Wall	Wood	1500	1949	1546	449	46	1939	439
39 a	Exterior Wall	Wood	1500	1721	1439	221	-61	1721	221
42 a	Exterior Wall	Wood	1500	1930	1146	430	-354	1432	-68
46 a	Exterior Wall	Wood	1500	1948	954	448	-546	1601	101
47 a	Exterior Wall	Wood	1500	1994	1088	494	-412	1580	80
56	Roof	Steel	1500	1887	1196	387	-304	1483	-17
Survey Unit 3									
N/A	Interior Counter	Wood	1500	1690	1014	190	-486	NM	N/A
N/A	Interior Counter	Wood	1500	1573	984	73	-516	NM	N/A
N/A	Interior Counter	Formica	1500	1918	1312	418	-188	NM	N/A
N/A	Interior Counter	Formica	1500	1811	1217	311	-283	NM	N/A
1	Interior Wall	Sheetrock	1500	NM	NM	N/A	N/A	1587	87
1 a	Interior Wall	Sheetrock	1500	NM	NM	N/A	N/A	1601	101
1 b	Interior Wall	Insulation	1500	NM	NM	N/A	N/A	2250	750
1 c	Interior Wall	Wood	1500	NM	NM	N/A	N/A	1439	-61
1 d	Interior Wall	Wood	1500	NM	NM	N/A	N/A	1530	30
1 e	Interior Wall	Tar paper	1500	NM	NM	N/A	N/A	1248	-252
1 f	Interior Wall	Tar paper	1500	NM	NM	N/A	N/A	1319	-181
1 g	Interior Wall	Wood	1500	NM	NM	N/A	N/A	1460	-40
1 h	Interior Wall	Wood	1500	NM	NM	N/A	N/A	1361	-139
1 i	Interior Wall	Wood	1500	NM	NM	N/A	N/A	1290	-210
2	Interior Wall	Sheetrock	1500	NM	NM	N/A	N/A	1305	-195
2 a	Interior Wall	Sheetrock	1500	NM	NM	N/A	N/A	1375	-125
2 b	Interior Wall	Insulation	1500	NM	NM	N/A	N/A	1989	489
2 c	Interior Wall	Wood	1500	NM	NM	N/A	N/A	1693	193

Table B–4 (continued). Additional Measurement Data

Loc. No.[a]	Surface	Media	Background Activity[b]	Scan Beta-Gamma Activity				Direct Beta-Gamma Activity	
				Gross Max.	Gross Min.	Net Max.	Net Min.	Gross	Net
Survey Unit 3 (continued)									
2 d	Interior Wall	Wood	1500	NM	NM	N/A	N/A	1488	-12
2 e	Interior Wall	Tar paper	1500	NM	NM	N/A	N/A	1544	44
2 f	Interior Wall	Tar paper	1500	NM	NM	N/A	N/A	1326	-174
2 g	Interior Wall	Wood	1500	NM	NM	N/A	N/A	1502	2
2 h	Interior Wall	Wood	1500	NM	NM	N/A	N/A	1519	19
2 i	Interior Wall	Wood	1500	NM	NM	N/A	N/A	1481	-19
3	Interior Wall	Sheetrock	1500	NM	NM	N/A	N/A	1255	-245
3 a	Interior Wall	Sheetrock	1500	NM	NM	N/A	N/A	1446	-54
3 b	Interior Wall	Insulation	1500	NM	NM	N/A	N/A	2180	680
3 c	Interior Wall	Wood	1500	NM	NM	N/A	N/A	1721	221
3 d	Interior Wall	Wood	1500	NM	NM	N/A	N/A	1135	-365
3 e	Interior Wall	Tar paper	1500	NM	NM	N/A	N/A	1319	-181
3 f	Interior Wall	Tar paper	1500	NM	NM	N/A	N/A	1297	-203
3 g	Interior Wall	Wood	1500	NM	NM	N/A	N/A	1375	-125
3 h	Interior Wall	Wood	1500	NM	NM	N/A	N/A	1316	-184
3 i	Interior Wall	Wood	1500	NM	NM	N/A	N/A	1714	214
4	Interior Wall	Sheetrock	1500	NM	NM	N/A	N/A	1700	200
4 a	Interior Wall	Sheetrock	1500	NM	NM	N/A	N/A	1763	263
4 b	Interior Wall	Insulation	1500	NM	NM	N/A	N/A	1913	413
35	Ceiling	Metal Duct	1500	2080	1108	580	-392	1589	89
63	Floor	Insulation	1500	NM	NM	N/A	N/A	2220	720
64	Floor	Concrete	1900	NM	NM	N/A	N/A	1954	54
65	Floor	Concrete	1900	NM	NM	N/A	N/A	1852	-48
66 a	Floor	Underside of Tile	1500	NM	NM	N/A	N/A	1678	178
66 b	Floor	Concrete	1900	NM	NM	N/A	N/A	1987	87
67 a	Floor	Underside of Tile	1500	NM	NM	N/A	N/A	1412	-88
67 b	Floor	Concrete	1900	NM	NM	N/A	N/A	1950	50
68	Floor	Concrete	1900	NM	NM	N/A	N/A	1700	-200

[a]Alpha-numeric location numbers (e.g. 48 a) represent instrusive measurements taken on material under or behind the surface material.

[a]Background activity includes average background ambient air and average material-specific activities (DOE 1997, *WASTREN* 1997a).

Note: All measurements were read in dpm/100 cm^2 and were collected with an Eberline E–600 meter with an Eberline SHP–340 probe to measure gross beta-gamma activity.

Key for Table B–4:
NM = no measurement
N/A = not applicable

Table B–5. Gamma Exposure Rate Measurement Data

Interior Static Measurements

Loc. No.	Gross		Net[a]
	cps	μR/h	μR/h
G1	75	11.7	-2.3
G2	75	11.7	-2.3
G3	80	12.1	-1.9
G4	80	12.1	-1.9
G5	80	12.1	-1.9
G6	85	12.5	-1.5
G7	80	12.1	-1.9
G8	70	11.3	-2.7
G9	70	11.3	-2.7
G10	80	12.1	-1.9
G11	80	12.1	-1.9

Loc. No.	Gross		Net[a]
	cps	μR/h	μR/h
G12	85	12.5	-1.5
G13	80	12.1	-1.9
G14	70	11.3	-2.7
G15	80	12.1	-1.9
G16	80	12.1	-1.9
G17	90	12.8	-1.2
G18	80	12.1	-1.9
G19	80	12.1	-1.9
G20	90	12.8	-1.2
G21	80	12.1	-1.9

Exterior Static Measurements

Location Number	Gross		Net[a]
	cps	μR/h	μR/h
11–V–1	110	14.3	0.3
11–V–2	110	14.3	0.3
11–V–3	110	14.3	0.3
11–V–4	110	14.3	0.3
11–V–5	110	14.3	0.3
11–V–6	100	13.6	-0.4

[a]Background gamma exposure rate for the facility is 14 μR/h (Table 2).

Note: Gamma exposure rates were read in cps and were measured with a Mount Sopris SC–132 scintillometer at 1 m above the floor or ground.

Key for Table B–5:

cps = counts per second

μR/h = microroentgens per hour (μR/h = cps x 0.0748 + 6.1)

Table B–6. Soil Sample Results for Exterior Areas

Sample Number	Cell Area (m^2)	Soil Sample Ticket No.	Sample Depth[a] (cm)	Concentration (pCi/g)					
				Ra-226		Th-230		Total Uranium	
				Gross	Net[b]	Gross	Net[b]	Gross	Net[b]
11–V–1	24.0	NCP 305	0 – 15	1.48 ± 0.45	0.5	1.0	-1.0	3.0	**1.0**
11–V–2	23.9	NCP 306	8 – 23	1.69 ± 0.38	0.7	1.1	**-0.9**	2.5	**0.5**
11–V–3	22.8	NCP 307	8 – 23	2.03 ± 0.50	**1.0**	0.98	**-1.0**	2.7	**0.7**
11–V–4	23.9	NCP 308	8 – 23	1.94 ± 0.50	**0.9**	0.92	**-1.1**	2.2	**0.2**
11–V–5	24.0	NCP 309	8 – 23	1.76 ± 0.55	**0.8**	1.1	**-0.9**	1.8	-0.2
11–V–6	22.8	NCP 310	8 – 23	1.82 ± 0.46	**0.8**	0.71	-1.3	1.6	-0.4

[a]Subsurface soil sample depths indicate the presence of an overlying pavement not included in the sample.
[b]See Table 2 for background concentrations used to calculate net concentrations.

Notes:

1) Ra-226 was analyzed by gamma spectrometry.
2) Th-230 and total uranium were analyzed by induction-coupled plasma-mass spectrometry with a flow-injection analysis system.
3) Analytical laboratory measurement methods, results, uncertainties, and quality control for these samples are contained in the Grand Junction Office Analytical Laboratory *Analytical Report*, Volumes 1 and 2, for Project L20A41000, June 11, 1997. All Ra-226 results were above minimum detectable activities. Uncertainties were not calculated for Th-230 and total uranium.
4) Bolded results were used to calculate the maximum net mean concentrations for contiguous areas totalling approximately 100 m^2, which are: Ra-226 = 0.9 pCi/g
   Th-230 = -1.0 pCi/g
   Uranium = 0.6 pCi/g

Key for Table B–6:

m^2 = square meter(s)
cm = centimeter(s)
pCi/g = picocuries per gram
Ra-226 = radium-226
Th-230 = thorium-230

Table B–7. Statistical Summary of Measurement Surveys

Net Building Surface Beta-Gamma Activity

Survey Unit	Surfaces	n	$t_{95\%,d.f.}$	$z_{95\%}$	Net Activity (dpm/100 cm^2)		
					$\bar{x}$	s	$\mu_{95\%}$
2	Exterior walls, roof, and roof overhang	30	1.699	–	59.43	142.26	100
3	Interior walls, floor, and ceiling	34	–	1.645	-7.56	123.76	28

Net Interior Gamma Exposure Rates

n	$t_{95\%,d.f.}$	Net Gamma Exposure Rates (μR/h)		
		$\bar{x}$	s	$\mu_{95\%}$
21	1.725	-1.95	0.42	-1.8

Net Exterior Gamma Exposure Rates

n	$t_{95\%,d.f.}$	Net Gamma Exposure Rates (μR/h)		
		$\bar{x}$	s	$\mu_{95\%}$
6	2.015	0.18	0.29	0.4

Net Soil Concentrations (Surface Layer)

Contaminant	n	$t_{95\%,d.f.}$	Net Concentrations (pCi/g)			
			$\bar{x}_{max.}$	$\bar{x}$	s	$\mu_{95\%}$
Ra-226	6	2.015	0.9	0.78	0.17	0.9
Th-230	6	2.015	-1.0	-1.03	0.15	-0.9
Total Uranium	6	2.015	0.6	0.30	0.54	0.7

Note: See Tables B–2, B–3, B–5, and B–6 for the survey data.

Key for Table B–7:

dpm/100 cm^2	=	disintegrations per minute per 100 square centimeters
μR/h	=	microroentgens per hour
pCi/g	=	picocuries per gram
n	=	number of measurements
$t_{95\%,d.f.}$	=	Student's t distribution statistic for n-1 degrees of freedom at 95% confidence (n≤30)
$z_{95\%}$	=	z distribution statistic at 95% confidence (n>30)

Table B–7 (continued). Statistical Summary of Measurement Surveys

Key for Table B–7 (continued):

$\bar{x}_{max.}$ = maximum mean of soil sample concentrations representing contiguous areas totalling approximately 100 m^2 (not used to calculate s and $\mu_{95\%}$)

$\bar{x}$ = sample mean

s = sample standard deviation

$\mu_{95\%}$ = upper limit of the true population mean at the 95% confidence level, derived from:

$n \leq 30$

$$\mu_{95\%} = \bar{x} + t_{95\%,d.f.} \frac{s}{\sqrt{n}}$$

$n > 30$

$$\mu_{95\%} = \bar{x} + z_{95\%} \frac{s}{\sqrt{n}}$$

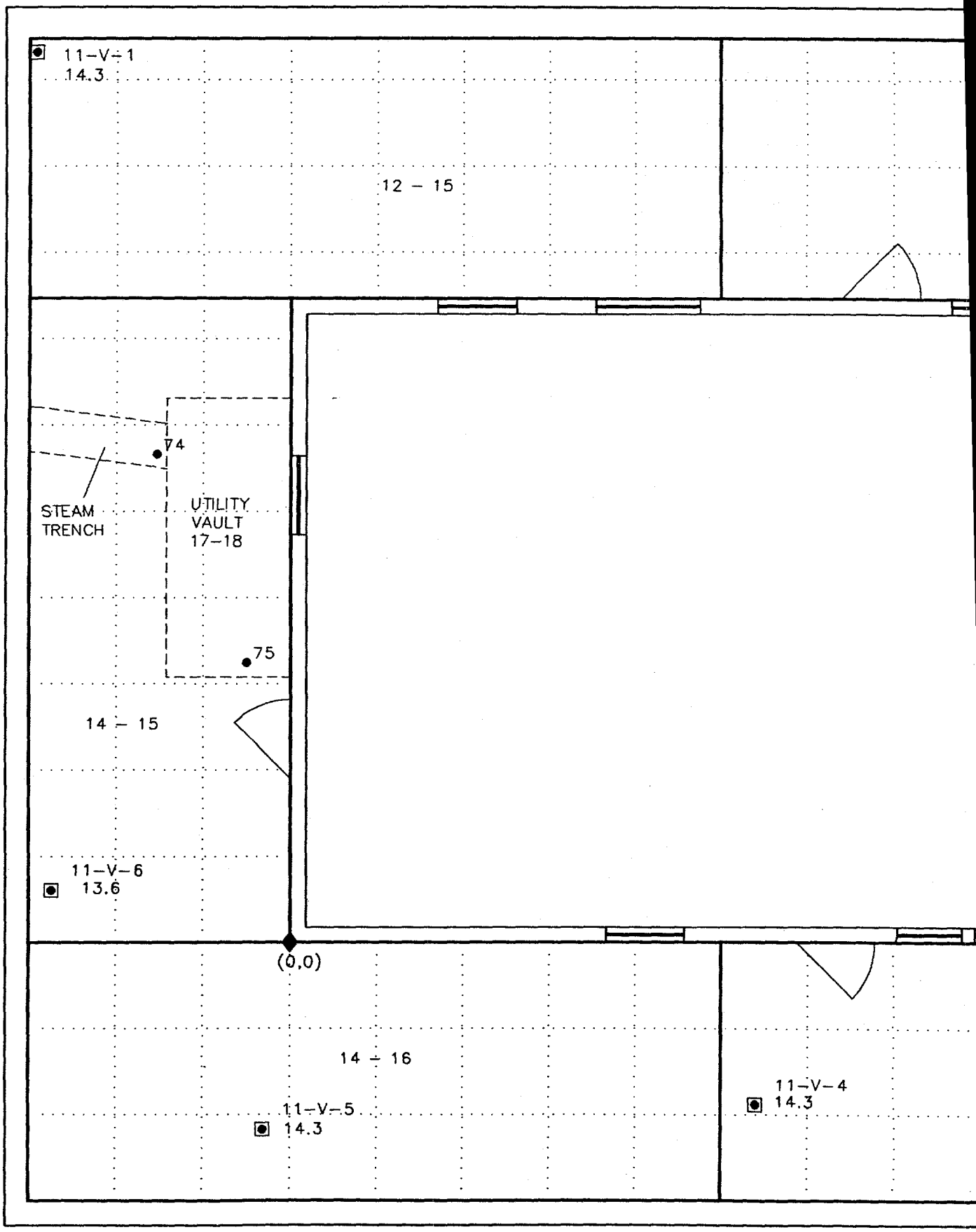
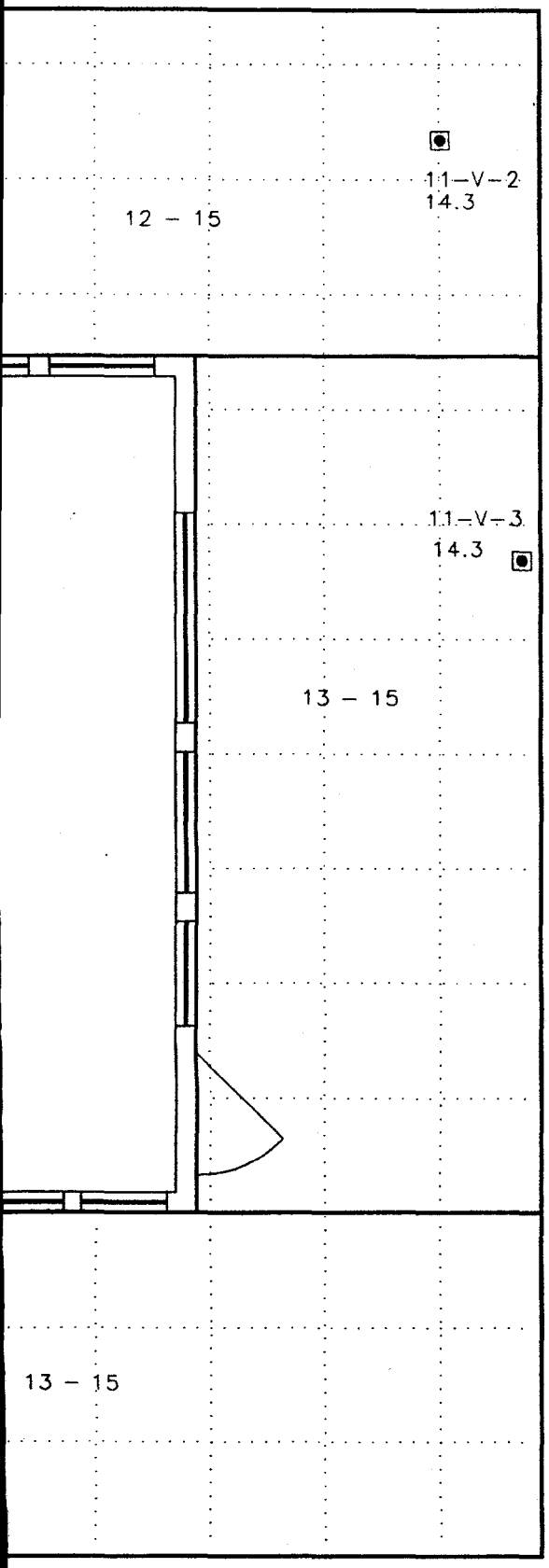


Figure B-1. Building 11 E



SCALE IN METERS

0 3

(X,Y)=(0,0) BUILDING COORDINATE SYSTEM
=(478.12, 644.89) FACILITY COORDINATE SYSTEM [METERS]

LEGEND

◆	BASE COORDINATE FOR 1–METER GRID SYSTEM
•	DIRECT MEASUREMENT LOCATION
□	SOIL SAMPLE LOCATION
35	MEASUREMENT LOCATION NUMBER
11–V–2	SOIL SAMPLE IDENTIFIER
13.6	GAMMA EXPOSURE RATE MEASUREMENT AT 1M ABOVE GROUND (μR/h)
12–14	GAMMA EXPOSURE RATE RANGE AT GROUND LEVEL (μR/h)
	EXTERIOR VERIFICATION AREA BOUNDARY
	BURIED UTILITY VAULT AND TRENCH

NOTE:
MEASUREMENT LOCATION NOS. 74 AND 75 ARE AT THE BOTTOM OF THE UTILITY VAULT AND TRENCH

WESTERN - Ground Activities

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE, COLORADO

Figure B–1 BUILDING 11 EXTERIOR GROUND SURVEY

PREPARED:	CHECKED:	DATE PREPARED:
		MAY 1997

PROJECT NUMBER:	FILENAME:
TCR–031–0015–00–000	T00045AA

erior Ground Survey

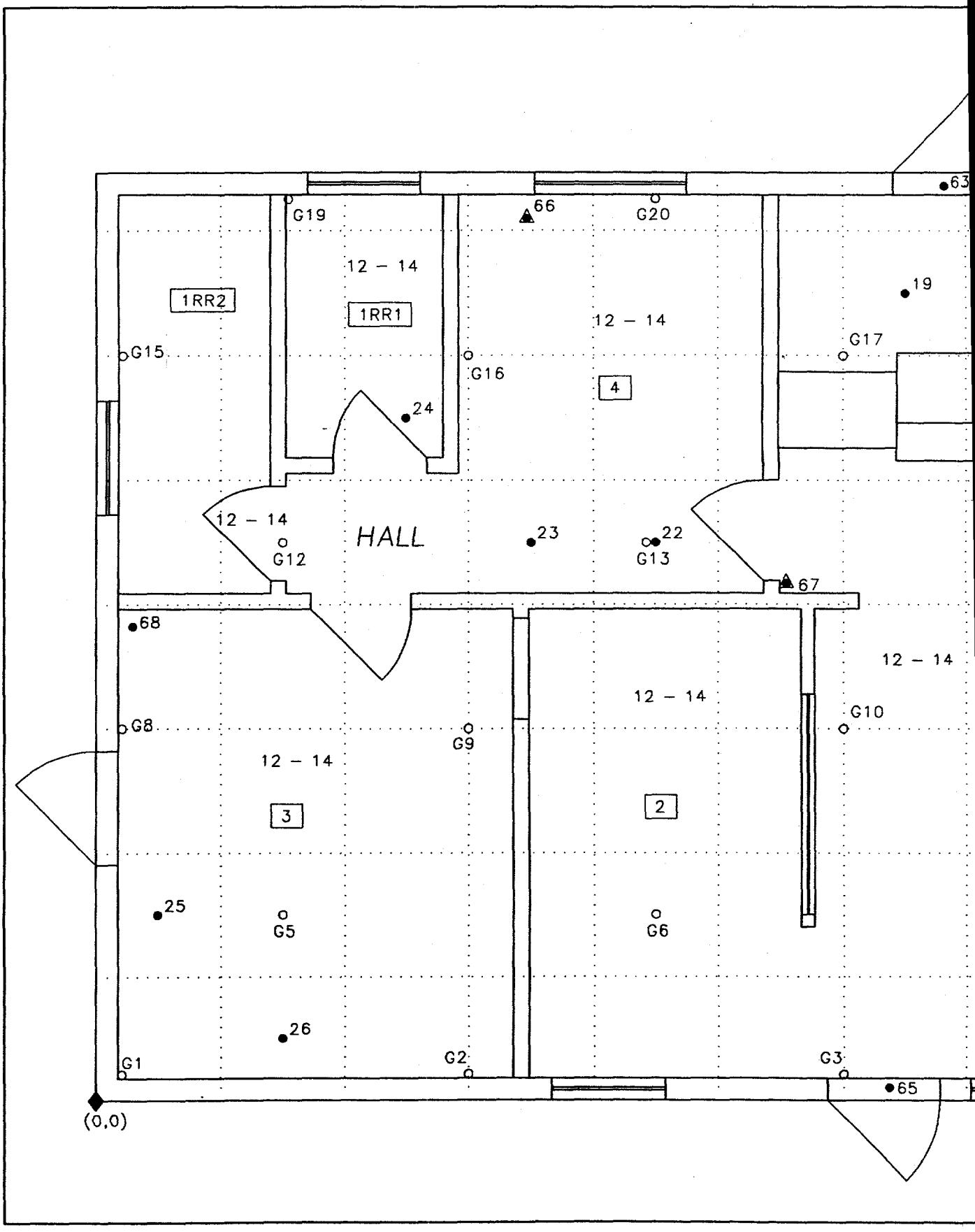
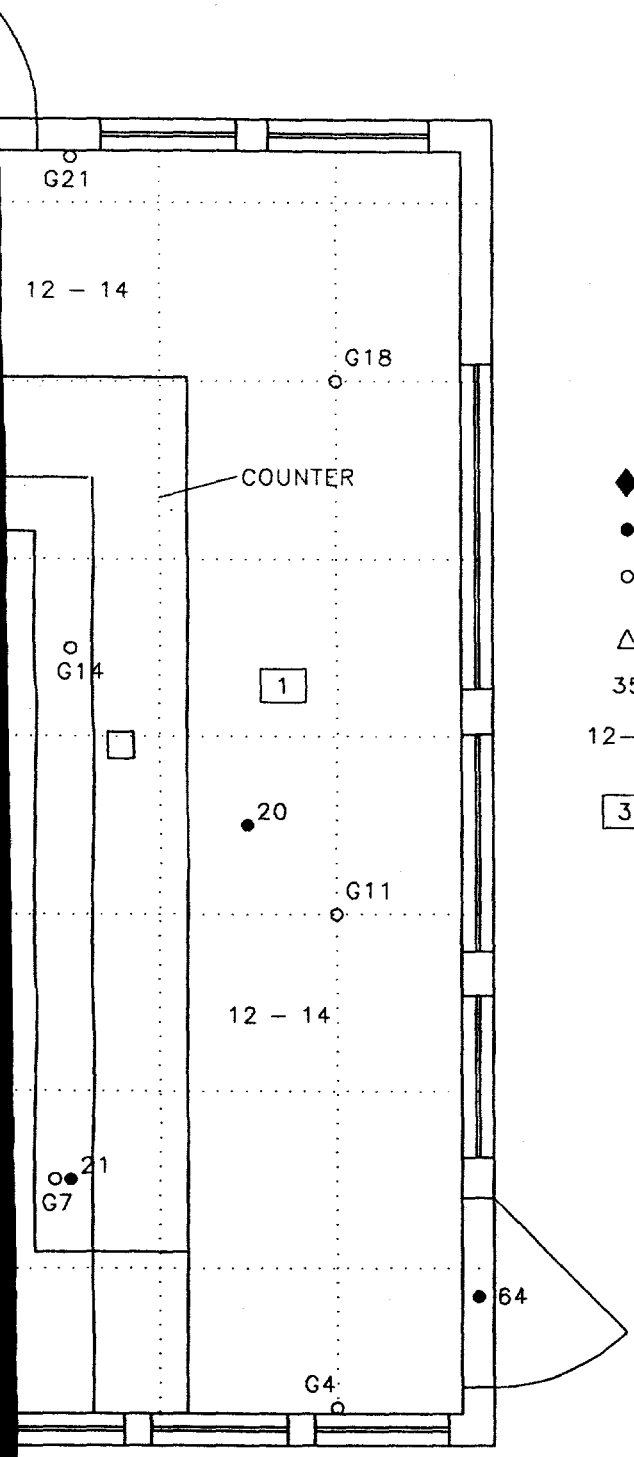


Figure B–2. Building 11 Floor a



SCALE IN METERS

0 2

Y
X

(X,Y)=(0,0) BUILDING COORDINATE SYSTEM
=(478.12, 644.89) FACILITY COORDINATE SYSTEM [METERS]

LEGEND

◆	BASE COORDINATE FOR 1 METER GRID SYSTEM
●	DIRECT MEASUREMENT LOCATION
o	GAMMA EXPOSURE RATE MEASUREMENT LOCATION AT 1M ABOVE FLOOR
△	INTRUSIVE MEASUREMENT LOCATION
35	MEASUREMENT LOCATION NUMBER
12–14	GAMMA EXPOSURE RATE RANGE AT FLOOR LEVEL LEVEL (μR/h)
3	ROOM NUMBER

EASTREN - Grand Junction	U.S. DEPARTMENT OF ENERGY GRAND JUNCTION OFFICE, COLORADO
BUILDING 11 Figure B–2 FLOOR AND INTERIOR GAMMA SURVEY	
PREPARED: CSW / CHECKED: [signature] / DATE PREPARED: MAY 1997	
PROJECT NUMBER: TCR–031–0015–00–000	FILENAME: T00046AA

d Interior Gamma Survey

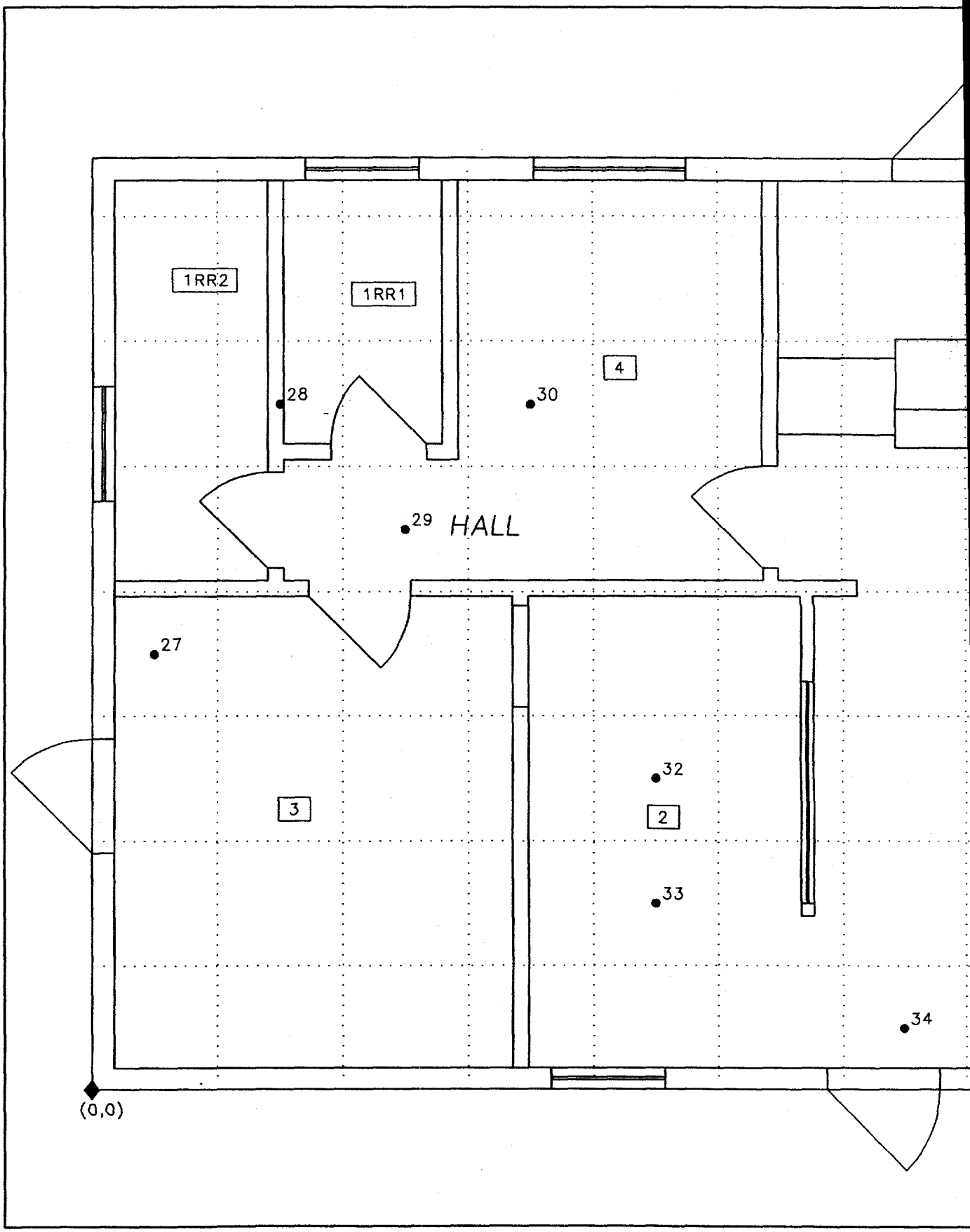
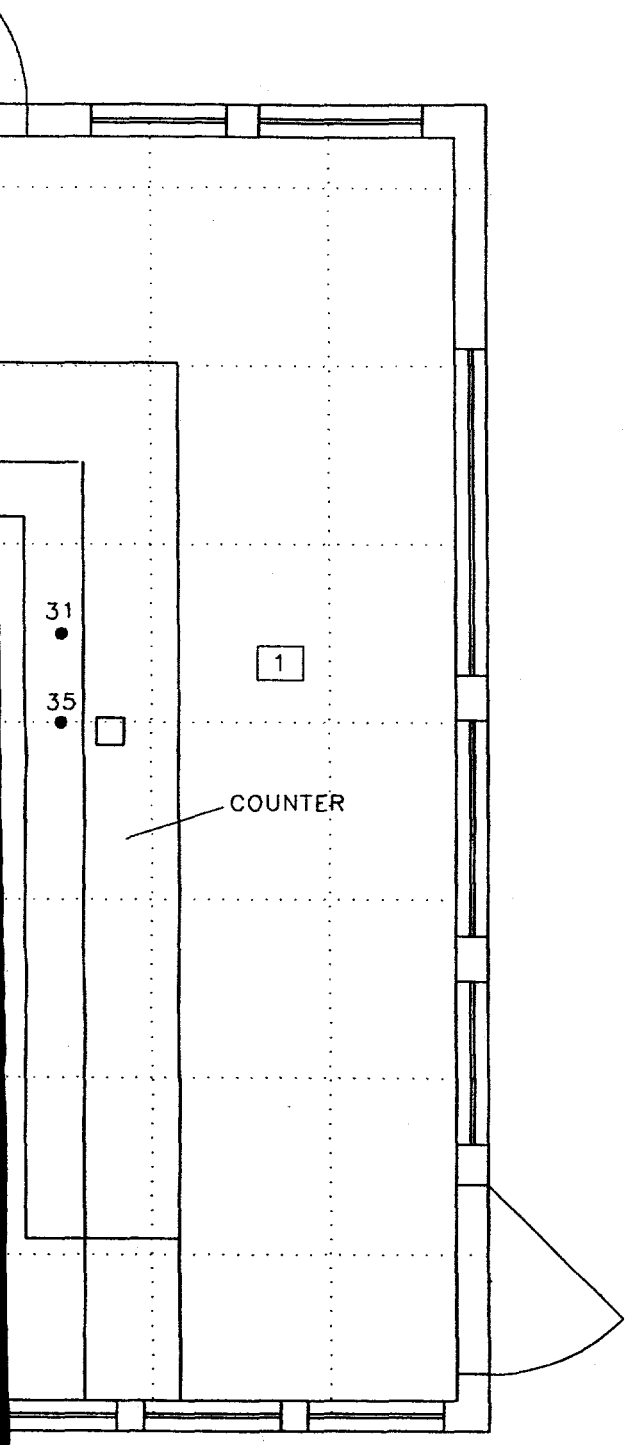


Figure B–3. Building



NORTH

SCALE IN METERS

0 2

Y
X

(X,Y)=(0,0) BUILDING COORDINATE SYSTEM
=(478.12, 644.89) FACILITY COORDINATE SYSTEM [METERS]

LEGEND

◆ BASE COORDINATE FOR 1-METER GRID SYSTEM

● DIRECT MEASUREMENT LOCATION

35 MEASUREMENT LOCATION NUMBER

[3] ROOM NUMBER

WASTREN - Grand Junction	U.S. DEPARTMENT OF ENERGY GRAND JUNCTION OFFICE, COLORADO
Figure B-3	BUILDING 11 CEILING SURVEY
PREPARED: CSW	CHECKED: [illegible]
DATE PREPARED: MAY 1997	
PROJECT NUMBER: TCR-031-0015-00-000	FILENAME: T00047AA

Ceiling Survey

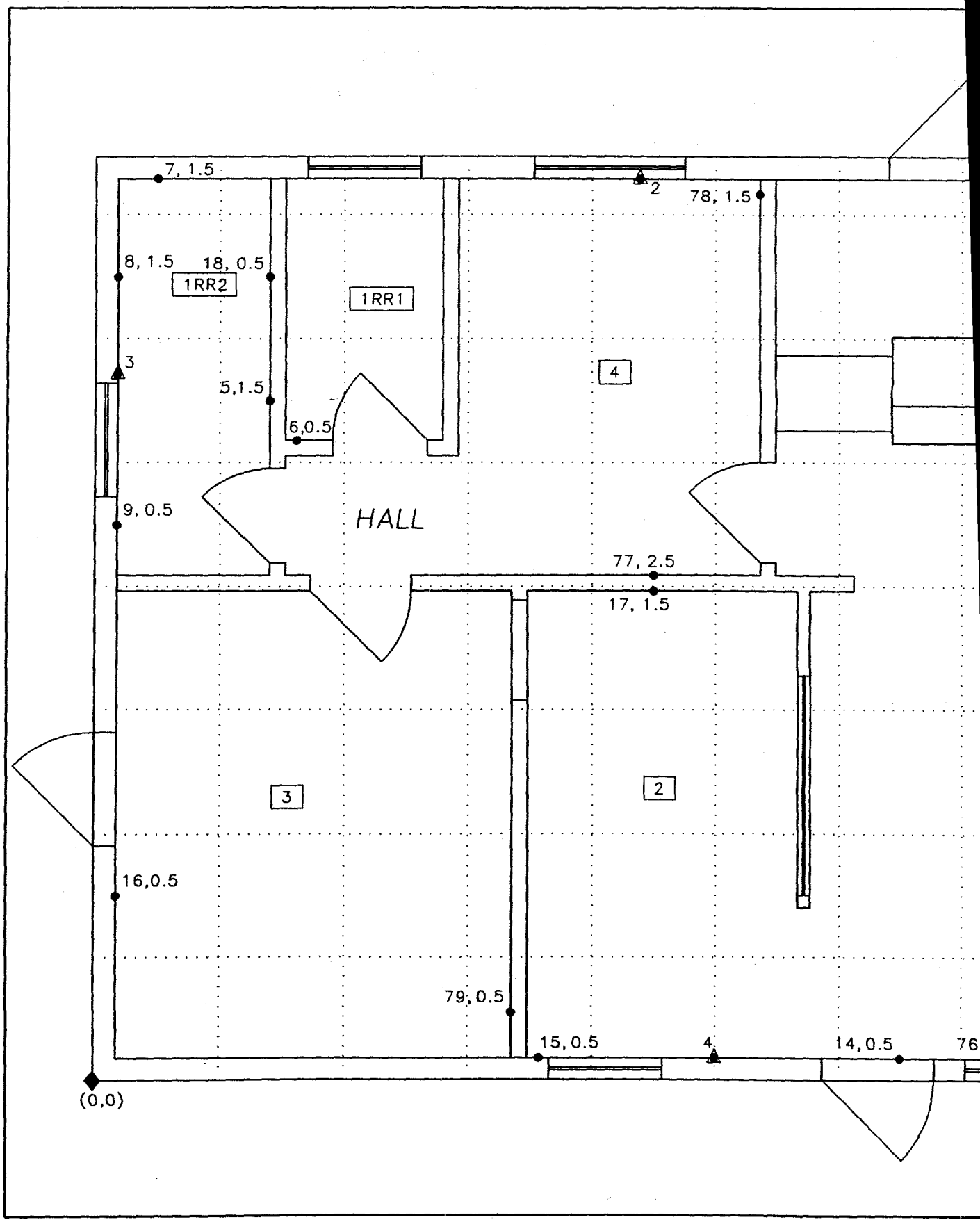
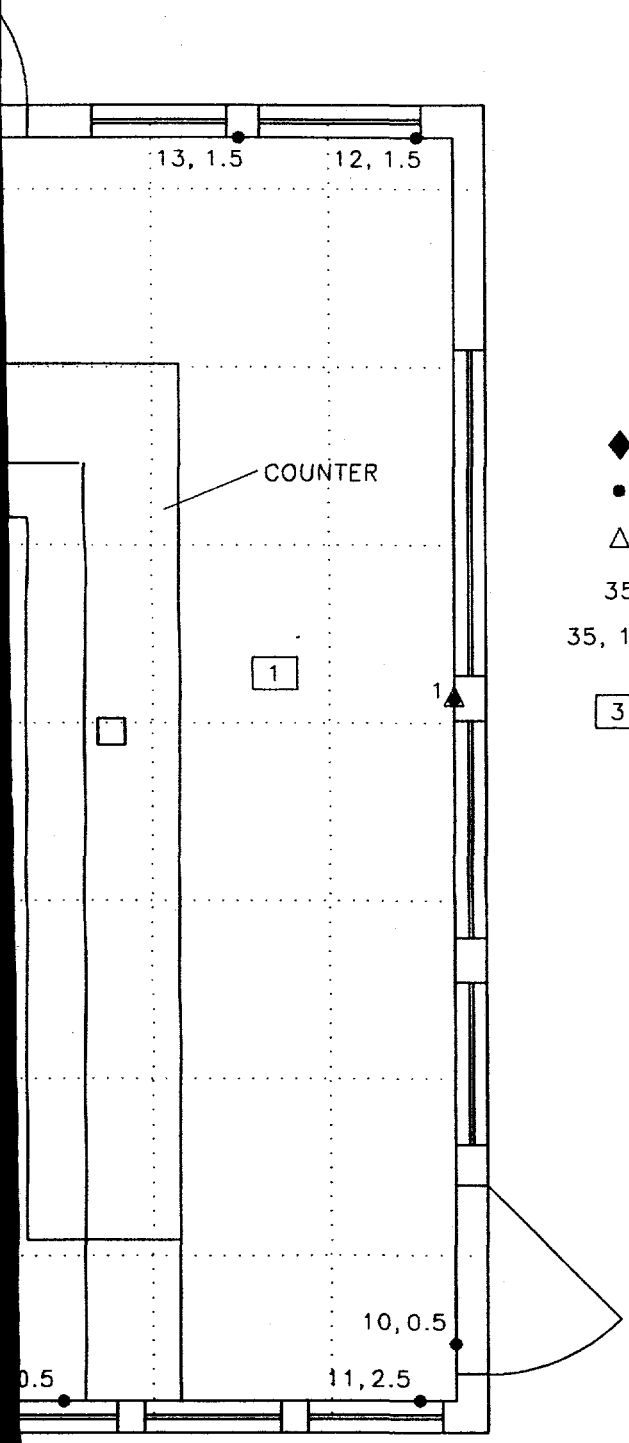


Figure B–4. Building 11 I



NORTH

SCALE IN METERS

0 2

Y
X

(X,Y)=(0,0) BUILDING COORDINATE SYSTEM
=(478.12, 644.89) FACILITY COORDINATE SYSTEM [METERS]

LEGEND

◆ BASE COORDINATE FOR 1-METER GRID SYSTEM

• DIRECT MEASUREMENT LOCATION

△ INTRUSIVE MEASUREMENT LOCATION

35 MEASUREMENT LOCATION NUMBER

35, 1.5 MEASUREMENT LOCATION NUMBER, FOLLOWED BY HEIGHT ABOVE FLOOR (METERS)

[3] ROOM NUMBER

EASTERN - Grand Junction	U.S. DEPARTMENT OF ENERGY GRAND JUNCTION OFFICE, COLORADO	
Figure B-4	BUILDING 11 INTERIOR WALL SURVEY	
PREPARED:	CHECKED:	DATE PREPARED: MAY 1997
PROJECT NUMBER: TCR-031-0015-00-000		FILENAME: T00048AA

terior Wall Survey

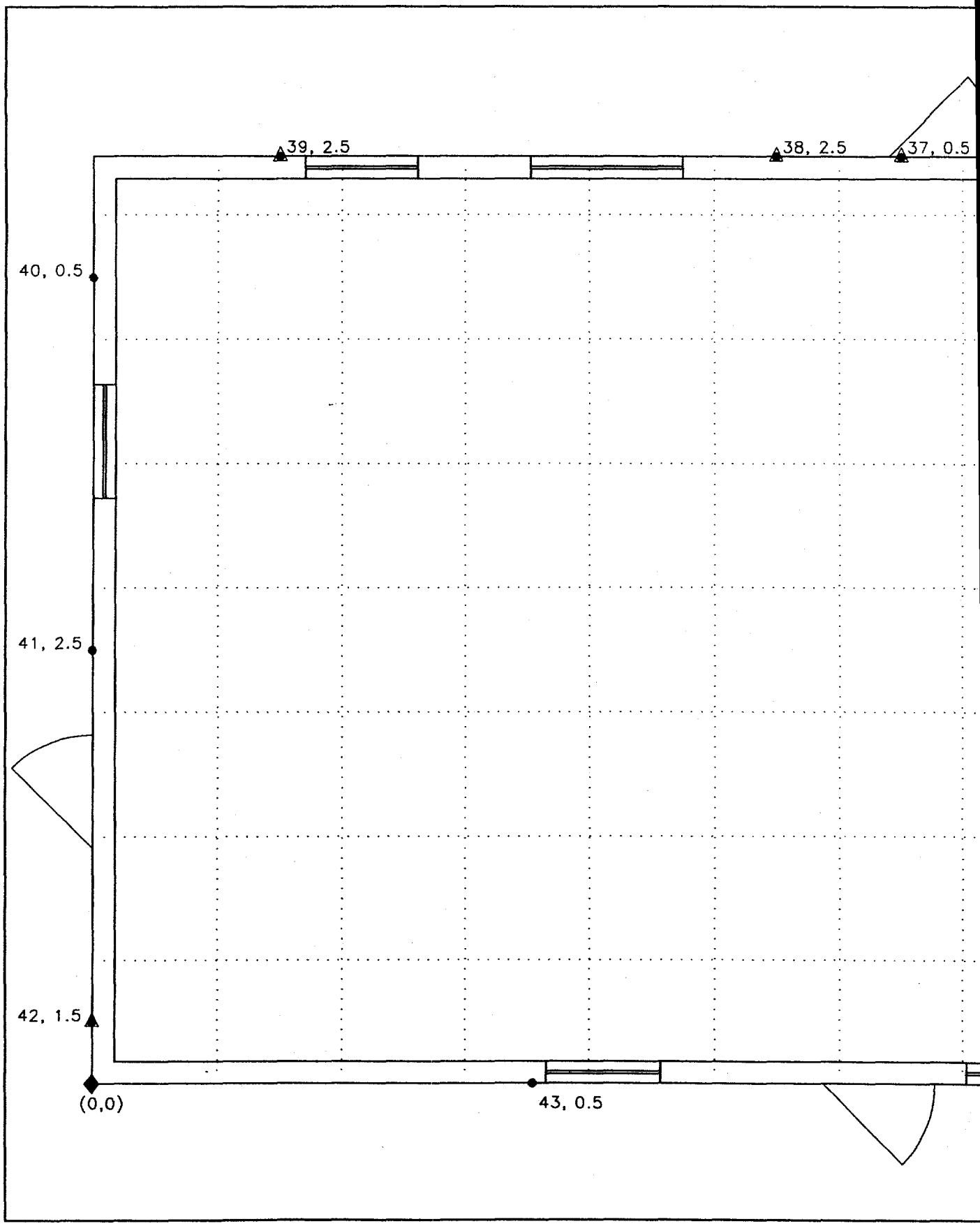
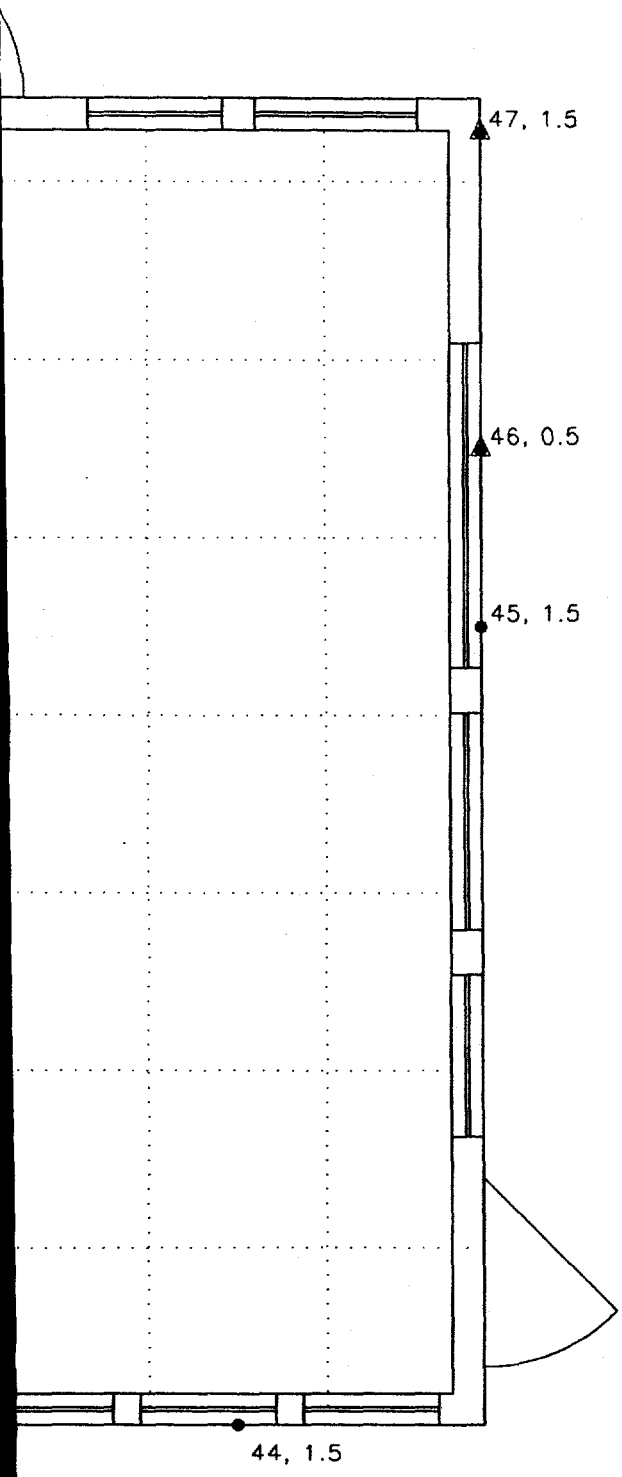


Figure B–5. Building 11 L



NORTH

SCALE IN METERS

0 2

Y
X

(X,Y)=(0,0) BUILDING COORDINATE SYSTEM
=(478.12, 644.89) FACILITY COORDINATE SYSTEM [METERS]

LEGEND

◆ BASE COORDINATE FOR 1–METER GRID SYSTEM

● DIRECT MEASUREMENT LOCATION

△ INTRUSIVE MEASUREMENT LOCATION

35, 1.5 MEASUREMENT LOCATION NUMBER, FOLLOWED BY HEIGHT ABOVE GROUND (METERS)

WESTREN - Grand Junction	U.S. DEPARTMENT OF ENERGY GRAND JUNCTION OFFICE, COLORADO
Figure B–5	BUILDING 11 EXTERIOR WALL SURVEY
PREPARED: CSW	CHECKED: [illegible]
DATE PREPARED: MAY 1997	
PROJECT NUMBER: TCR–031–0015–00–000	FILENAME: T00049AA

terior Wall Survey

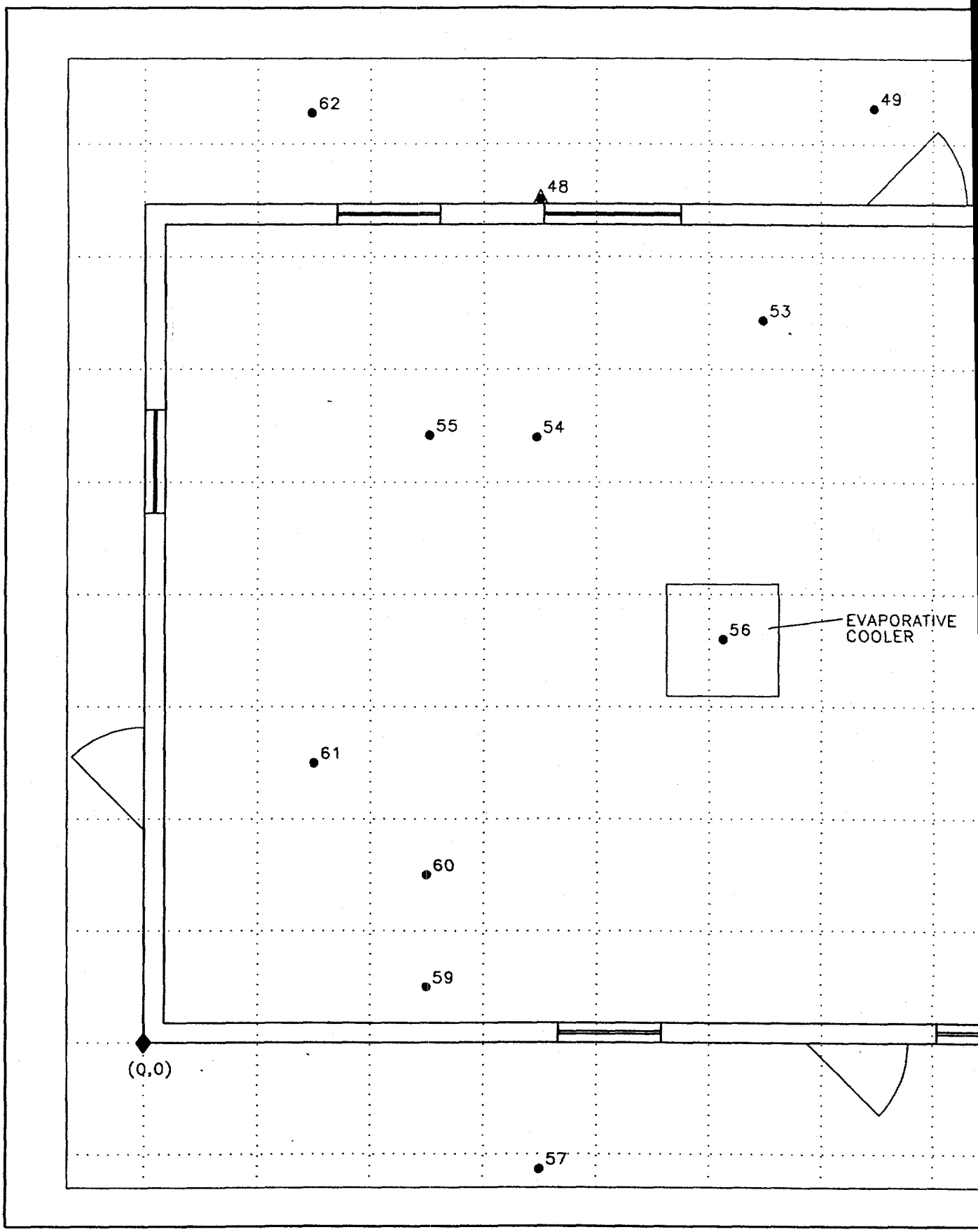
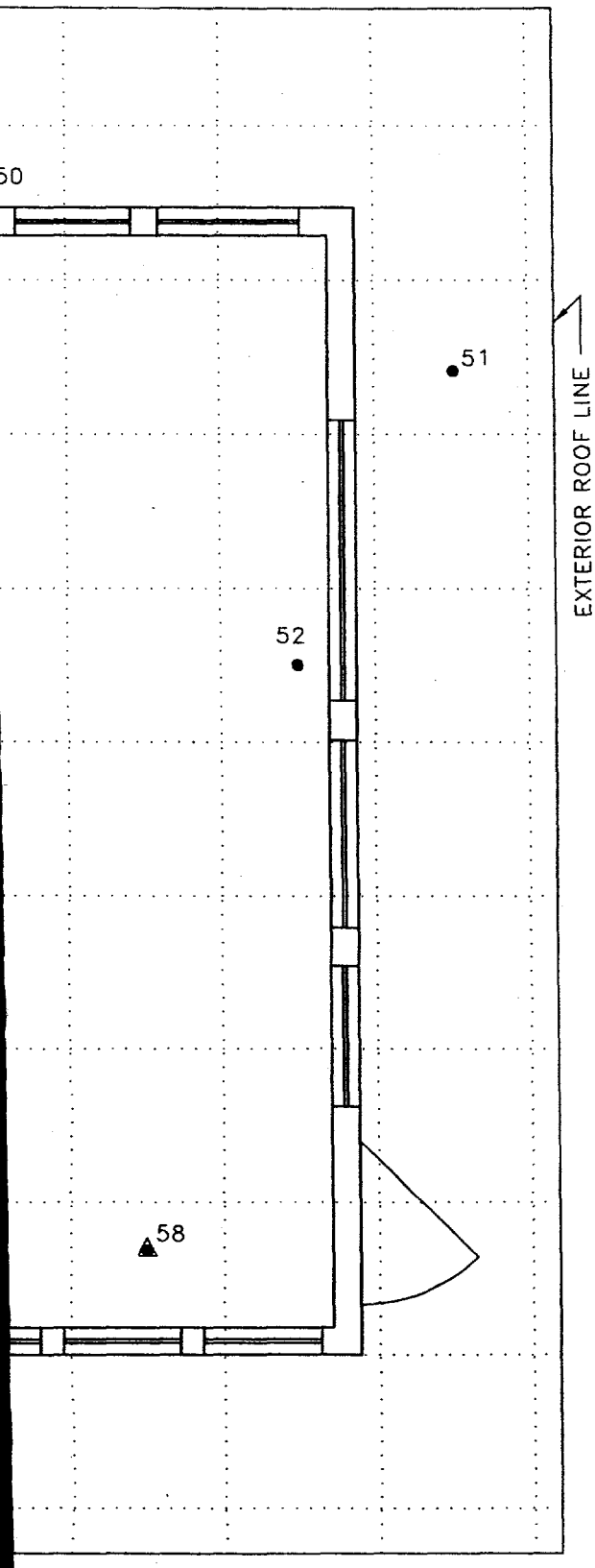


Figure B–6. Building



NORTH

SCALE IN METERS

0 2

Y
X

(X,Y)=(0,0) BUILDING COORDINATE SYSTEM
=(478.12, 644.89) FACILITY COORDINATE SYSTEM [METERS]

LEGEND

◆ BASE COORDINATE FOR 1–METER GRID SYSTEM

● DIRECT MEASUREMENT LOCATION

△ INTRUSIVE MEASUREMENT LOCATION

35 MEASUREMENT LOCATION NUMBER

WASTREN - Grand Junction

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE, COLORADO

Figure B–6 BUILDING 11 ROOF SURVEY

PREPARED:	CHECKED:	DATE PREPARED:
GW	RM	MAY 1997

PROJECT NUMBER:	FILENAME:
TCR–031–0015–00–000	T00050AA

Roof Survey

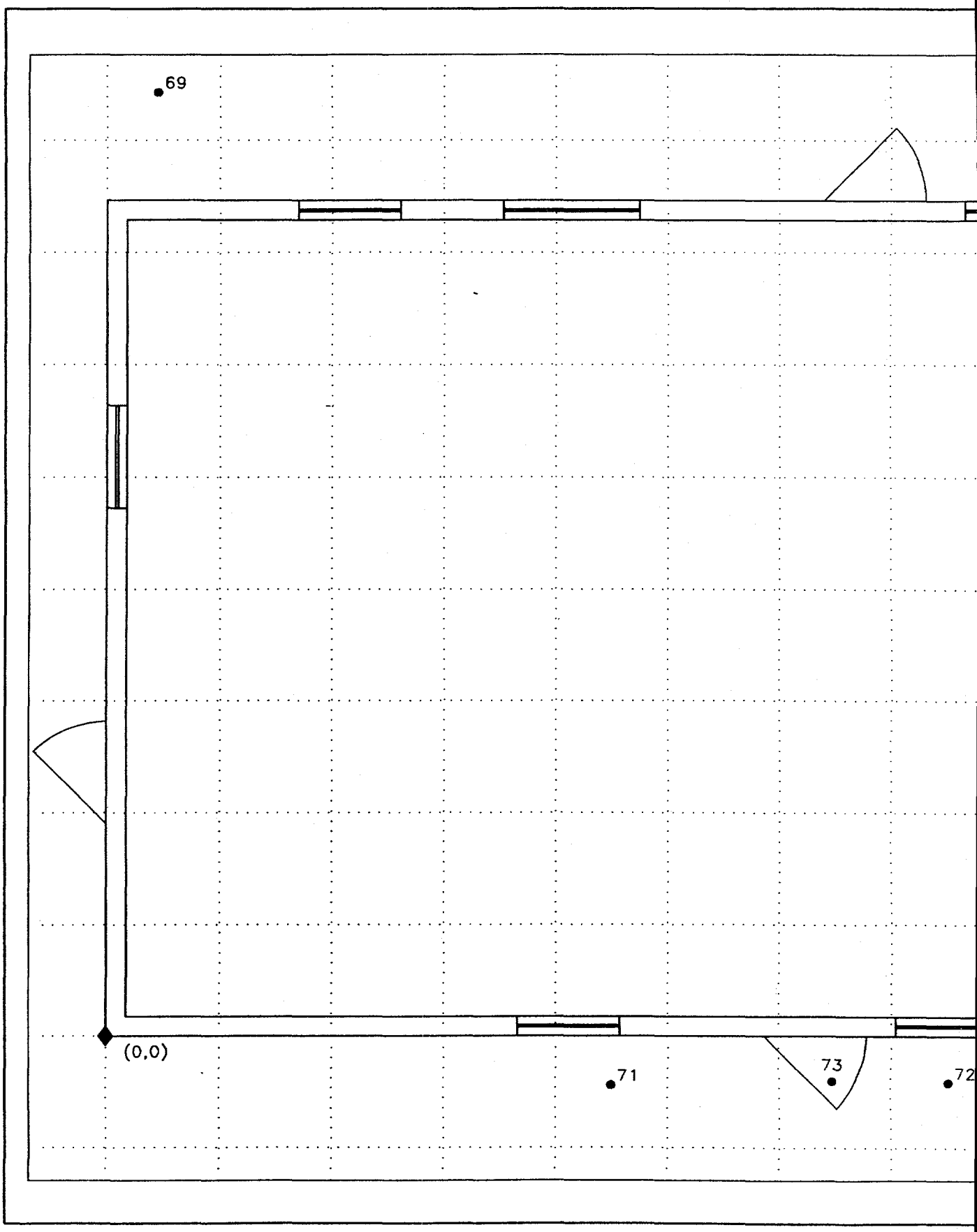
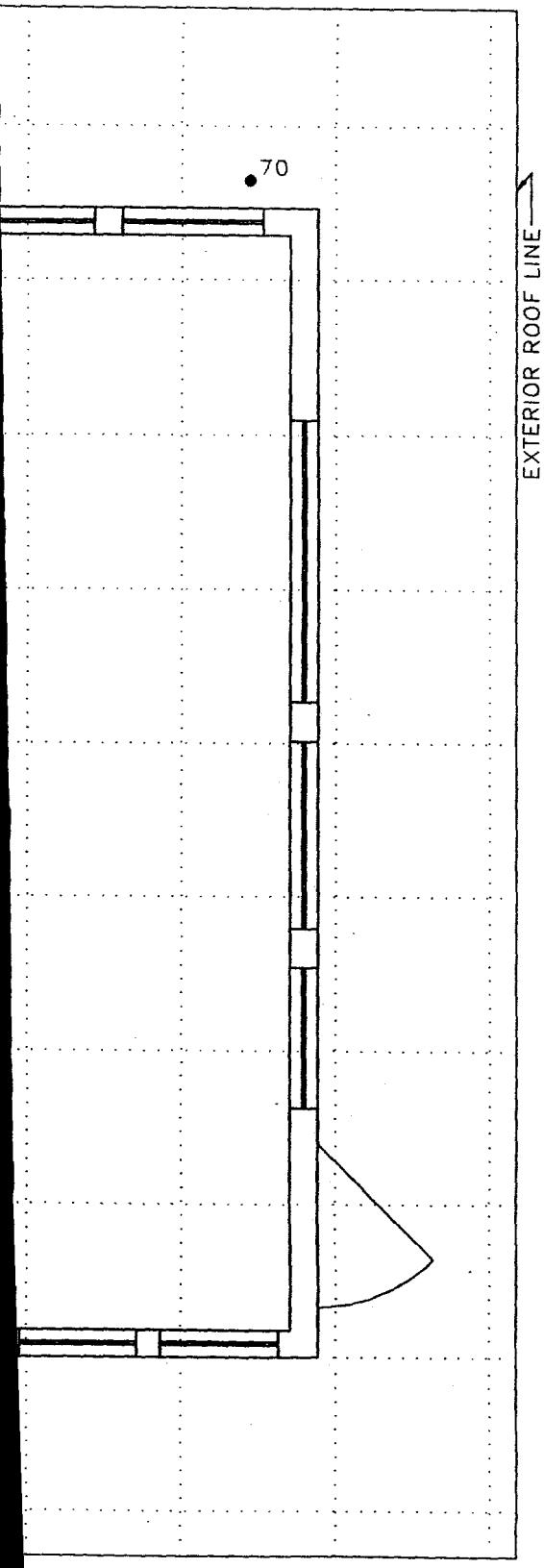


Figure B–7. Building 11 Undersi



NORTH

SCALE IN METERS

0 2

Y
X

(X,Y)=(0,0) BUILDING COORDINATE SYSTEM
=(478.12, 644.89) FACILITY COORDINATE SYSTEM [METERS]

LEGEND

◆ BASE COORDINATE FOR 1-METER GRID SYSTEM

• DIRECT MEASUREMENT LOCATION

35 MEASUREMENT LOCATION NUMBER

EASTERN - Grand Junction

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE, COLORADO

Figure B-7 BUILDING 11 UNDERSIDE OF ROOF OVERHANG SURVEY

PREPARED:	CHECKED:	DATE PREPARED:
CSW		MAY 1997

PROJECT NUMBER:	FILENAME:
TCR-031-0015-00-000	T00051AA

of Roof Overhang Survey