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TITLE: SSFL Area IV Radiological Characterization Field Sampling, Analysis, and Data Management Plan

-APPROVALS-

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1.0 INTRODUCTION

This document presents the plan for field activities, analysis, and data management as specified in the Santa Susana Field Laboratory (SSFL) Area IV radiological characterization plan (Ref. 3-1). The size, topography, and major development of Area IV relevant to radiological characterization are shown in Figure 1-1. The plan specifies performance of a walk-about survey of near-surface gamma activity, performance of a systematic gridded survey of ambient gamma activity at 1 meter above the ground surface, collection of soil and water samples for detailed laboratory analysis of their radioisotopic content, and measurement within soil sampling holes of local soil gamma activity. The plan also specifies collection of data from off-site areas having comparable biogeomorphology, for the purpose of establishing values for the natural isotopic and ambient gamma radiological background. The plan covers collection, analysis, evaluation, and management of the data from these activities.

The Area IV Radiological Characterization Program includes three contractor activities governed by statements of work (Ref. 3-2, 3-3, and 3-4). These activities (land survey, geophysical survey, and radiochemical analysis) support this plan. Data from them will be handled as described here.

This document differs from the plan described in Reference 3-1 in the following ways.

1. The gamma activity measurements which are termed "in situ" in the Characterization Plan are termed "in-soil" in this report. The change is to a more descriptive term.

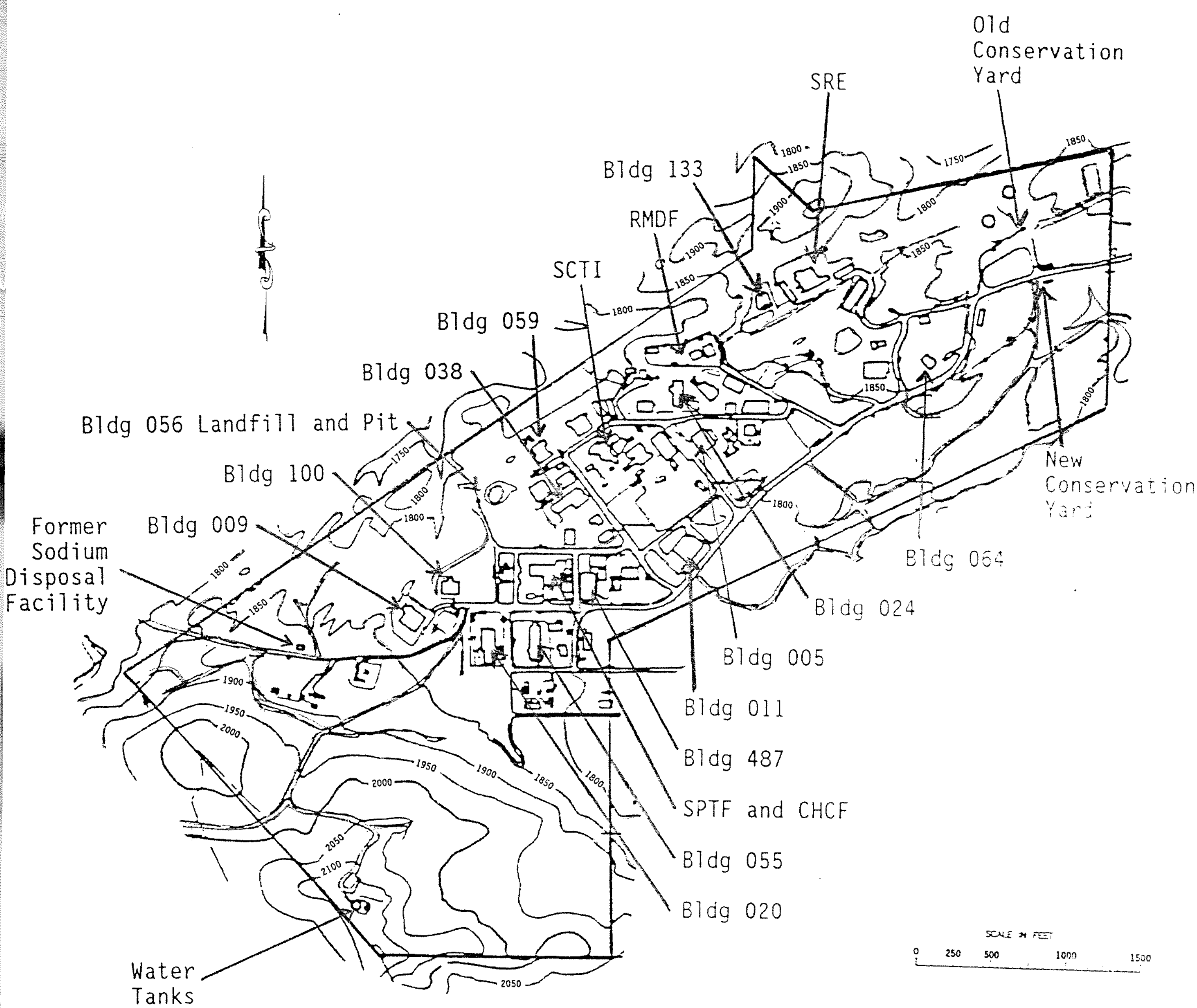
2. Background soil sampling in this plan for analysis of isotopes of thorium and uranium is made conditional on a need following review of the sampling and analysis for these isotopes included in the Brandeis-Bardin Institute (BBI) multi-media sampling followup study (Ref. 3-5 and 3-6).

3. Disturbed-soil samples in this plan will be surface samples rather than subsurface samples at the undisturbed layer as described in the characterization plan. Surface contamination (e.g., fallout) will have been diluted by soil mixing or relocated by soil displacement; however, surface samples will be as representative as subsurface samples.

4. The list of inactive sanitary leachfields to be sampled in this plan does not include that for Building 020, since it is covered by the Building 020 decontamination and decommissioning (D&D) program.

5. The quality assurance soil samples per batch of up to 20 samples are specified in Reference 3-1 as one blind duplicate sample and one field replicate sample. These samples monitor the variabilities of sampling and sampling plus analysis, respectively. Sampling-only variability is expected to be reflected generally by the variability of results from samples at different locations within an analysis

Figure 1-1 Area IV Facility Map



region, which is expected to have similar composition and history throughout (Section 4.6.1.1). Therefore, the blind duplicate sample has been deleted. The use of two quality assurance samples for each sample batch has been maintained by specifying a matrix spike/matrix spike duplicate for each batch. The replacement is a standard quality assurance sample used to determine whether the sample matrix interferes with either extraction of the analyte from the matrix or the analysis. The new set of quality assurance samples is the same as used in the BBI studies.

6. Equipment rinseate samples will be collected for soil samples selected at random within each batch of up to 20 samples, rather than at the end of each batch. Random selection was used for the BBI equipment rinseate samples.

2.0 SCOPE

2.1 PURPOSE OF PLAN

The purpose of this radiological sampling and survey plan is to collect sufficient data to allow an assessment of the current radiological status throughout Area IV. Plan activities focus on those areas that are thought to be free of radioactive contaminants (i.e., that have not been previously identified as potentially or actually contaminated), and where no comparable radiological survey has either already been done or is planned to be done as part of a separate decontamination/decommissioning project. This survey will be comprehensive enough to locate any significant (relative to regulatory limits) pockets of radioisotopic contamination which can be detected from above-ground measurements, in order to confirm the completeness of previous identification of contaminated areas or to identify additional contaminated areas for evaluation.

2.2 EXPECTED OUTPUT

Plan activities will provide data for comparison of Area IV and background area levels of gamma radiation dose rates and radionuclide soil concentrations, and for identification of locations of elevated radioactivity.

1. Comparison to background. The ambient gamma radiation survey and in-soil gamma radiation measurements will sample gamma radiation levels at discrete locations above ground and within the soil, respectively. Soil sample collection and analysis will provide radionuclide concentrations at specific areas and at randomly selected locations. Each of these three sets of data will be compared to data from background locations by means of statistical comparison of the data.

2. Detection of hot spots. The walk-about survey radiation scan is the primary method for detection of local areas of elevated radioactivity. It complements the comparison-to-background measurements by providing more complete coverage of the surface, but at reduced sensitivity.

The end product of the work covered by this plan will be a comprehensive final report containing the peak gamma activity location data from the walk-about survey, along with ambient gamma radiation levels recorded during the area characterization survey. The report will also contain the analytical results from the soil sample survey, together with the measured in-soil and surface gamma radiation levels at the soil sample locations. All Area IV data will be tabulated by their location coordinates and displayed graphically. The results obtained from this sampling and survey will be compared to data from off-site locations to determine whether any of the on-site locations are significantly different from natural background.

If soil sample locations are found to contain above-background concentrations of radioisotopes, or if gamma measurements exceed the expected range of natural background radiation, the measured values will be compared to regulatory limits. Any areas exceeding regulatory limits will be candidates for followup study subsequent to the characterization program.

2.3 SEQUENCE AND SCHEDULE

The activities specified in this plan will be coordinated to the extent practical in order to provide efficient completion of Area IV radiological characterization. The goal will be to collect all data in a designated region to enable conclusions to be drawn as the project progresses. Overall coordination of field activities using the guidelines given in Section 4.1 will be the responsibility of the associate program manager. Survey and sampling activities coordination will be the responsibility of the survey and sampling managers, respectively. Data will be validated as received. Data analysis will proceed as validated data sets are available.

The overall schedule for performance of this plan and the major milestones are defined in the Area IV Characterization Program Management Plan (Ref. 3-7). The schedule is based on starting field activities in February 1994, and anticipates issuance of the final report in May 1996.

3.0 REFERENCES

3-1 A4CM-AN-0003, "Radiological Characterization Plan, Santa Susana Field Laboratory Area IV," April 1, 1994

3-2 Statement of Work, "Santa Susana Field Laboratory Area IV Land Survey and Grid Mapping" (Purchase Order 94033966)

3-3 Statement of Work, "Geophysical Survey, SSFL Area IV" (Purchase Order TBD)

3-4 Statement of Work, "Santa Susana Field Laboratory Area IV, Chemistry Laboratory Analysis Services" (Purchase Order 94034044)

3-5 "Multi-Media Sampling Report for the Brandeis-Bardin Institute and the Santa Monica Mountains Conservancy," March 10, 1993 (prepared by McLaren/Hart Environmental Engineering Corporation)

3-6 "Work Plan for Additional Soil and Water Sampling at the Brandeis-Bardin Institute and Santa Monica Mountains Conservancy," October 22, 1993 (prepared by McLaren/Hart Environmental Engineering Corporation)

3-7 A4CM-AN-0001, "Area IV Characterization - Project Management Plan," April 25, 1994

3-8 Area IV grid survey report, to be issued

3-9 A4CM-SP-0001, "SSFL Area IV Gamma Survey Procedures in Support of the Site Radiological Characterization Study," March 7, 1994

3-10 GEN-ZR-0005, "Radiological Survey of the Source and Special Nuclear Storage Vault-Bldg T64," August 19, 1988

3-11 A4CM-QN-0001, "Quality Assurance Plan for Area IV Site Characterization, Monitoring & Surveillance," April 5, 1994

3-12 Atomics International drawing 303-GEN-017, Sheet No. 2, "Central Sewage System Plan & Topography," Revision 7, November 15, 1962 (initial issue dated August 27, 1959; initial as-built issue dated February 26, 1960)

3-13 Atomics International drawing 303-GEN-018, Sheet No. 3, "Central Sewage System Plan & Topography," Revision 5 dated November 15, 1962 (initial issue dated August 27, 1959; initial as-built issue dated February 25, 1960)

3-14 ESG-DOE-13385, RMDF Leach Field Decontamination Final Report, September 15, 1982

3-15 DOE/EV-0005/46 (ANL-OHS/HP-84-101), "Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratory, Rockwell International, Ventura County, California," dated February 1984 (prepared by Argonne National Laboratory)

3-16 A4CM-SP-0002, "Area IV Characterization Project - Soil Sampling Procedure," June 9, 1994

3-17 A4CM-SP-TBD, "Area IV Characterization Project - Water Sampling Procedure," to be issued

3-18 MIL-STD-414, Sampling Procedures and Tables for Inspection by Variables for Percent Defective, June 11, 1957

3-19 "Radiological Surveys: Methods, Criteria and Their Implementation," Waste Management Conference '91, February 24-28, 1991

3-20 "Sampling Inspection Methods for Radiological Surveys," Proceedings of Measurement Science Conference, Pasadena, CA, January 27-28, 1994

3-21 "Sampling Inspection and Survey Interpretation: A Comparison of Methods," Proceedings of Symposium on Waste Management, Tucson, AZ, February 28, 1993

3-22 "Statistical Treatment of Radiological Survey Data for Cleanup Decisions and Regulatory Compliance," SPECTRUM '92, Proceedings of International Meeting on Nuclear and Hazardous Waste Management, Boise, ID, August 23-27, 1992

3-23 N704SRR990020, "Radiological Inspection Methods for Release for Unrestricted Use," November 30, 1982

3-24 NRC Regulatory Guide 6.6, "Acceptance Sampling Procedures for Exempted and Generally Licensed Items Containing By-Product Material"

3-25 DECON-1, State of California Guidelines for Decontaminating Facilities and Equipment Prior to Release for Unrestricted Use, June, 1977

3-26 DOE Order 5400.5, "Radiation Protection of the Public and the Environment," February 8, 1990

3-27 NRC Dismantling Order for the L-85 Reactor Decommissioning, NRC to M. E. Remley, March 1, 1983

3-28 DOE/04/8901, "A Manual for Implementing Residual Radioactive Material Guidelines," June, 1989

3-29 N001SRR140125, "RESRAD Calculations for Soil Radioactivity Limits at SSFL," January 12, 1994

4.0 AREA IV RADIOLOGICAL SAMPLING AND SURVEY PLAN

4.1 FIELD ACTIVITY SEQUENCE

Field activities will be coordinated to meet the goals of efficient operation and collection of all data from a designated region in as short a time as practical to enable conclusions to be drawn as the project progresses. The various activities involved have interactions with each other and depend on completion of other activities (e.g., Area IV land survey). Activity details may also depend on the results of earlier activities (e.g., soil sampling at locations of elevated gamma activity). Therefore, the sequence of activities cannot be defined in advance. It will be specified by the associate program manager after considering the factors influencing the sequence and the goals stated above.

The following guidelines have been established to aid in planning the activity sequence.

1. Perform gamma measurements and soil sampling at background areas as early as practicable. All measurements and sampling in an area should be planned for the same trip because of the distance to the areas; however, sampling may need to be delayed if gamma measurements are made before the analytical laboratory is under contract.

2. Perform soil sampling (and the associated in-soil radiation measurements) separately from the ambient gamma and walk-about surveys in Area IV. The rationale for this is to collect the samples in batches rather than spreading them over a long period of time. It also allows the start of radiation measurements prior to establishment of the contract with the analytical laboratory. Collecting batches of samples in a short time has the advantage of reducing sample storage time while providing samples to the laboratory in analysis batch sizes (20 samples). In-soil radiation measurements are part of the soil sampling procedure and are thus not done at the same time as other radiation measurements.

3. Perform the ambient gamma and walk-about surveys in each survey block before moving to the next block.

4. Perform radiation measurements in a sequence determined by availability of land survey markers and by the terrain. This will minimize travel time and provide systematic coverage. There are no areas expected to have elevated radiation levels which would prompt early attention.

5. Perform soil sampling after the ambient and walk-about surveys are completed in the survey blocks to be sampled. This will allow inclusion of all soil samples to be collected in the area, including those as followup to elevated gamma readings observed during the gamma surveys.

6. Perform soil sampling in the areas around the former Sodium Disposal Facility when the laboratory is under contract and the geophysical

survey of the area is completed. This area is considered the most likely to be contaminated.

7. Assign the priorities for other screening area soil sampling in this order: drainage channels, leachfields, and buildings.

8. Sample the SRE Pond (water and sediments) when convenient.

9. Sample the SRE drains when convenient after determining that there are no other measurements or sampling to be done in the areas affected by excavation of the drain piping.

4.2 DETERMINATION OF NATURAL RADIOACTIVITY BACKGROUND

4.2.1 Background Locations

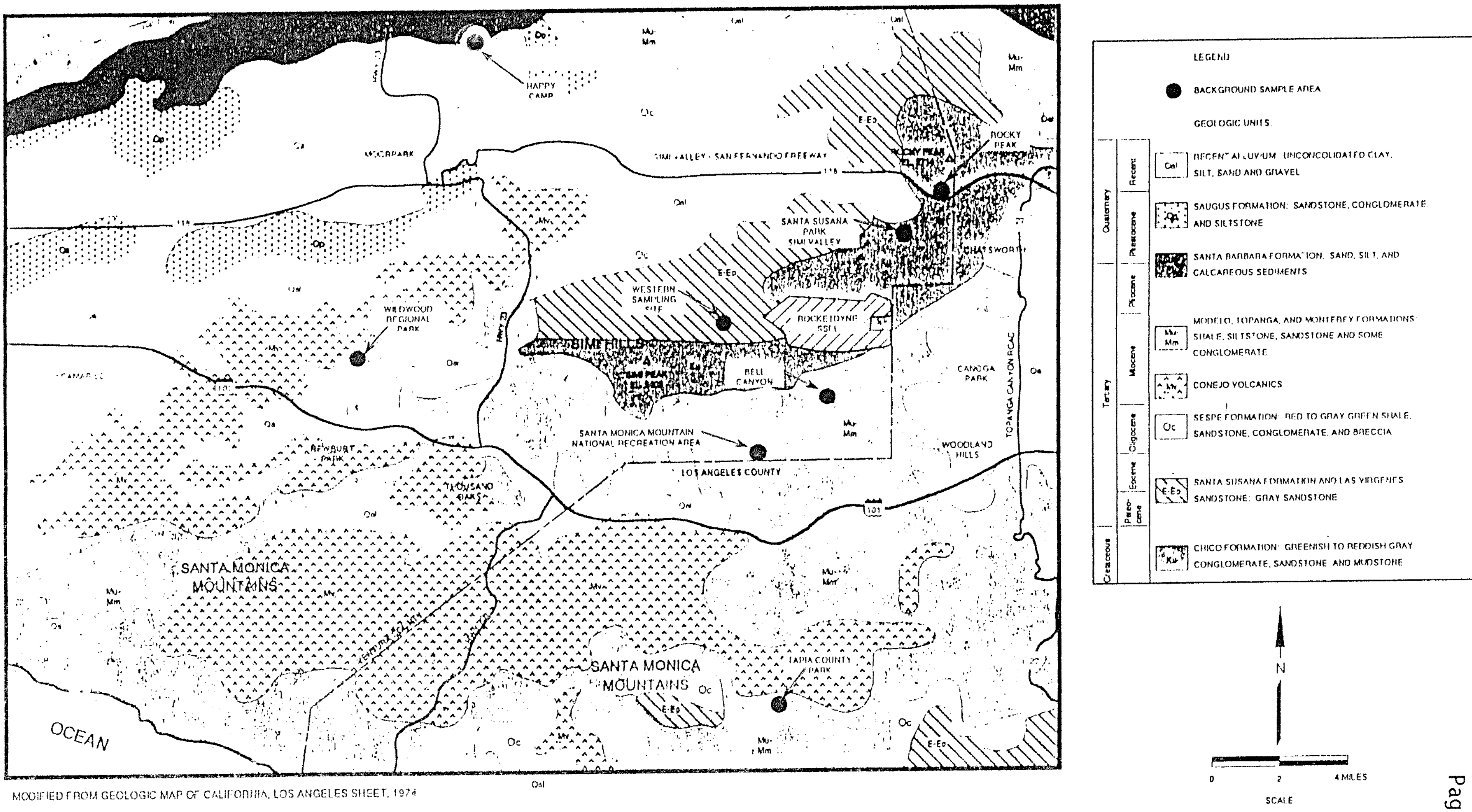
Area IV survey results will be compared with characteristics at the background locations used for the multi-media sampling program conducted at the Brandeis-Bardin Institute (BBI) (Ref. 3-5 and 3-6). Background areas for the multi-media study were sampled to provide a basis for evaluating the results from samples collected at the BBI to distinguish naturally occurring radionuclides from those which might have originated at Rocketdyne. Six locations investigated in the initial study (Ref. 3-5) were selected on the basis of soil type, surface geology, slope, exposure, similarity of vegetation, wind direction, accessibility, distance from Rocketdyne, and recommendations by regulatory agencies and citizen groups. Two additional background locations were selected for investigation during the follow-up study (Ref. 3-6), which also included additional sampling at initial background locations. The eight locations, which will be used in this plan, are shown in Figure 4-1 and are described in Appendix A.

4.2.2 Background Measurements

Natural radioactivity background evaluation for Area IV characterization will use gamma radiation levels and soil radionuclide concentrations at the BBI study background locations specified in Section 4.2.1 and described in Appendix A.

1. Ambient gamma radiation surveys will be made in each of the background locations, since they were not included in the earlier study. The survey will be performed using the methods described in Section 4.4, modified for the smaller survey block used for the BBI study. The 100 ft by 100 ft cell at each of the background locations and the 25-ft grid spacing of the ambient gamma survey will provide 25 measurements per location, or a total of 200 measurements for statistical analysis to define background.

2. The soil analysis results in the BBI study will be used as the background for evaluation of Area IV soil isotopic concentrations. In the initial BBI study three samples were collected at each of the six background areas. Sampling was at randomly selected locations within the 100 by 100 ft grids described for each background area in



MODIFIED FROM GEOLOGIC MAP OF CALIFORNIA, LOS ANGELES SHEET, 1974

Figure 4-1 Locations of Background Sampling Areas for Brandeis-Bardin Institute Multi-media Study

Appendix A. In the followup study samples were collected at five locations in each of two new background areas, five locations in three of the earlier background areas, and five locations in ravines in the two new and one earlier background areas. Again, sampling was at randomly selected locations. Sample analysis included measurement of concentrations of gamma-emitting isotopes, Sr-90, and isotopes of plutonium (Pu-238 and Pu-239). Analysis for isotopes of uranium and thorium was not included in the original BBI study, but was added for the followup study in the new background areas and two of the earlier areas to support the needs of this plan.

The BBI study provides sets of 43 background concentrations (20 concentrations for isotopes of thorium and uranium) for statistical analysis: five each for the two new background areas, five each for the three (two for uranium and thorium) initial background areas at which additional sampling was done in the followup study, and three each for the three (none for uranium and thorium) background areas covered only in the initial study. The BBI study also provides sets of 15 background concentrations in ravines, 5 each in three background areas.

3. Samples may be collected as part of this plan at background soil sample locations, using the methods described in Section 4.6.3, for analysis for isotopes of thorium and uranium. The need for this sampling will be determined after review of the BBI study measurements of these isotopes for their sufficiency in defining the background.

4. In-soil gamma radiation will be measured in each of the holes made by soil sampling for this plan. These measurements will be made only at locations of additional sampling, if any, done as part of this plan.

4.3 ESTABLISHMENT OF A SURVEY BLOCK

The field activities of this plan will be carried out in increments within areas termed survey blocks. Each survey block will be a 200 by 200 ft square, except where local conditions (e.g., terrain, buildings, or Area IV boundary) require use of a smaller area. Radiation measurements will be made within a survey block before proceeding to the next block. The use of survey blocks permits performance of activities systematically and in manageable amounts. The blocks will be defined using the Area IV grid system described in Section 4.3.1. The layout of a survey block is described in Section 4.3.2.

4.3.1 Area IV Grid System

A grid system throughout Area IV will be used to support the activities described by this plan. The grid system consists of a network of east/west and north/south coordinate lines at a 200-ft separation, with the location of the lines defined relative to the federal coordinate system established in 1990. The purpose of the grid system is to enable definition of a position reference system, selection of statistically random locations, and relocation at positions of interest if desired in the future. Layout of the grid was done by a civil engineering firm under a subcontract (Ref. 3-2). The land survey is described and the results reported in Reference 3-8.

The grid system is identified by labelled stakes installed at (or near) each intersection of an array of east/west and north/south lines having a 200-ft spacing. The stakes are labelled by marking each with a letter and a number indicating the east/west and north/south lines whose intersection it marks. Each stake is also marked with its coordinates in the federal coordinate system. The locations of the corner stakes are shown in Figure 4-2. The location coordinates of each stake are listed in Appendix B.

4.3.2 Location Identification Method

A survey block is a square whose corners are marked by four stakes (except in cases of irregularly shaped survey blocks as described in Section 4.3.3). To identify locations within a regular survey block, the survey or sampling team will lay a measuring tape between the two 200-foot-grid markers that form a north/south line just east of, and (similarly, with a second measuring tape) just west of the survey block. The tape starting end (0 in.) will be on the south end. Using a third measuring tape, running east/west (perpendicular) between the first two tapes (with the zero on the west end) and through the survey location, the survey or sampling team will then be able to determine sample and measurement coordinate points relative to the 0,0 point of the survey block. This survey location and labeling scheme provides permanent traceability of the physical location of each survey point without a need for individual marker stakes or monuments, and without potential interference from site modifications which may occur in the future.

4.3.3 Alternate Location Identification Methods

The location identification method described in Section 4.3.2 will be used wherever possible. In some locations, however, the necessary access to part or all of a survey block will not be possible. Examples are areas of heavy vegetation, rough terrain, buildings, or large rock outcroppings. In such cases alternate methods will be used. These will use the 200 ft by 200 ft grid system defined by the marker stakes described in Section 4.3.1, but in a way tailored to the conditions. The exact method for each situation will be selected to address the difficulties presented. The plan for each survey block will be defined by the survey manager or sampling manager, as applicable. The methods described below will be used or adapted as needed.

1. In cases where an obstruction limits access within a survey block, it may be possible to divide the block into multiple clear areas. In these cases one or more boundary tapes will be moved to lines within the survey block, but still running north-south or east-west. These tapes and a transverse tape can then be used to define location coordinates in the manner similar to that described in Section 4.3.2. The transverse tape may extend beyond the space between the two "boundary" tapes. The coordinate determination is basically the same as in Section 4.3.2, but is modified by the addition of a step to adjust for the position of one of the reference tapes.

Figure 4-2 Area IV Survey Grid

2. In cases where vegetation or rough terrain prevent running a tape to a measurement or sampling location, approximate locations (e.g., to provide 20-ft spacing for ambient gamma survey measurements or a 50-ft interval between drainage channel soil samples) will be used and their coordinates determined relative either to points on the grid system or to secondary points related to that system. This will be done by triangulation using distances from unknown to known points measured using tapes, and angles from the measurement or sampling location to known points measured using a sighting compass. The data to be obtained will be specified by the survey or sampling manager for each location to meet its constraints. The survey or sampling team will record the data and note on the datasheet that triangulation data was recorded. Evaluation of the data to determine the location coordinates will be done by the survey or sampling manager. The uncertainty of the data will be used to estimate the uncertainty of the coordinates.

4.4 AMBIENT GAMMA SURVEY

An ambient gamma survey will be conducted at discrete points over most of Area IV (see Section 4.4.2.3 for a description of excluded areas). The data to be obtained at each specified location will be measurements of the ambient gamma dose rate at 1 meter above the ground surface. For each full survey block measurements will be made at 81 grid intersection points.

This section describes in general the plan and requirements for the ambient gamma survey. The detailed procedure is Reference 3-9.

4.4.1 Ambient Gamma Survey Protocol Considerations

4.4.1.1 Applicable Ambient Gamma Survey Guidelines

Gamma activity measurements will be made at specified locations as directed by the survey manager. Daily instructions to the survey team by the survey manager will include identification of the survey block in which to make the measurements, starting location in the survey block and direction to proceed for subsequent measurements (Section 4.4.2.2) and locations at which previous measurements are to be repeated to investigate questionable data (Section 4.4.3.2). Repeat measurements may also be specified to provide additional duplicate measurements to evaluate reproducibility.

Gamma activity measurements will be made simultaneously by two instruments that will be mounted on a fixture designed to facilitate quick placement and alignment, and to ensure that the instruments are one meter above, and pointing vertically toward, the surface. Making simultaneous survey measurements with paired, duplicate instruments will provide a continuous check on instrument reliability to detect instrument instability, drift, intermittent excessive noise, or other failures. The availability of paired data will also provide an improvement in measurement precision by a factor of 1.4.

Ambient gamma activity data will be recorded as specified in Reference 3-9. Data will include the survey block identifier, measurement location coordinates, and the gamma readings.

4.4.1.2 Ambient Gamma Survey Investigation Levels

The gamma level at which further investigation will be done is based on a maximum acceptable gamma dose rate of 5 μR/hr above the average background gamma dose rate. This limit has been selected as being below the limit of 20 μR/hr above background specified by DOE for formerly used sites remedial action programs and in compliance with the 5 μR/hr-above-background limit required by NRC for decontamination of licensed facilities. (The NRC limit is not applicable directly to Area IV characterization, but is applicable to licensed Area IV facilities.)

If a gamma activity measurement is greater than the investigation level, specific investigation of the occurrence will be done. The survey manager will evaluate the above-limit gamma activity measurements to determine whether the activity is related to the natural geology of the area. Gamma readings near sandstone outcroppings can easily exceed nominal soil radiation levels by 4 μR/hr. Therefore, the survey manager will be cognizant of expected variability in normal background in assessing whether 5 μR/hr increases represent real contamination. If the activity is soil-related and not clearly caused by the natural geology, the survey manager will notify the manager of Radiation Protection and Health Physics Services (RP&HPS) and the associate program manager for direction on further action (e.g., collecting soil samples for laboratory analysis).

The investigation level is based on the background count rate and the gamma detector count rate equivalent to 5 μR/hr. The background count rate will be determined as described in Section 4.2. The gamma detector count rate-to-dose rate equivalence will be determined and monitored as described in Section 4.4.1.3. Until this information is available, initial values based on prior measurements will be used. Background will be that from measurements made in non-radiological areas of SSFL (outside Area IV) as part of the 1988 Area IV Radiological Survey (Ref. 3-10). The average dose rate at three locations was 15.3 +/- 0.7 μR/hr, or 3289 +/- 151 cpm using the conversion factor described in Section 4.4.1.3. The values determined in this plan will be documented and used for subsequent data evaluation.

4.4.1.3 Gamma Detector Count Rate Conversion Factor

Gamma survey instrument response in terms of dose rate has previously been determined by simultaneous measurements with the detectors and a Reuter-Stokes High Pressure Ionization Chamber, which measures ionization energy and reads directly in μR/hr. The count rate-to-exposure rate relationship was 215 cpm per 1 μR/hr at background gamma levels. This relationship will be used initially to compare measured count rates to dose rate criteria. The count rate-to-dose rate conversion factors will be confirmed by means of simultaneous measurements with the gamma survey detectors and the Reuter-Stokes detector as part of the daily functional checks of the gamma survey instruments (Section 4.4.3.1). The count rate-to-μR/hr conversion factor and its uncertainty will be determined. Any change in the factor will be documented. The revised value will be used in subsequent data analysis.

4.4.1.4 Gamma Detector Counting Time

The ambient gamma survey readings will be taken simultaneously from the two detectors, using a counting period of one minute.

4.4.2 Determination of Gamma Survey Locations

4.4.2.1 Survey Grid Sizing

Gamma dose rates will be measured at the intersections of a grid having a spacing of 25 ft. This value is specified for reasons of cost and survey design. It provides uniform sampling (supplemented by the complete coverage of the walk-about scan) of gamma dose rates at a sufficient number of points to allow statistical analysis within each survey block, as well as within groups of blocks having similar characteristics. On the other hand it specifies a manageable, although large, number of measurements (i.e., approximately 20,000 measurements). It provides a uniform, complete grid within each 200 ft X 200 ft survey block, which simplifies survey design.

4.4.2.2 Survey Grid Layout

Each individual 200-ft by 200-ft survey block established by the initial civil engineering survey (Section 4.3.1) will be further divided into a grid spaced at 25-ft intervals along both north/south and east/west directions. The ambient gamma survey readings will be taken at each intersection of the grid.

The grid spacing establishes 49 measurement locations within each survey block and 32 on the perimeter. Single coverage of all of these locations within blocks surrounded by other blocks in a matrix of survey blocks would be provided by measuring at the locations on two sides of each survey block. This would give a total of 64 measurements per survey block. In order to provide repeat measurements for monitoring data quality and to simplify the procedure, measurements will be made on three sides of each survey block, giving a total of 72 measurements per survey block. (Adaptation of this plan will be made by the survey manager for special cases, such as survey blocks on the Area IV boundary and irregular survey blocks.) Measurements will be made on the southern boundary of each survey block, but not on the northern boundary (or, depending on the direction the survey is progressing through the survey blocks, measurement on the northern but not on the southern boundary). The latter locations will be covered by measurements of the southern boundary of the adjacent block. Measurements will be made on both the east and west boundaries of each survey block. Since the plan is to traverse the survey block from west to east, measuring on both boundaries incorporates all locations on the traverse, which simplifies the procedure. Measurements on the east and west boundaries will be made twice, once for each of two east-west-adjacent survey blocks. These duplicate measurements will be used for evaluation of measurement repeatability.

4.4.2.3 Areas Excluded from the Ambient Gamma Survey

Complete coverage of Area IV will be reduced by exclusion of areas having certain characteristics. The areas excluded are shown in Figure 4-3. The characteristics and status are the following:

1. Major rocks. Area IV contains many large rock outcroppings which are not potential sources of contamination and in many cases are not easily or safely accessible. Survey measurements are not planned on these; however, a rock surface may be included if it is convenient.

2. Buildings. The interior of buildings and other structures (tanks, open-sided test stands, etc.) are not considered to need characterization. Areas surrounding buildings and structures (including areas inside fences) are included in the survey if they are not included in the facility D&D.

3. Areas characterized by other studies. Other studies include prior studies (Area IV radiological survey and completed D&D final surveys) and related activities (planned D&D final surveys and remedial actions).

4. Irregular survey blocks in difficult terrain at the Area IV boundary. These areas are small and are not likely locations of radiological contamination because of access difficulty. Their survey would be very labor intensive and will be attempted only if nearby contamination indicates extension into the irregular survey blocks.

In addition to the excluded areas there will be other areas in which it may be necessary to deviate from the regular grid spacing. Measurement locations will be modified in the field as necessary to protect endangered or protected plant species. Also, there are areas of dense natural vegetation in Area IV for which access for the systematic survey would require extensive clearance of undergrowth and disruption of the native wildlife. Measurements and sampling in these areas will be at selected representative locations to minimize vegetation clearance.

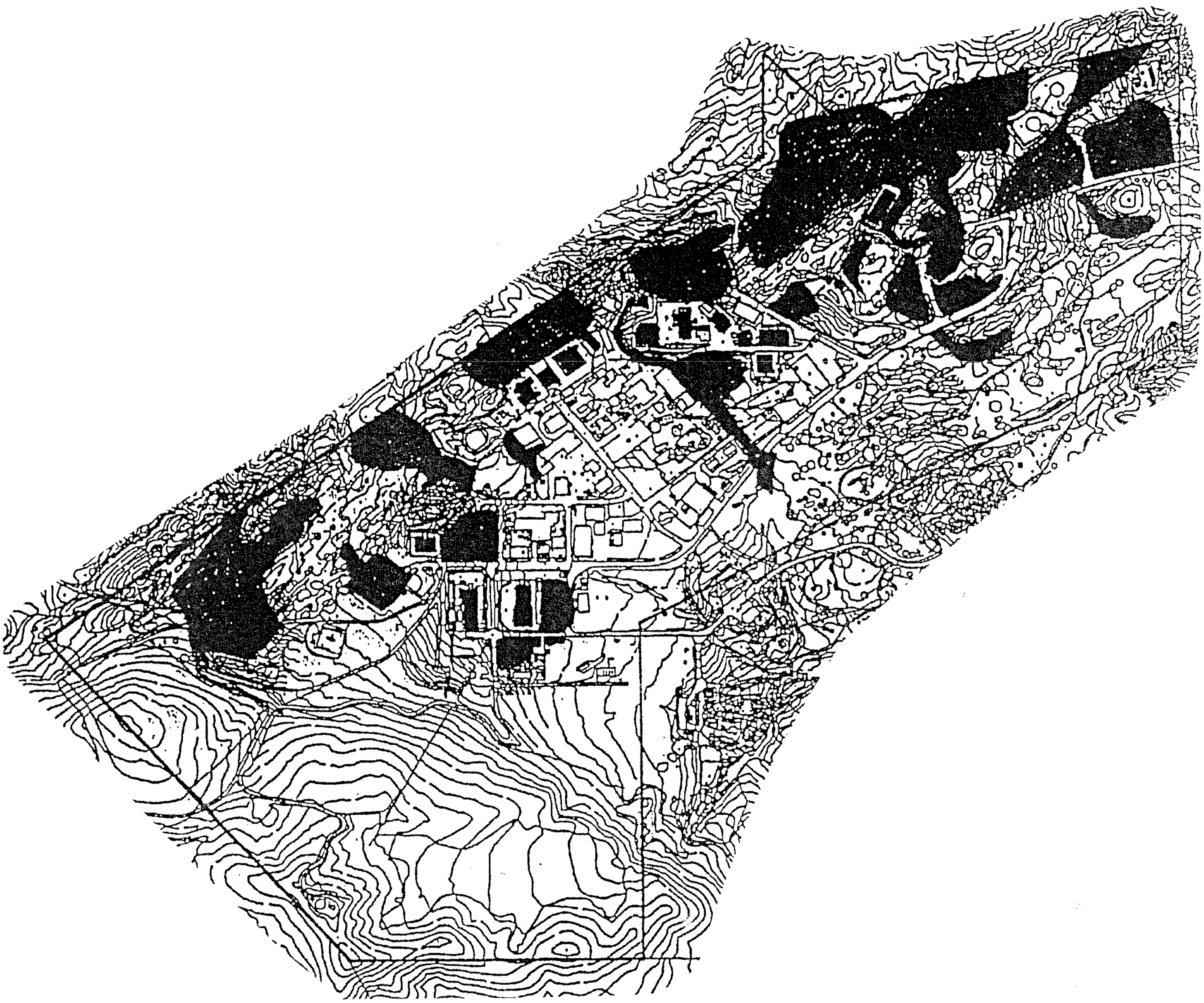
4.4.3 Ambient Gamma Survey Quality Management

Ambient gamma survey quality will be maintained by meeting the data quality needs specified in Reference 3-1 and by oversight by the ETEC Quality Assurance and Training department in accordance with Reference 3-11 to assure effective execution of the requirements of this plan.

Data quality needs were specified in Reference 3-1 by defining the required precision, accuracy, representativeness, completeness, and comparability (PARCC) data quality indicators. These indicators will be applied as described below.

1. Precision will be assessed by comparison of duplicate gamma activity measurements. The data will be considered acceptable if sets of repeat measurements are not statistically different from sets of initial measurements when compared as described in Section 7.1.3.

Figure 4-3 Areas Excluded from the Ambient Gamma Survey



2. Accuracy of gamma activity measurements will be assessed through instrument performance integrity testing (Section 4.4.3.1). The data will be considered acceptable if performance is unchanged when evaluated statistically.

3. Representativeness will be provided by sampling the gamma activity at enough locations to provide for evaluation data set sizes sufficient for statistical analysis. The smallest data set for which analysis is planned is that for the survey block, which contains 81 activity values if all boundaries are included.

4. Completeness will be provided by ensuring that the data are valid for at least 90% of the planned measurement locations within each data set. Measurements at locations of questionable or invalid data will be repeated if necessary to provide this quality. Data sets containing less than 100% of the planned measurements will be reviewed to ensure that the data set is still representative.

5. Comparability of the measurements will be provided by use of established procedures to assure measurement consistency, frequent checks of equipment functional performance, and maintenance of detailed records of field activities.

4.4.3.1 Instrument Performance Integrity

Radiation level measurements will be supported by calibration and functional performance surveillance activities to allow assessment of data validity. These tests will be used to provide data for field verification of proper instrument operation before proceeding with measurements, and for detection of long-term shifts or drift in instrument performance.

4.4.3.1.1 Instrument Calibration

All radiation detection instruments will be maintained on a quarterly calibration cycle by the RP&HPS Radiation Instrumentation Services laboratory. The NaI gamma survey meters will be calibrated against an Am-241 standard source, and verified against both Cs-137 and Ra-226 standard sources.

4.4.3.1.2 Functional Performance Testing

Performance of the gamma radiation detection systems will be verified at the beginning of each shift, at a mid-shift time convenient for the survey team, at the end of each work shift, and at other times when it is desired to verify proper operation (following interruptions of work, apparent performance changes, etc.). All performance checks will be performed at the location specified in the procedure (Ref. 3-9), with the detectors in the same positions each time. Counts during a fixed time interval will be recorded both with a Cs-137 calibration source in a repeated position (e.g., at the base of the ambient gamma survey detector fixture) and with the source removed (i.e., only the background gamma radiation present). The count rate conversion factor (counts/min per μR/hr) of each detector will be determined before and after recalibration.

4.4.3.2 Survey Data Integrity

Survey data integrity will be ensured by on-line review by the survey team of the data as it is being collected and by daily review by the survey manager. The survey team will compare readings from the two detectors during the functional performance tests and gamma activity measurements. They will also note the readings during the tests relative to previous values. Although data review is not a primary responsibility of the survey team, their training and familiarity with normal daily variation of the readings will allow them to detect significant changes in instrument performance. They will notify the survey manager of observed changes before proceeding with measurements.

The survey manager will perform a review of each day's instrument performance tests and gamma activity measurements to provide an initial review of the data validity. Instrument performance test results and channel comparisons will be compared to control charts to detect any out-of-limit conditions. Repeated measurements will be compared to earlier results to verify that normal reproducibility was observed. Malfunctioning instruments will be repaired or replaced before continuing. In the event of questionable data (e.g., inconsistency between the detectors, shift in instrument performance, or a condition potentially affecting measurement validity noted by the surveyor) the survey manager will direct the survey team to repeat the measurements.

4.4.3.3 Maintenance of Survey Records

Survey records will consist of a survey logbook, instrument calibration records, instrument qualification report datasheets, and gamma survey datasheets. Survey logbooks will be controlled and maintained in accordance with ETEC Procedure 6-04. They will be bound with numbered pages, and will be maintained throughout the duration of the survey. Pertinent notes and explanatory comments about the survey will be entered in the logbook. Written recommendations from the Health & Safety Officer will also be entered. The logbook will be controlled by the survey manager during the survey and assigned to the survey team during field activities. After completion of the survey and analysis the logbook will be returned to ETEC Document Management. A copy will be stored in the Area IV Radiological Characterization files in Building 100 in Area IV.

Records of calibrations of gamma detectors used for field measurements will be maintained in the files of the RP&HPS Radiation Instrumentation Services laboratory in Area IV Building 011, where the calibrations are performed.

The instrument qualification report and gamma survey datasheets will be used by the survey team to record data during field activities. They will be given to the survey manager when completed. After an initial review for data validity, the survey manager will place the datasheets in a working file. They will be used for entry of the data into a computer database for subsequent analysis and maintained for reference. After completion of analysis they will be placed in the Area IV Radiological Characterization files in Building 100 of Area IV.

4.5 WALK-ABOUT SURVEY OF NEAR-SURFACE GAMMA ACTIVITY

A walk-about survey of near-surface gamma activity will be conducted over the entire Area IV (except as described in Section 4.5.2.2) to detect any local concentrations of radioactivity. During this survey, the survey team will walk along east/west or north/south grid lines while sweeping a gamma detector over the surface and listening to the audible count rate indication to detect increases above background.

This section describes in general the plan and requirements for the walk-about survey. The detailed procedure is Reference 3-9.

4.5.1 Walk-about Survey Protocol Considerations

4.5.1.1 Applicable Walk-about Survey Guidelines

The walk-about survey will be done using one gamma detector mounted on a walk-about survey detector fixture. The fixture is a balanced boom which allows the surveyor to hold the detector near the ground surface while walking and sweeping it from side to side. The detector will be connected to a counter/scaler (with an audio speaker) carried by the surveyor. When an increase in the audible click rate is detected the surveyor will note the current traverse position (location and sweep phase) and leave the traverse line to walk in the direction of increasing activity. The locations of the peak of these gamma activities will then be identified and documented. The gamma activity at each peak-activity location will be measured by a 1-min count at the surface using the walk-about survey detector and at 1 m above the surface using the same equipment and method as for the ambient gamma survey (Section 4.4).

Walk-about survey data will be recorded as specified in Reference 3-9. The data will include documentation of the traverses made and the locations and magnitudes of local areas of elevated activity. The data for each traverse will be the survey block identification, northing distance at each end of the traverse, the approximate detector elevation (where obstacles require raising the detector above the surface), and the time to complete the traverse. Data for locations of elevated activity will include the coordinates of the peak location, surface gamma activity as recorded by the walk-about survey detector, and activity at 1 m above the surface, measured as in the ambient gamma survey.

4.5.1.2 Walk-about Survey Investigation Levels

Any detected increase in activity during a walk-about survey traverse will require that the surveyor proceed in the direction of increasing activity until the location of the maximum activity is found. The gamma activity will be measured at that location in the same manner as for the ambient gamma survey (Section 4.4). Investigation levels and follow-up investigations will be as described in Section 4.4.1.2.

4.5.1.3 Gamma Detector Count Rate Conversion Factor

Gamma survey instruments for the walk-about survey will be the same as used for the ambient gamma survey. The factor for converting detector counting rates to dose rates will be determined and verified periodically as described in Section 4.4.1.3.

4.5.2 Walk-about Survey Coverage

4.5.2.1 Traverse Parameters

During the walk-about survey the survey team will walk along east/west or north/south grid lines while listening for changes in meter click rates. The survey will be done by traversing grid lines to provide systematic coverage of the area within each survey block, with the block boundary coordinates established with tapes as described in Section 4.3.2. A traverse line spacing of 5 ft will be used to provide the necessary coverage.

The surveyor will walk along the traverse line, which centers the detector pivot point in the band being surveyed. During the traverse the detector will be swept from side to side (180 degrees) while being held as close to the ground as possible and ensuring that it does not hit either the ground or an above-ground obstacle (e.g., a rock or debris). In areas of thick weed cover the detector will be kept above the weeds unless it has been verified that no obstacles exist. The detector sweep rate will be approximately one 180 degree arc in 4 sec. Walking speed along the traverse line will be at a rate which places the detector sweep within 1 ft of each point on the surface. The walking speed will be approximately 1/4 - 1/2 ft/sec.

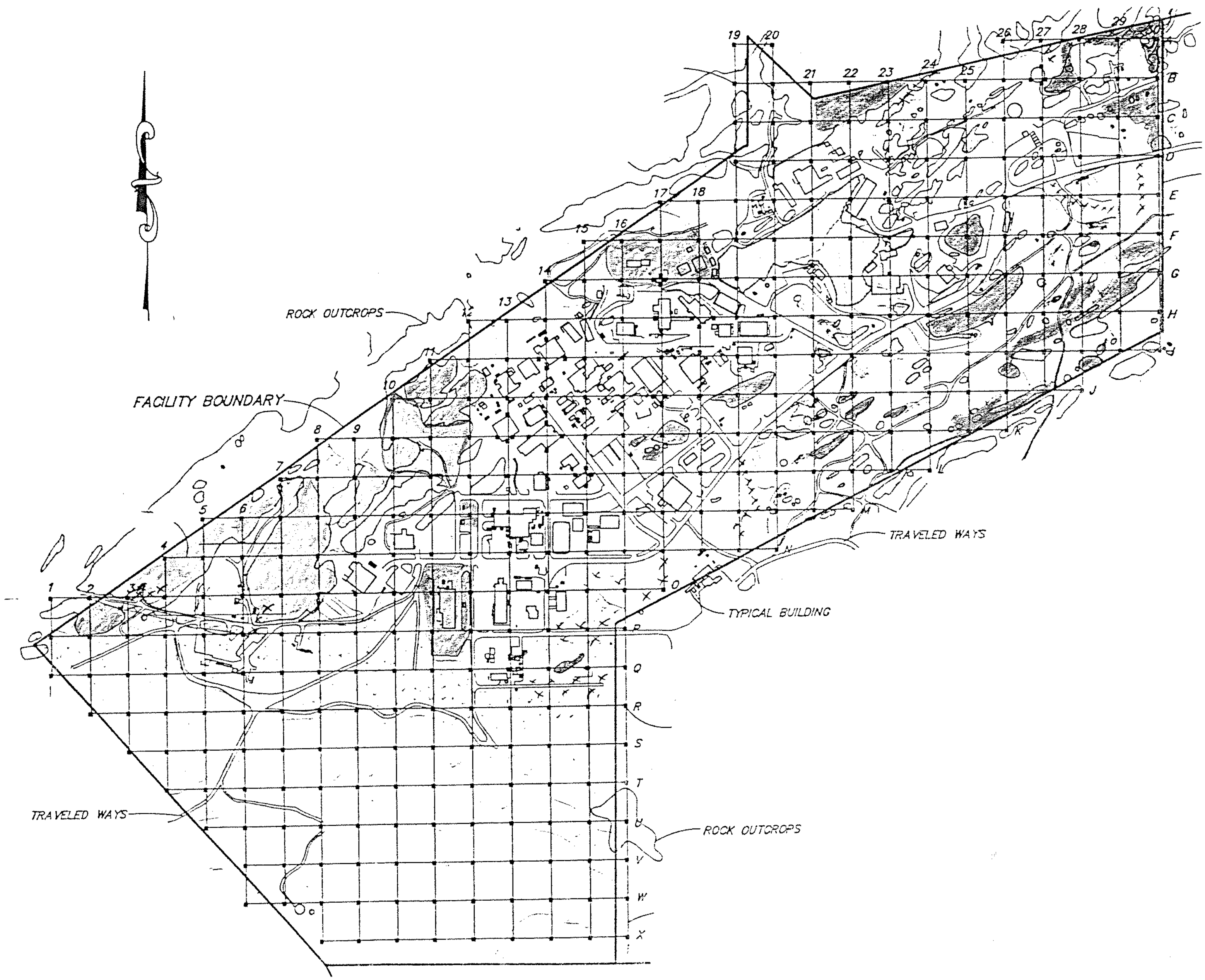
The walk-about survey of a survey block may be done by more than one surveyor operating at the same time. Each will perform in a coordinated manner the operations described here to provide complete coverage of the survey block. The survey manager is responsible for coordination of multiple surveyors to ensure complete and coordinated coverage of the surface.

The procedure for the walk-about survey shall include directions to provide equal coverage on both the left and right of the grid line at the start of a traverse.

4.5.2.2 Areas Excluded From the Walk-about Survey

The walk-about survey will cover all of Area IV except for areas occupied by major rock outcroppings or buildings and areas characterized (or to be characterized) by a D&D or remedial action program. Areas with dense vegetation and endangered or protected plant species are not excluded, but may require adaptation of the procedures. The areas excluded are shown in Figure 4-4.

Figure 4-4 Areas Excluded from the Walk-about Survey



4.5.3 Walk-about Survey Quality Management

4.5.3.1 Instrument Performance Integrity

The walk-about survey gamma measurement instrumentation will be supported by calibration and functional surveillance activities similar to those for the ambient gamma survey (Section 4.4.3.1). The only differences will be the use of only one detector instead of two, and a different detector positioning method because of the use of a different detector fixture.

4.5.3.2 Survey Data Integrity

Gamma measurements will be recorded and evaluated at locations of elevated activity as done in the ambient gamma survey. The integrity of this data will be provided by review as described in Section 4.4.3.2.

The integrity of detection of locations of elevated activity will be provided by training of the surveyors, and by the recorded traverse line endpoints and their times.

4.5.3.3 Maintenance of Survey Records

The handling of walk-about survey records will be the same as for the ambient gamma survey (Section 4.4.3.3), except for use of datasheets specific to the walk-about survey instead of the ambient survey.

4.6 SOIL SAMPLING

Soil samples will be collected at locations at which elevated gamma activity is detected in the ambient gamma survey (Section 4.4) or walk-about survey (Section 4.5), and at pre-specified locations (Sections 4.6.1 and 4.6.2). Table 4-1 presents a summary of the soil sampling. Sample collection, handling, and analysis will be as described in Section 4.6.3 for all locations.

Pre-specified sampling locations are defined in the following two types of areas.

1. Randomly selected locations for sampling radioactivity concentrations in subregions of Area IV. (Section 4.6.1)

2. Locations in screening areas which, on the basis of past activities, may be contaminated with radioactive materials. These include both purposefully and randomly selected locations. (Section 4.6.2)

4.6.1 Soil Survey Locations

4.6.1.1 Soil Survey Analysis Regions

For the soil survey, Area IV has been divided into regions having similar geology, terrain, and past use. All of the area within a region is thus expected to have the same radiological background. There are six of these regions, which are shown in Figure 4-5, the Area IV topographical map with

Table 4-1 Summary of Soil Samples

Region or Area		Number of Samples
Soil survey (11 samples in each of 6 regions)		66
Areas around the former Sodium Disposal Facility		28
Area of former trench	11	
South of road	10	
Ravines west of facility	5	
Ravine east of facility	2	
Natural drainage channels		56
SRE Pond	5	
Old Conservation Yard (north)	6	
Old Conservation Yard (south)	15	
17th Street	13	
Southeast	17	
Inactive sanitary leachfields (4 samples at each of 6 leachfields)		24
Areas around buildings		TBD(1)
Locations of elevated gamma activity		10(2)
Quality assurance samples(3)		30
Field duplicates	10	
Laboratory matrix spikes	10	
Decontamination rinseate samples	10	

Notes:

(1) The number of samples to be collected around buildings will be determined by review of past activities at the building, prior radiological surveys, and a visual inspection.

(2) The number of samples will be determined by the gamma survey results

(3) Quality assurance samples will be splits of regular samples (field duplicates) or regular samples designated for this use (laboratory matrix spikes), at a rate of 1 of each type for every batch of up to 20 regular samples. They require separate analysis but do not represent additional locations.

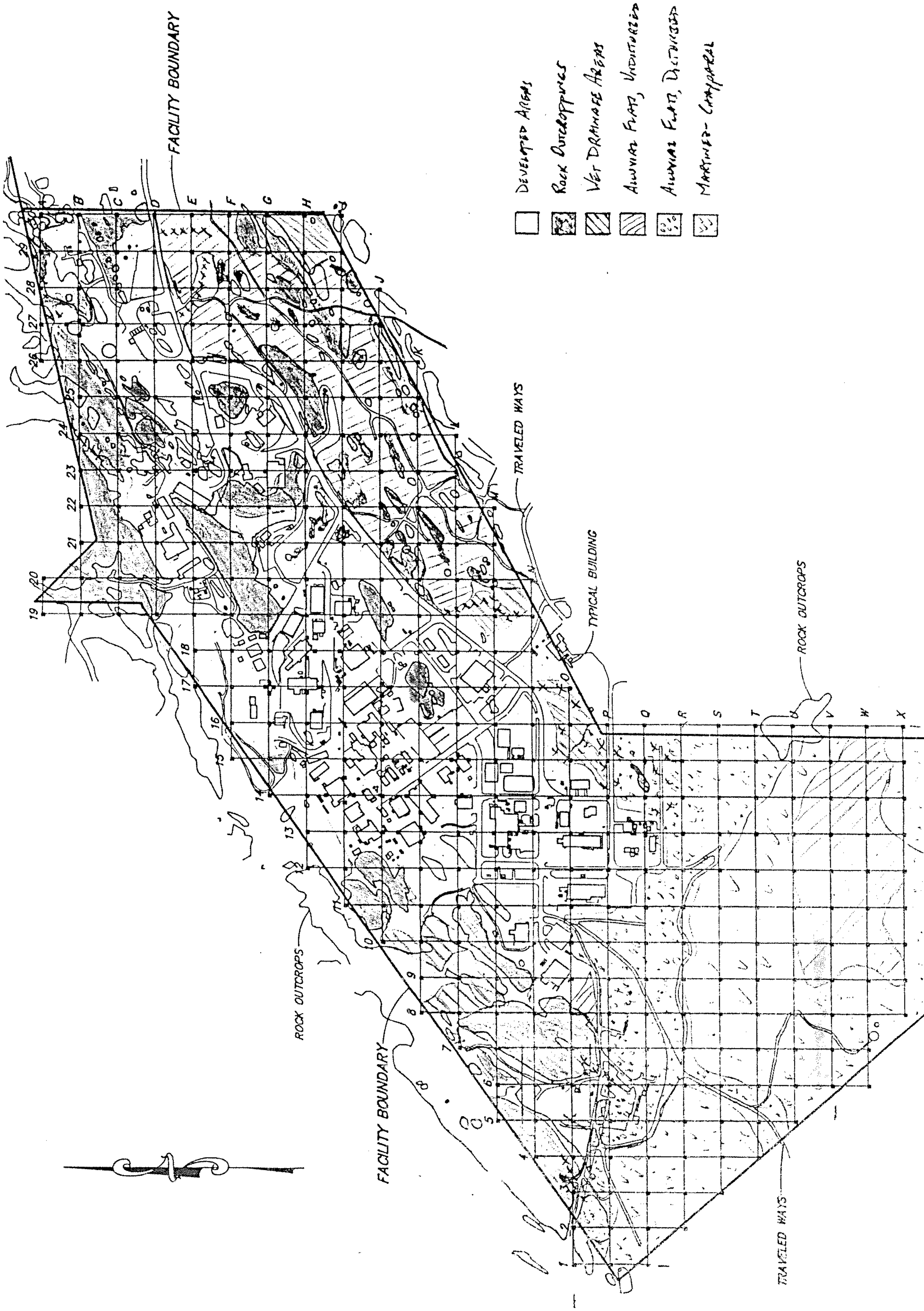


Figure 4-5 Soil Survey Analysis Regions

analysis region boundaries shown. Note that a region may include subregions which are not contiguous. The boundaries are included in the CAD-CAM file of the map, with more detail in that form than is possible in the figure. The detailed boundaries will be used in selecting sampling locations (Section 4.6.1.2). The regions are described below.

1. Developed Areas (Dv) - These areas are dominated by buildings and structures, and are mostly covered by Tarmac. There is a shallow cover of alluvium intermixed with imported construction dirt overlaying the Chatsworth Formation bedrock.

2. Rock Outcroppings (Rc) - Most of the area is rock outcroppings of Chatsworth Formation sandstone, with occasional oak woodland patches in the intermittent drainage courses.

3. Drainage Areas (Dr) - This consists of natural flats and catch basins in the water run-off paths where run-off soil can settle out. Thick riparian vegetation grows in wet soil pockets.

4. Alluvial Flats, Undisturbed (Au) - The topsoil has mostly been left undisturbed. There are some remnant stands of native grassland. Fallout isotopes are at or near the surface.

5. Alluvial Flats, Disturbed (Ad) - The topsoil has been turned by plow or earthmover. It is generally covered by invasive annual grasses. Fallout isotopes are mixed throughout the soil to the depth of the earth movement.

6. Martinez - Chaparral (Mch) - This is exposed Martinez Formation soil dominated by thickly wooded chaparral.

4.6.1.2 Soil Survey Sampling Locations

A set of 11 soil samples will be collected at randomly selected locations in each analysis region. The analysis for previous surveys at Area IV has shown that a minimum set of this size is necessary to support the planned statistical analysis (Section 7.1.2).

Sampling locations are selected as described in Appendix C. The coordinates for each region are listed in Appendix D, Table D-1. The chosen locations are the first eleven sets of coordinates from a list of randomly selected sets of coordinates which pass the following screens:

1. Is the location within the region and at least 10 ft from the region boundary? This screen eliminates randomly selected locations which are within the rectangle circumscribing the irregularly shaped region but are either outside the region itself or within a boundary zone in which it is assumed there is a transition from the composition of the adjacent region.

2. Is the location paved or occupied by a building or a surface rock? Such locations are excluded from the survey.

3. Would sampling at the location disturb endangered or protected plant species?

4. Has the location been verified by a field check to assure that there is not a reason for rejection that is evident only at the location?

Survey soil samples will be surface samples.

4.6.2 Screening Area Soil Sampling Locations

There are areas where, on the basis of the history of Area IV operations, no radioactive materials are expected to be located but where they could be present. These areas are defined as screening areas for soil sampling to verify the absence of non-natural radioactive materials. There are four sets of screening areas: areas around the former Sodium Disposal Facility, natural drainage channels, inactive sanitary leachfields, and areas around buildings in which radioactive materials have been used. The areas are shown in Figure 4-6. They are described and their soil sampling locations are specified in the following subsections.

4.6.2.1 Areas Around Former Sodium Disposal Facility

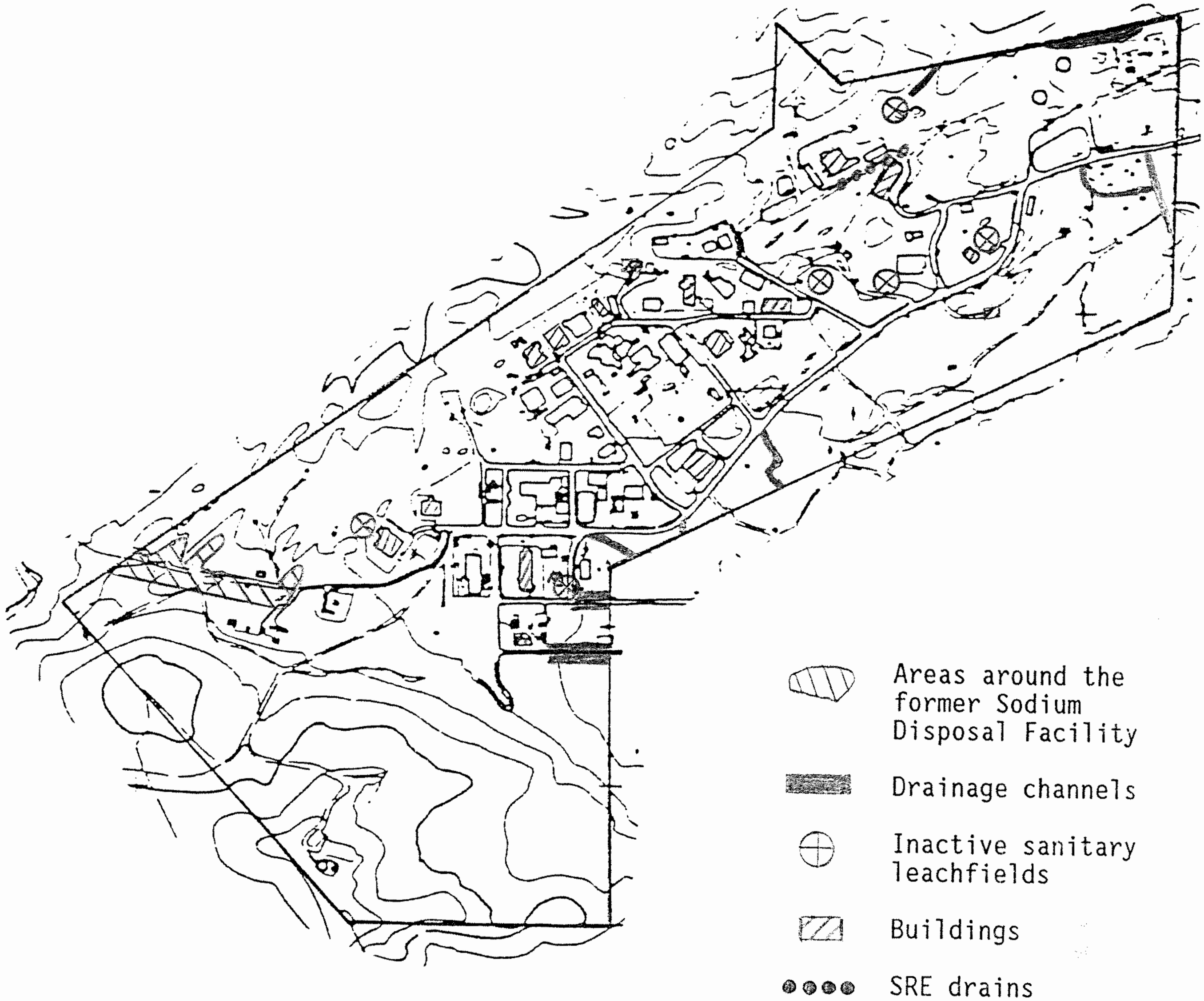
The former Sodium Disposal Facility (SDF) and the region immediately surrounding it have been decontaminated in a separate program; however, areas surrounding the region covered by that program are to be screened for radiological contamination as part of this plan. The surrounding areas were sometimes used as temporary storage areas. There is also evidence of use of a former trench south of the SDF for disposal. To determine whether radioactive contamination exists in the areas surrounding the SDF decontamination region, they will be investigated by soil sampling and a geophysical survey. The geophysical survey to detect any subterranean debris is a subcontracted activity (Ref. 3-3).

The areas to be sampled are ravines to the east and west of the facility, and the area along the road south of the facility (particularly the area in which the former trench was located). The areas and sampling locations are given in Appendix D. The sampling locations and depths were selected on the following bases.

1. Sample at 11 randomly selected locations in the area of the former trench, which was about 20 ft wide and 150 ft long. It was roughly parallel to the road at a distance of no more than 5 ft. The sampling locations have been selected as described in Appendix C, using a sampled area 20 ft wide by 150 ft long with its north boundary 5 ft from the road.

   Sampling depth will be the minimum of 3 ft below the surface, bedrock, or the depth of a debris layer, if such a layer exists to indicate the former bottom of the pit. A trench dug along the road as part of the SDF cleanup program showed that the bedrock depth in the area varies between 2-1/2 and 12 ft. It is likely that the trench depth was no more than the shallowest bedrock, so deeper sampling is not expected to be needed to reach buried debris.

Figure 4-6 Locations of Screening Areas



The sampling plan will be reviewed after the geophysical survey. If subterranean debris is found by the survey, additional or modified sampling may be done.

2. Sample at approximately 100-ft increments along the road, both 5 ft and 50 ft south of the road. Sampling will be at the surface. The soil in much of this area has been disturbed by grading to establish a staging area for cleanup of the SDF. Surface contamination (e.g., fallout) would be diluted by soil mixing or relocated by soil displacement; however, surface samples will be as representative of soil contamination levels as subsurface samples.

3. Sample at the road and at 50 ft and 100 ft north of the road in ravines and open areas east and west of the SDF. Sampling will be at the surface. (The area has not been disturbed.)

4.6.2.2 Natural Drainage Channels

The watersheds of natural drainage channels will be screened for sources of radioactivity by sampling for accumulations of radioactive materials along the channels. The channels will be sampled at the surface (unless otherwise noted below) at approximately 50 ft intervals from the edge of the developed area (where the natural channel begins) to the boundary of Area IV or until a set of eleven locations has been sampled. The sets of samples for channels which will have fewer than 11 samples will be combined with similar drainage channel sets to provide sets of at least 11 samples for statistical analysis.

The exact sample locations will be chosen in the field in order to select the part of the channel where sediment accumulation is most likely. The coordinates of the locations sampled will be determined either by using tapes defining a sampling block (Section 4.3.2) or by an alternate method (Section 4.3.3). The channels and special considerations, if any, for their sampling are identified below. Approximate sampling locations are given in Appendix D. Exact sampling locations will be chosen in the field by walking the channels in the vicinity of these locations to identify locations likely to accumulate sediment and debris.

1. SRE Pond drainage channel.

2. Old Conservation Yard (north) drainage channel. This area is at the beginning of flowpaths down the slope from SSFL. Runoff has not yet consolidated into well-defined channels. The sample locations specified have been chosen to be representative of the runoff in this direction from the Old Conservation Yard.

3. Old Conservation Yard (south) drainage channel. Two channels flow south from the Old Conservation Yard and join as they leave Area IV. The combined channel, which returns to Area IV for a short distance, will not be sampled unless necessary to follow radioactivity contamination in the planned samples.

4. 17th Street drainage channel. In addition to sampling in the main channel, low areas where runoff can be held up will also be sampled. Samples will be collected in the low areas to detect any buildup of

radioactive materials that could have occurred as a result of occasional standing water. Samples at the low-area locations will be sampled at a depth of 3 ft as well as at the surface.

5. Southeast drainage channels.

4.6.2.3 Inactive Sanitary Leachfields

Inactive sanitary leachfields which served facilities containing radioactive materials before installation of the current sanitary sewage collection system, will be screened to determine whether radioactive materials were released into the leachfields. The leachfields involved are those which served Buildings 003/SRE, 009, 030, 064, 093, and 373. (Building 020 and the RMDF also contained radioactive materials while served by their leachfields; however, they are covered by the D&D program.)

Approximate locations of the leachfields are shown in Figure 4-6. More detailed locations are shown in Figures D-8 and D-9, which are sections of the Reference 3-12 and 3-13 drawings. The exact locations will be determined either by probing to detect the leachfield piping using a rod or, if that is not effective, by a geophysical survey. The surface coordinates above the piping and the depth of the piping will be determined to the extent necessary to define the sample locations and depths.

Soil samples will be collected at a depth of six inches below the leachfield piping at four locations in each leachfield as shown in Figures D-8 and D-9: immediately downstream of the distribution box (i.e., center of the upstream end of the leachfield); 50 ft downstream along the center of the leachfield; and inside the outermost transverse piping on both sides of the upstream end of the leachfield. The coordinates of these locations are listed in Appendix D. Selection of the locations and depth was based on providing coverage of the leachfield at multiple locations to provide representative readings, and by the distribution of radioactivity following a release into the RMDF leachfield (Ref. 3-14). In that case, the reactivity concentration was highest at the central upstream location specified in this plan. The four locations per leachfield will be combined to provide a set of sufficient size for statistical comparison to background.

4.6.2.4 Areas Surrounding Buildings

The areas around buildings in which activities have involved radioactive materials will be screened for the presence of radioactive contamination. The screening has two parts. The first part is reviewing records of previous activities at each building (including D&D) and surveying the building for likely locations at which contamination might have occurred. The second part is sampling at locations selected on the basis of the review and survey. The coordinates of the sampling locations are listed in Appendix D.

4.6.2.5 SRE Drains

The SRE facility is served by buried sewer and storm drains. Sludge in these drains was sampled at accessible locations as part of the SRE post remedial action survey (Ref. 3-15). This plan supplements that sampling by removing sections of the drains at intermediate locations to allow sampling of the sludge in the interior straight runs of the drains. Sampling of the straight runs was recommended by the team which performed the referenced survey because of their belief that contaminant concentrations could be higher there than at the entry and exit points.

Figure 4-7 shows the locations of the drains, previous sampling locations, and locations to be sampled as part of this plan. Sludge will be sampled in one section of each drain. Sampling locations are indicated in Figure 4-7. They are midway between accessible locations sampled previously and will be representative of the straight runs of the pipe. The sanitary sewer location, adjacent to Building 163, was chosen to be as far downstream as possible before the drain passes under that building. The storm sewer location was chosen to be centered between the accessible locations at the entry and exit points of the drain (Figure 4-7).

Access to the piping interior for sampling will be obtained by removing sections of pipe. Asphalt paving removal, soil excavation, pipe removal, and restoration will be necessary. A sample of sludge will be collected from each drain. The samples will be identified, handled, and analyzed in the same manner as soil samples in this plan (Sections 4.6.3.1.1 and 4.6.3.1.2).

After exposure of the pipes, they and the soil around them will be examined for evidence of leakage. If any area of leakage is found, a soil sample will be collected at the location of greatest apparent leakage. The samples will be identified, handled, and analyzed in the same manner as other soil samples in this plan (Sections 4.6.3.1.1 and 4.6.3.1.2).

4.6.3 Soil Sampling Method

4.6.3.1 General

Soil samples will be collected at the specified locations and depths in accordance with the procedure (Ref. 3-16) based on this document, which states the considerations which must be applied to soil sampling. Rinse water samples will also be collected as quality assurance samples supporting the soil sampling program by documenting that there is no carryover of contamination between samples. This section addresses considerations which apply to all sampling: sealing the sample in the sample container (sample identification and origination record keeping, and sample handling), sampling equipment decontamination, quality assurance samples, and field actions in case of a measured high gamma activity.

4.6.3.1.1 Sample Identification and Origination Record Keeping

Each sample will be assigned a consecutive project sample identification number when it is collected. The number will have the form A4CM-YY-XXXX, where A4CM is the documentation code for the Area IV characterization project,

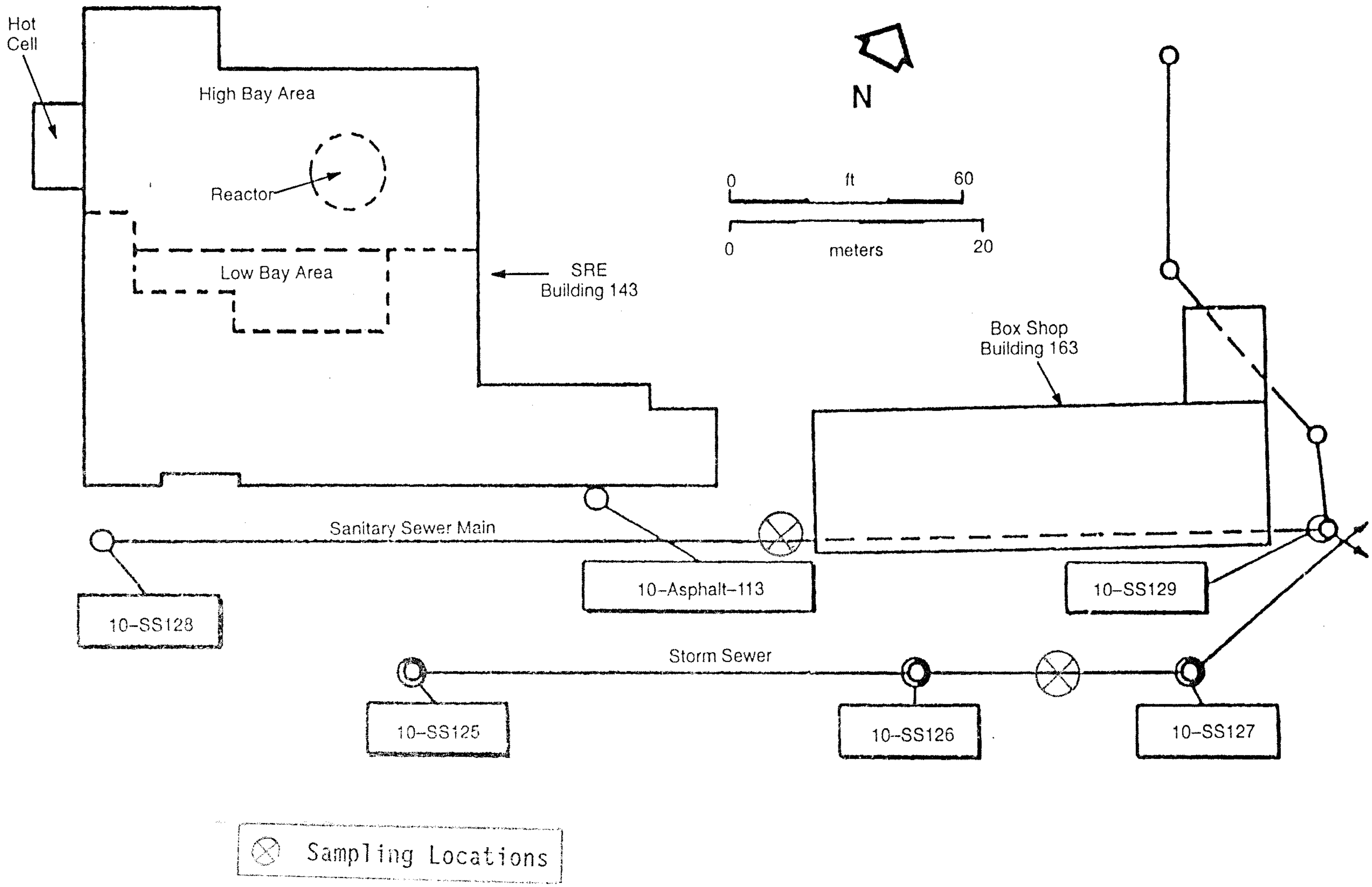


Figure 4-7 SRE Drain Sampling

YY is the year, and XXXX is the next in a series of 4-digit numbers. The number will be recorded on the sample container label and in the Sampling Logbook.

Sample collection data will be recorded in the Sampling Logbook. The data entry will include the sample identification number, sampling location coordinates, sampling depth, type of sample (regular, field duplicate, matrix spike, or equipment rinseate), date and time of collection, names of the collector and others on the sampling team, and notes about the sampling which might be useful in evaluation of the data (e.g., weather). A preprinted label will be completed and affixed to the sample container. The completed label will include the project sample identification number, name of the collector, and date of collection. Additional information may be included only if it cannot be used to identify which samples are quality assurance samples. (Thus, sample location and time of collection cannot be included.) The label will then be affixed to the side of the sample container in such a fashion that the lid cannot be removed without tearing the label. The sample container will be sealed in a new plastic bag.

A Chain-of-Custody Record form (to be provided by the analytical laboratory which will perform the sample analyses, but to be included in the soil sampling procedure, Reference 3-16) will be completed for each sample. The information on the form must include the project sample identification number, sample collection date, name of sample collector, analyses requested, and the required analysis turnaround time. Additional information may be included only if it cannot be used to identify which samples are quality assurance samples. The analysis specified for all samples will be as discussed in Section 5.0. The completed form will be attached to the outside of the plastic bag containing the sample container.

4.6.3.1.2 Sample Handling

Documented samples will be transported from the field to the analytical laboratory in a series of steps described in this section. During this process the sample will always be in the custody of an identified individual. Custodial responsibility will be controlled using the Chain-of-Custody Record form. The initial responsibility rests with the sample collector, who initiates the form by entering the initial information and signing to accept initial custody responsibility. Each transfer of responsibility will be documented on the form. The new custodian will sign the form to accept responsibility and will enter the date and time of receipt. The previous custodian will enter the date and time of the transfer to complete his/her period of responsibility.

1. Each sample will be placed in a field sample transport container after completion of the initial documentation as described in Section 4.6.3.1.1. The container and its samples will remain in the personal custody of the sample collector during each period of field sampling or until formal transfer of custody to the sample custodian or another member of the sampling team.

2. The field sample transport container will be taken to the Sample Collection Center and formally transferred to the sample custodian by signoff of Chain-of-Custody forms. The Sample Collection Center is

the designated location for processing samples for shipment to the analytical laboratory and for control of samples pending shipment. The location of the Sample Collection Center will be specified in the soil sampling procedure (Ref. 3-16). Sample Collection Center activities are summarized below and are specified in detail by desk instructions issued by internal letter. The initial release of the desk instructions is included as Appendix E of this plan. The sample custodian is the person responsible for operation of the Sample Collection Center and has formal control of samples while they are in the center.

The transfers may be made at any time of the day, but must be made before a time when the samples cannot be in the personal custody of the sample collector or another member of the survey team to whom transfer has been documented on the Chain-of-Custody Record form. Transfer must be made before the end of the day to allow sample storage in a locked, secure location overnight.

3. The sample custodian will record newly received samples in the Sample Control Logbook, which will be maintained for tracking samples and maintaining a record of sample status and Sample Collection Center inventory. The data will be entered in order of receipt and will include the project sample identification number, and date and time of receipt. The sample custodian will prepare the samples for shipment to the analytical laboratory by placing them in a shipping container and preparing the shipment paperwork, or will store them in a locked, secure location. Samples in the Sample Collection Center (including those prepared for and awaiting shipment) must be in either the personal custody of the sample custodian or in a locked, secure location. Activities in the Sample Collection Center will be performed in accordance with the written desk instructions.

4. Samples will be shipped to the analytical laboratory in batches of 20. There is no holding time limitation for any of the specified analyses, so samples may be held until a full batch is accumulated. Samples need not be shipped in the order they are collected and a batch smaller than 20 samples may be shipped; however, each batch must include one each of the quality assurance soil samples. Deviations from first-in, first-out and full batches may be prompted by interest in prompt analysis of particular samples. The sampling manager will specify the samples to include in each batch and authorize their shipment.

   Custody of samples will be transferred to the shipper receiving the shipment at the time of pickup of a shipping container. Entries on the Chain-of-Custody Record form will document the transfer. The sample custodian will record the shipment of each sample in the Sample Control Logbook by entering the time and date of shipment and the shipper number.

5. Receipt of analysis results or a returned sample will be recorded in the Sample Control Logbook by entering the time and date of receipt and the transmittal number. Returned samples will be stored in the

locked, secure location until authorization is given for shipment for reanalysis, archiving, or disposal.

4.6.3.1.3 Sampling Equipment Decontamination

Sampling equipment will be thoroughly cleaned after the collection of each sample to prevent cross-contamination between samples. Unless reused immediately, cleaned equipment will be stored to maintain cleanliness until the next use.

Sampling equipment decontamination rinse water will be sampled once per batch of 20 samples for analysis to document that no significant contamination carryover has occurred. Rinseate samples will be identified and handled in the same manner as soil samples (Sections 4.6.3.1.1 and 4.6.3.1.2).

Materials used for cleaning will be collected and handled as potentially radioactive waste. Disposal will follow normal Rocketdyne procedures.

4.6.3.1.4 Field Response to High Measured Gamma Activity

The gamma radiation level will be measured at each sampling location prior to collecting the sample. It is not expected that these levels will be significantly above the levels from naturally occurring radioisotopes and fallout. Background varies with location, but is expected to be about 15 μR/hr, or 3200 cpm (Section 4.4.1.2).

Locations having gamma count rates in the expected range and at somewhat higher levels may be sampled with no further review; however, there are radiation levels which would warrant review of the situation and consideration of a revised procedure. The limiting gamma activity which would trigger such a review has been established as 100 μR/hr, or about 21,500 cpm. This provides a margin of a factor of 5 below the Department of Transportation 1/2 mr/hr limit for "limited quantity" shipments, which would be exempt from "specification packaging and labeling" to indicate radioactive contents. It is also a factor of 5 above the maximum normal count rate discussed in the preceding paragraph. Thus, expected variations of background would not approach the limit. Gamma count rates equivalent to 100 μR/hr would indicate the presence of radioactive contamination such that the situation should be reviewed before proceeding.

In cases where the measured gamma level at a sampling location is less than 100 μR/hr the sample will be collected, processed, and handled as described in this plan. If the gamma level is 100 μR/hr or greater, the sample will be collected and transferred to Building 100, where a gamma scan will be done. The isotope concentrations of the sample, gamma levels in the region surrounding the sample location, and geomorphological factors will be evaluated by the RP&HPS manager. Followup characterization activities will be determined by the sampling manager and the RP&HPS manager.

4.6.3.2 Soil Sample Collection

Soil samples will be surface or subsurface samples. The methods for removing the samples differ for the two types, but the following aspects of the method will be common.

1. For each field sampling operation the sampling manager will specify the locations (coordinates and depth) for collection of samples in a given time period and the order of their collection. The sampling team will proceed with the required sampling equipment and supplies to these locations in the order specified. The order of sampling cannot be established in advance because gamma-survey-determined locations will be inserted as the characterization progresses.

2. The gamma radiation dose rate at the surface will be measured prior to sampling (unless an ambient gamma survey measurement has been made at the location).

3. Samples will be collected as described in Sections 4.6.3.1.1 and 4.6.3.1.2, and placed in a clean container. At each location a sample for tritium analysis will be placed in an amber glass container, and a sample for the other analyses will be placed in a plastic container. The collection procedure must prevent contamination of the container with extraneous dust and soil.

4. After completion of sample collection, the in-soil gamma activity will be measured by lowering a gamma detector into the hole, as described in Section 4.7.

4.6.3.2.1 Surface Soil Sampling

Surface soil samples are those collected from the first 6 in. of soil. Prior to removing soil the surface will be cleared of debris. A plug of soil will be removed using a stainless steel or teflon tool. The diameter of the plug will be chosen to provide the sample volume specified by the analytical laboratory. The volume will be included in the soil sampling procedure (Ref. 3-16). The sides of the plug must be vertical to ensure that equal volumes of soil are collected over the entire 6-in. depth.

4.6.3.2.2 Subsurface Soil Sampling

Subsurface samples are those collected at depths below the first 6 in. of soil. To obtain these samples the material overlying the elevation to be sampled will be removed using a tool appropriate to the desired depth and location (e.g., stainless steel trowel for shallow samples or power auger for depths of several feet). The following criteria will be applied.

1. Field measurements will be made of removed soil. It will be scanned for gamma radioactivity and, as a personnel safety precaution, for volatile organic compounds. The results of the measurements will be recorded in a datasheet or the logbook.

2. At the desired depth a 6-in.-depth sample of the volume specified will be collected.

3. Precautions will be followed during the sampling procedure to ensure that the sample is not contaminated by soil from other depths.

4.6.4 Soil Sampling Quality Management

Quality control of soil samples will be provided by application of procedures (Ref. 3-16) based on the criteria of this plan. These provide uniform sampling, documentation of information pertinent to description of the sample and evaluation of the results of its analysis, decontamination of sampling equipment to prevent contamination transfer, and control of samples after collection.

Data quality needs were specified in Reference 3-1 by defining the required precision, accuracy, representativeness, completeness, and comparability (PARCC) data quality indicators. These indicators will be applied as described below.

1. Precision of soil sample analysis will be assessed by comparison of the results for pairs of field duplicate samples and pairs of matrix spike and matrix spike duplicate samples. The results will be used to evaluate the uncertainties to be assigned to the measured concentrations.

2. Accuracy of soil sample analysis results will be assessed by review of the percent recovery for the matrix spike samples. Measured soil concentrations (or their uncertainty) will be adjusted in accordance with the percent recovery to account for matrix interference effects.

3. Representativeness will be provided by sampling at enough locations to provide evaluation data set sizes sufficient for statistical analysis. The smallest data set for which analysis is planned is the eleven-sample set for a single analysis region.

4. Completeness will be provided by ensuring that the data are valid for at least 90% of the planned measurement locations within each data set. Measurements at locations of questionable or invalid data will be repeated if necessary to provide this quality. Data sets containing less than 100% of the planned measurements will be reviewed to ensure that the data set is still representative.

5. Comparability of the measurements will be provided by use of established procedures to assure sampling consistency, maintenance of detailed records of field activities, and application of standard analysis protocols and laboratory quality assurance practices.

4.6.4.1 Quality Assurance Samples

Verification of the quality of soil sample analysis data will be provided by collection and analysis of quality assurance samples. The types of quality assurance samples are described below. One of each type will be collected in each set of up to 20 regular soil samples. Each will be associated with a regular sample selected at random from those in the set. The positions of quality assurance samples in the sequence of samples have been selected for the anticipated number of sets to be collected. The positions are tabulated in Appendix F. The sampling manager will use these sets of positions in the order listed to specify the regular samples with which quality assurance samples will be associated in each set to be collected. Each batch of up to 20 soil samples sent for analysis will include one of each of the quality assurance soil samples. Quality assurance water samples (equipment decontamination rinseate samples) will be accumulated to provide a batch for analysis.

1. Field duplicate sample. A field duplicate (or split) sample is an aliquot of a field sample taken from the same container as the primary field sample and analyzed as a separate sample. Soil will be collected, placed into a container, mixed to provide a homogeneous sample, and split into two separate samples. One sample will be identified as the primary field sample and one as the blind duplicate sample. The two samples will thereafter be separate samples identified, handled, and analyzed separately. The field duplicate sample is included to provide a measure of the variability of the analysis process. Since this purpose is satisfied as well by the more easily collected surface samples, field duplicate samples will all be surface samples unless they are for a sample set containing only subsurface samples.

2. Matrix spike/matrix spike duplicate sample. A matrix spike/matrix spike duplicate sample is a regular sample specified for this quality assurance function. After routine analysis of an aliquot of the sample the laboratory will perform matrix spike and matrix spike duplicate analyses. The matrix spike is an aliquot of the sample to which a known amount of the subject radionuclide (or a surrogate) is added by the laboratory and a routine analysis performed on the aliquot. The matrix spike duplicate is a second aliquot which is spiked and analyzed separately. The results of the spiked aliquot analyses are expressed in terms of percent recovery of the radionuclide (or surrogate) added. The results of the duplicate analyses are expressed in relative percent difference from the result for the original spiked aliquot. The percent recovery is an indicator of accuracy of the measured concentrations, while the relative percent difference provides a measure of the precision of the analysis process.

3. Equipment rinseate sample. An equipment rinse water sample will be collected after decontamination for one sample in each batch of up to 20 soil samples. After sampling equipment decontamination, deionized water will be poured over the equipment and collected for analysis. Analysis will be for the same constituents as for soil samples: gamma-emitting isotopes, Sr-90, tritium, and isotopes of thorium, uranium, and plutonium.

4.6.4.2 Maintenance of Sampling Records

Sampling records will consist of a sampling logbook, sample chain-of-custody forms, and laboratory analysis records. Survey logbooks will be controlled and maintained in accordance with ETEC Procedure 6-04. They will be bound with numbered pages, and will be maintained throughout the duration of sampling field activities. Pertinent notes and explanatory comments about the samples and the conditions of their collection will be entered in the logbook. Written recommendations from the Health & Safety Officer will also be entered into the logbook. The logbook will be controlled by the sampling manager during the period of sampling activities, and assigned to the sampling team during field activities. After completion of sampling and analysis requiring the logbook it will be returned to ETEC Document Management. A copy will be stored in the Area IV Radiological Characterization files in Building 100 in Area IV.

Chain-of-custody forms will accompany the samples throughout their analysis, post-analysis storage, and reanalysis, if any. A file of copies of chain of custody forms will be maintained in the Sample Collection Center for all samples received from the field until the sample final disposition. The chain-of-custody forms received from the laboratory as part of the analysis results package will be stored in the Area IV Radiological Characterization files in Building 100 in Area IV.

An analysis report will be received from the laboratory for each batch of samples analyzed. After review to ensure data validity the report will be stored in the Area IV Radiological Characterization files in Building 100 in Area IV.

4.7 IN-SOIL RADIATION MEASUREMENTS

Gamma activity in the soil will be measured at each soil sampling location. These measurements will provide gamma activity levels directly related to the radioisotope concentrations being determined at the same location by analysis of the soil sample. This allows confirmation that the radioisotopes present in the soil are correctly defined.

Gamma activities will be measured with the same gamma detectors and associated counters/scalers used for the ambient gamma and walk-about surveys (Section 4.4 and 4.5). The detector will be inserted into the hole far enough to ensure that the solid angle of detector exposure to air is small, so that the measurement is dominated by soil gamma activity. Data recorded will include the measurement location (survey block identification, coordinates, and depth), count rates, time and date of the measurement, name of the person making the measurement, and any comments concerning the measurement which might aid in evaluation of the data.

The in-soil radiation measurement instrumentation will be supported by calibration and functional surveillance activities similar to those for the ambient gamma survey (Section 4.4.3.1).

Handling of in-soil radiation measurement records will be the same as for those of the ambient gamma survey (Section 4.4.3.3).

4.8 WATER SAMPLING

Water in the SRE Pond will be sampled in accordance with the procedure (Ref. 3-17) based on this document, which states the considerations which must be applied to water sampling. The SRE Pond is one of two bodies of year-round standing water in Area IV. The other body, the Building 056 Pit, is not within the scope of this plan since it is covered by a related activity, the Remedial Action Program.

4.8.1 Sample Collection

Water samples will be collected from two locations in the SRE Pond. Two samples will provide adequate representation of the pond because of its small volume. The locations will be selected in the field on the basis of the water extent at the time of sampling, sampling in different areas of the pond, and accessibility. The coordinates of the locations will be determined using a method described in Section 4.3.2 or 4.3.3. The coordinates will be measured to the nearest foot if possible under the circumstances. The estimated uncertainty in the coordinates will be recorded.

The samples will be near-surface water collected as grab samples. The sample container will be submerged in the water, then removed and capped. Sampling will be done in a manner to avoid inclusion of non-typical surface debris or surface film. Containers will be handled to avoid stirring up sediment in order to prevent contaminating the sample with bottom solids. If the water depth is too shallow for collection directly in the sampling container or if the presence of a preservative in the sample container makes direct sampling impractical, a secondary container (beaker, flask, or other transfer device) will be used to transfer water to the sample container.

Water samples for tritium analysis will be collected in amber glass containers containing no preservative. Water samples for other analyses will be collected in plastic containers containing 1N HNO_3 to bring the sample pH to less than 2.

Sample identification and origination data, sample handling, and sampling equipment decontamination will be the same as for soil samples (Sections 4.6.3.1.1, 4.6.3.1.2, and 4.6.3.1.3, respectively).

4.8.2 Quality Assurance Samples

Water sampling will be supported by collection of quality assurance samples for analysis. Since there are few water samples to be collected, the number of quality assurance samples will be few. One sample will be designated a matrix spike/matrix spike duplicate sample. Field blank samples and, if applicable (if sampling equipment is used rather than collecting the sample directly in the sample container), an equipment rinseate sample will be collected. There will be no field duplicate samples.

A field blank sample is a field-prepared sample of deionized water taken to the sampling location. Two such samples will be prepared. One sample will be deionized water poured into an amber glass container (for tritium analysis). The other sample will be deionized water poured into a plastic bottle (for gamma scan and radioisotopic concentration analysis). The samples will be collected, identified, documented, handled, and analyzed the same as the pond water samples. Field blank samples are included to provide a measure of error associated with the field environment, containers, cross-contamination, and laboratory analysis.

An equipment rinseate sample is a sample of the deionized water rinse at the end of the sampling equipment decontamination process. One such sample will be collected in a plastic bottle after the final decontamination of any sampling equipment used for collecting pond water samples. Analysis by gamma scan and for isotopic composition will be specified. The equipment rinseate sample will be collected after completion of the last decontamination in the water sampling activity. The rinseate sample is included to verify satisfactory decontamination for prevention of cross-contamination of samples. The use of only one sample (no sample for tritium analysis) is sufficient to verify the absence of cross-contamination.

5.0 SAMPLE ANALYSIS

The samples of soil, water, and sludge collected as described in Sections 4.6 and 4.8 will be analyzed by a contracted radiochemistry laboratory. The statement of work for this analysis is included for information as Appendix G of this plan.

6.0 DATA MANAGEMENT

Data management for the Area IV characterization program is control of documents, correspondence, field data, and a database of radiation measurements and sample radionuclide concentrations. Documentation will include plans, procedures, validation reports, data evaluation reports, and progress reports. All technical correspondence related to the program will be included. Field data will be log books, datasheets, and sample change-of-custody forms. The database will provide a systematic approach to managing the large quantity of data that will be generated. It will be the means for recording, storing, and retrieving the data for performing data analysis and generating reports.

Records will be maintained throughout the duration of the project and following its completion to retain a verifiable, traceable means of demonstrating the quality, robustness, and completeness of the characterization survey. The records will be maintained as listed below.

1. Quarterly instrument calibration records will be maintained by the group performing the calibrations, RP&HPS Radiation Instrumentation Services laboratory in Building 011 in Area IV.

2. Daily instrument performance check datasheets will be maintained in the Area IV Characterization file in Building 100 in Area IV.

3. Field survey and sampling logbooks will be returned to ETEC Document Management. Copies will be maintained in the Area IV Characterization file in Building 100.

4. Field datasheets will be maintained in the Area IV Characterization file in Building 100. The data (after transcription to a computer spreadsheet) will be maintained in electronic form at Building 100 in Area IV during the program. The data spreadsheets will be maintained on hard disks. Backup copies will be maintained on floppy disks.

5. Cumulative probability plots for sets of gamma measurement data and soil sample data will be maintained in the Area IV Characterization file in Building 100. The plots will be stored electronically at Building 100 on hard disk and backed up on floppy disks during the program.

6. The chain-of-custody forms for samples will be maintained in the Area IV Characterization file in Building 100.

7. Sample analysis reports transmitted by the analytical laboratory will be maintained in the Area IV Characterization file in Building 100.

8. Documents to report the results of the characterization program will be released by ETEC Engineering in conformance with ETEC Procedure 2-13, ETEC Document Release. Documents released using this procedure are maintained by ETEC Document Management in Building 038 in Area IV. These documents are specified in the Area IV Characterization Program Management Plan (Ref. 3-7).

7.0 DATA EVALUATION

7.1 EVALUATION APPROACH

A large quantity of gamma radiation and soil isotope concentration data will be gathered in this characterization program. It will be evaluated and organized as described in this section so that it may be presented in a simple, understandable manner. The principal means of presentation will be graphical. The following sections describe the evaluation approach and its application for the different types of data to be obtained.

Data will be validated to ensure it appropriately reflects the Area IV characteristics being measured. Sets of validated data will be evaluated using statistical analyses to verify that all samples in a set represent the same population, to determine whether a set is statistically different from background, and, if different, to compare the set with regulatory limits. Measurements collected from a uniformly distributed population having only random variability, will have a normal distribution with a mean (average) which estimates the nominal value of the uniform distribution, and a standard deviation which reflects the magnitude of the random variability. Data analysis will be based on the data having a normal distribution, with verification of this assumption included in the data review.

7.1.1 Data Validation

Data obtained from field activities and laboratory analyses will be reviewed in a validation process. The process will provide systematic inspection of the data for procedural and instrument errors and confirmation of expected findings. The resulting validated data will be the Area IV characterization database for use in data evaluation.

Two types of data will be generated by the characterization activities: sets of radiation measurements and sets of radionuclide concentrations. The validation of these data is described in Sections 7.1.1.1 and 7.1.1.2.

7.1.1.1 Radiation Measurements Validation

Radiation measurements will result in sets of radiation level data for defined areas. These will be reviewed by the survey manager after completion of measurements in an area to verify the validity of the data, although the data will also be reviewed as it is being collected, as part of the field activities. The validation procedure will include the following:

1. Collection and review of datasheets for completeness and for field notes which require followup activities.

2. Verification that instrument calibration was current.

3. Review of instrument functional performance check data, including analysis of distribution of both the data collected during measurements being validated and that collected to date, to ensure that no performance shifts or drift has occurred.

4. Examination of the data to confirm that the findings are reasonable and that results of the ambient gamma survey and walk-about survey are consistent.

5. Review of times recorded for walk-about survey traverses for consistency with rates which provide adequate sensitivity.

6. Identification of data that is anomalous or suspect, and which might require a followup investigation.

7. Verification that the data satisfies the PARCC criteria stated in Section 4.4.3.

7.1.1.2 Laboratory Analysis Data Validation

Sample collection and analysis will generate sets of radionuclide concentrations for samples collected in a defined area. Validation of these data will be for each batch of samples sent to the laboratory, although documentation will be collected by cell (or group of partial cells). The validation procedure will be performed by RP&HPS or ETEC Engineering and include the following:

1. Collection and review of field datasheets for completeness and clarity, and for field notes requiring followup.

2. Review of laboratory analysis report for completeness and conformance to the laboratory request.

3. Review of chain-of-custody form for continuity.

4. Verification by RP&HPS that the reported radionuclide concentrations are consistent with method uncertainties and sensitivity limits.

5. Evaluation of quality assurance sample results.

6. Verification that the data satisfies the PARCC criteria stated in Section 4.6.4.

7.1.2 Cumulative Probability Plots

Initial evaluation of each validated data set will verify that the data satisfy the assumption of representing a single normal distribution with no significant contaminant component (i.e., a background distribution). This will be done using a graphical presentation of the data in a special format which provides direct evaluation of the statistical significance of the data. A typical plot of a normal distribution has a characteristic bell-shaped shape (Figure 7-1a). The probability of occurrence of a particular value, or probability density, is plotted against the value itself. If the curve is changed to be a plot of the cumulative probability (area under the curve to the left of a given measurement) it becomes an S-shaped curve (Figure 7-1b). If the linear cumulative probability scale is replaced by a special "normal" probability scale, the curve becomes a straight line (Figure 7-1c). The plot is usually rotated to make the probability scale (expressed as percent) the horizontal axis for ease of reading (Figure 7-1d).

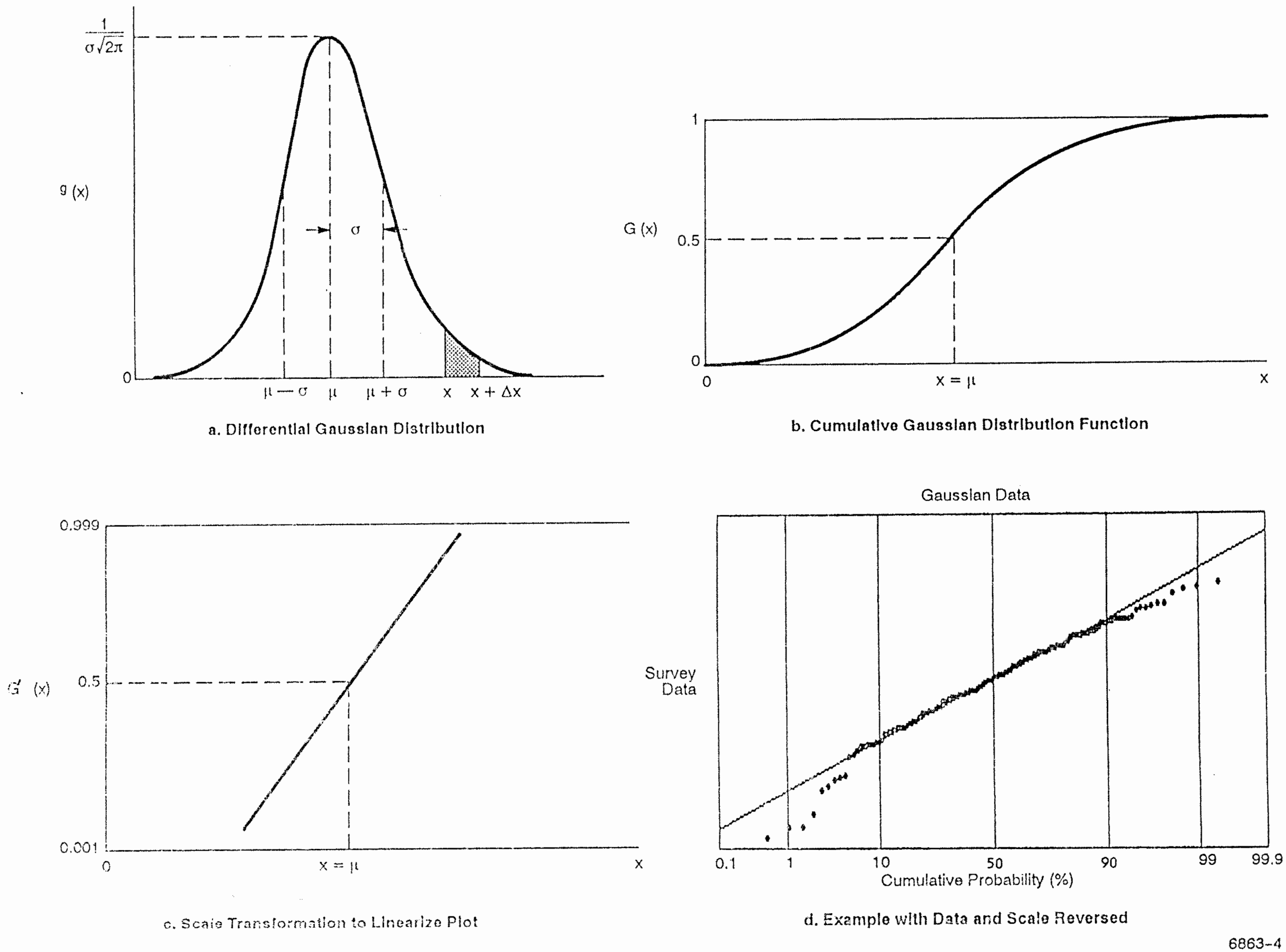


Figure 7-1 Derivation of Cumulative Probability Plot

A set of data consisting of measurements from a single distribution will give a normal cumulative probability plot which is a straight line with the mean of the data at a cumulative probability of 50% and the standard deviation of the data related to the slope of the curve.

The goodness of fit of the data to such a straight line will determine the validity of the assumption of a normal distribution for the data. Figure 7-1d is an example of normally distributed samples from a single population.

A set of data combining measurements from two or more distributions (e.g., background and one or more contaminated areas) will consist of a curve having two or more straight-line sections with different slopes. An example of a two-distribution sample is given in Figure 7-2. The four data points which deviate from the straight line through the background data provide visible demonstration of contamination.

The goodness of fit to a straight line in a cumulative probability plot will depend on the number of samples in the data set. Experience at Area IV has shown that a set with at least 11 values will consistently show good fits to the derived Gaussian distribution. Significant deviations from a normal distribution are not masked by random variations in data sets with 11 or more points. Smaller sample sets are subject to such masking. Therefore, the cumulative probability plot evaluation requires data sets with 11 or more points to assure visual detection of significant departures from the assumed Gaussian.

7.1.3 Statistical Comparison of Data Sets

Normal distributions which are fit to two sets of data will differ, even if the same underlying population is being sampled, as the result of sampling variability. If the data sets represent different populations (such as two different background levels, or background and background plus contamination), their difference will contain the difference between the populations as well as that from statistical fluctuations. To evaluate the difference between two sets of data, a difference that is considered significant must be defined. For this plan, the significance of the difference between two data sets will be determined by a statistical comparison using the Student's t distribution with a 95% confidence level.

7.1.4 Statistical Comparison to Regulatory Limits

If a sample data set is determined by the Student's t test to be statistically different from background, the data will be compared to well-established regulatory limits for ambient gamma radiation and soil radioisotope concentrations which are imposed as cleanup standards for release of property for radiologically unrestricted use (Section 7.1.5).

There is a probability that a data set statistically different from background will occur even if no contamination is present. Background gamma radiation is

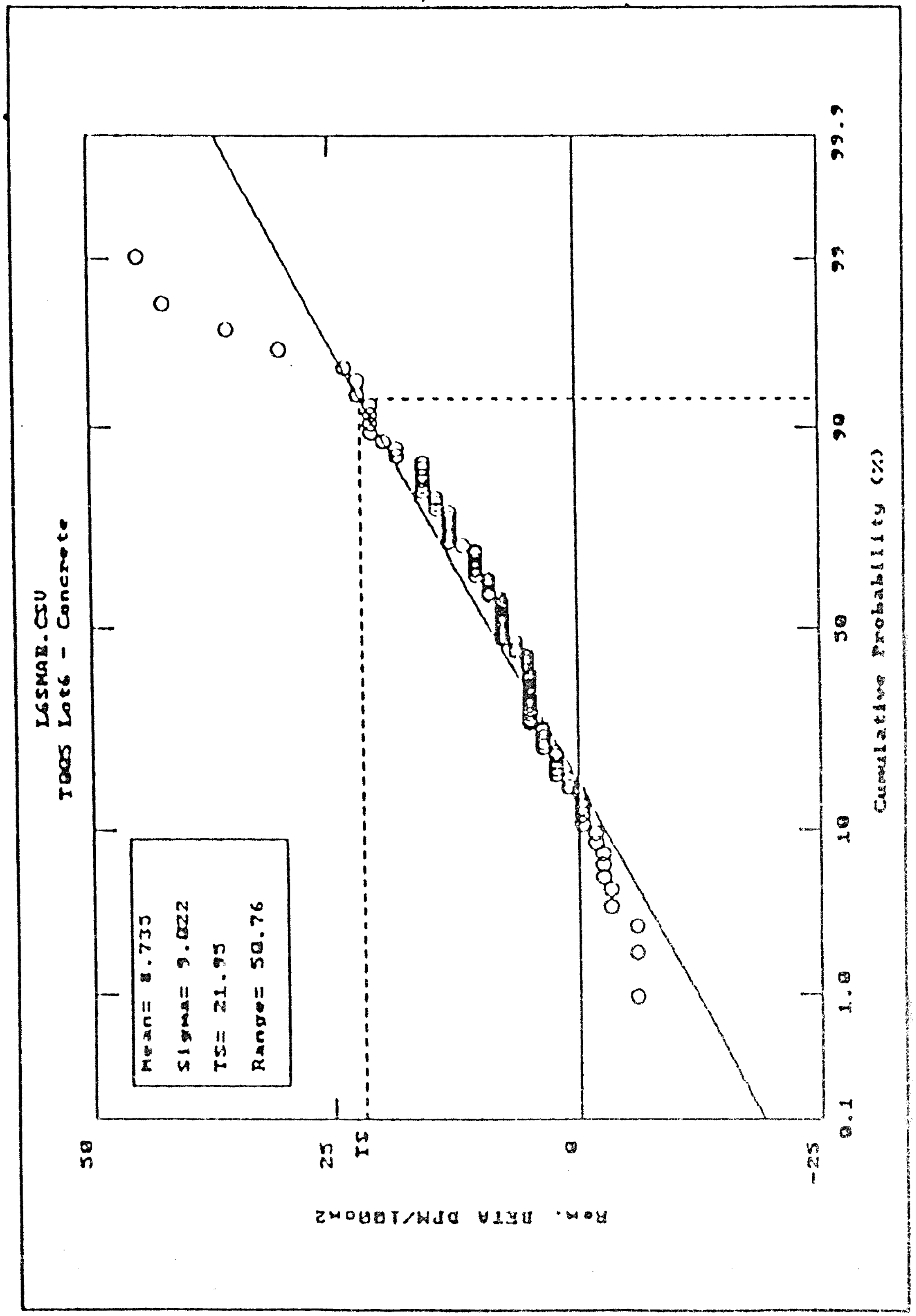


Figure 7-2 Example of Cumulative Probability Plot for Data Set with Contamination

highly variable and is influenced by soil and rock mineral content (e.g., uranium, thorium, potassium, and radium content), rock depth, topography, elevation, sunspot activity, instrument variability, etc. Soil concentration is also highly variable and is influenced by soil and rock mineral content, soil cultivation, precipitation, rainfall runoff patterns, preferential sedimentation, world-wide weapons test fallout patterns, sampling techniques, laboratory methods, etc. Because of this variability it is somewhat problematic to be able to specify exactly what "background" is. As a result it is expected that application of the Student's t test will indicate that some Area IV data sets are above background, even if no contamination is present. In order to preclude such cases from becoming perceived issues or problems, a comparison to regulatory limits will be done.

The data set comparison to a regulatory limit will use a statistical method known as "sampling inspection by variables" (Ref. 3-18), which provides a convenient method for comparing a set of data having a normal distribution with a single-valued regulatory limit. The method was developed in the quality assurance industry and has been applied successfully to radiological surveying data by Rocketdyne for the past 12 years (Ref. 3-19 through 3-23). The method uses a "test statistic" (TS) defined as follows.

$$TS = \overline{x} + ks$$

where $\overline{x}$ = mean of the distribution

s = observed sample standard deviation

k = tolerance factor

TS and $\overline{x}$ are compared with an acceptance limit (L) to determine acceptance or the need for other investigation.

The values of $\overline{x}$ and s are calculated from the data. L is defined as described in Section 7.1.5.2. The value of k is based on the number of samples in the set and the choices for acceptable risk. It is calculated in accordance with the following equations.

$$k = \frac{\sqrt{K_2 + K_2^2 - ab}}{a}$$

$$a = 1 - \frac{K_\beta}{2(n-1)}$$

$$b = K_2^2 - \frac{K_\beta^2}{n}$$

where

K_β = number of standard deviations above the mean exceeded with the probability selected for limiting the poorest quality that should be accepted in an individual lot, or Lot Tolerance Percent Defective

K_2 = number of standard deviations above the mean exceeded with the probability selected for accepting a lot of quality equal to the poorest allowed by K_β, or consumer's risk.

n = number of samples

The acceptible risk probability on which are based the values of K_2 and K_β is chosen to be 10%. The values correspond to assuring, with 90% confidence, that 90% of the area (assuming a uniform distribution throughout) has residual contamination below 100% of the applicable limit (a 90/90/100 test). The choice of values for the consumer's risk is consistent with industrial sampling practices and NRC and State of California guidelines (Ref. 3-24 and 3-25, respectively). For these choices of risk, $K_\beta = K_2 = 1.282$.

The statistical criteria for acceptance of areas as meeting the regulatory limits are presented below.

a) Accept: If TS is less than or equal to L, accept the region as satisfying the requirement for release for radiologically unrestricted use and requiring no further investigation. Figure 7-3 is an example of a sample lot accepted by the test.

b) Collect additional measurements: If TS is greater than L but $\overline{x}$ is less than L, independently resample and combine all measured values to determine if TS $\leq$ L for the combined set. If so, accept the region as satisfying the requirement for release for radiologically unrestricted use and requiring no further investigation. If not, consider the region contaminated and subject to remediation. Figure 7-4 is an example where additional measurements must be taken in order to accept or reject the sample set.

c) Reject: If TS and $\overline{x}$ are both greater than L, the region is considered contaminated and will be referred as a candidate for a remediation study as a followup to the characterization program. Figure 7-5 is an example of sample lot rejection by the test.

7.1.5 Regulatory Limits

The regulatory limits to be used for evaluation of data sets as described in Section 7.1.3 are established to ensure that future uses of the land will not be impacted from a radiological health and safety perspective. This is done by ensuring that the annual radiation dose to a user is a sufficiently small part of the natural background dose. The regulatory limits are discussed below.

7.1.5.1 Ambient Gamma Regulatory Limit

DOE Order 5400.5 (Chapter V) (Ref. 3-26) recommends use of 20 µR/hr above background (at 1 meter above the surface) for release of land for

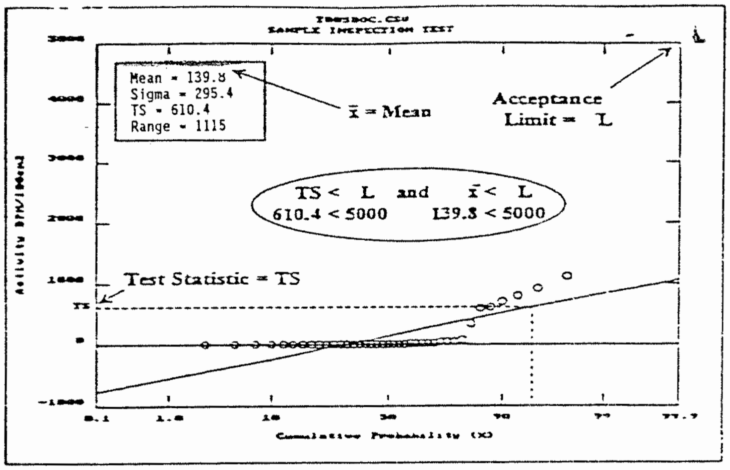


Figure 7-3 Example of Sample Lot Accepted

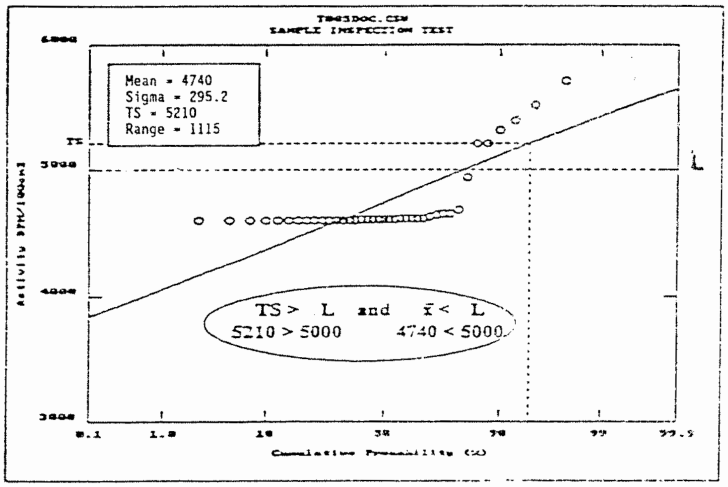


Figure 7-4 Example of Sample Lot Requiring Additional Measurements

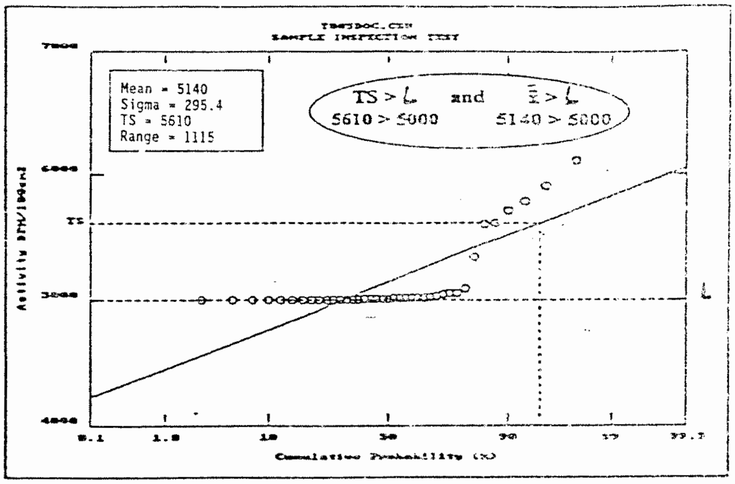


Figure 7-5 Example of Sample Lot Rejected

radiologically unrestricted use. NRC (Ref. 3-27) and the State of California (Ref. 3-25) specify a limit of 5 μR/hr above background (at 1 meter above the surface). The lower limit will be used for consistency with all limits, conservatism, and application of as low as reasonably achievable (ALARA) principles.

7.1.5.2 Soil Isotopic Concentration Acceptance Limits

Specific acceptance limits (L) for background-subtracted soil concentrations are derived from regulatory dose limits. DOE Order 5400.5, Chapter V (Ref. 3-26) specifies that site-specific soil concentration limits shall be derived from pathways dose analysis using approved models. The dose limit is specified as 100 mrem/yr. This plan will use a more restrictive dose limit of 10 mrem/yr, in keeping with ALARA principles and conservatism. Isotope-specific soil concentrations based on a dose of 10 mrem/yr for a potential residential user have been derived using the RESRAD code (Ref. 3-28) These soil concentration guidelines are discussed in Reference 3-29 and are listed in Table 7-1. Where several isotopes are identified as exceeding background, then the "sum of fractions" rule will be used to determine whether the regulatory limit is met. The rule requires that the following inequality be satisfied.

$$\sum_{i} \frac{C_i}{L_i} < 1$$

where i = all isotopes which exceed background

C_i = the single value representing the measured distribution of isotope i relative to background

L_i = the single isotope release limit equivalent to 10 mrem/yr for isotope i

7.2 EVALUATION PLAN

7.2.1 Data Validation

Data from field activities and laboratory analyses will be validated as described in Section 7.1.1. Field data will be the gamma detector functional performance count rates and associated Reuter Stokes ionization chamber dose rate readings, count rates of the gamma detectors in the two positions during the ambient gamma survey, and recorded gamma detector counting rates during the walk-about gamma survey.

7.2.2 Statistical Evaluation of Data

Cumulative probability plots will be developed for each data set and evaluated for goodness of fit to a single normal distribution. The validated data in the set will be processed by the program CUMPLOT2 (or subsequent revisions) to produce a plot similar to Figure 7-3, 7-4, or 7-5. The program has been developed by Rocketdyne for such data analysis.

Table 7-1 Single-Isotope Concentration Land Release Limits

Isotope	Release Limit (pCi/gm)(1)
Am-241	0.7
Co-60	0.7
Cs-134	1.5
Cs-137	3.2
Eu-152	5.9
Eu-154	1.5
Fe-55	695,000
H-3(2)	4190
K-40(2)	13.7
Mn-54	2.8
Na-22	1.1
Pu-238	24.9
Pu-239	22.4
Pu-240	22.4
Pu-241	21.4
Pu-242	23.7
Ra-226(2)	0.98
Sr-90	362
Th-228(2)	1.2
Th-232(2)	0.7
U-234(2)	23.2
U-235(2)	5.5
U-238(2)	24.6

(1) Allowable concentrations above background, from RESRAD calculation based on a 10 mrem/year dose limit for an individual

(2) Naturally occurring isotope

The basic data sets for evaluation will be gamma radiation measurements for single survey blocks or soil radioisotope concentrations for single analysis regions or screening areas. (Screening areas are subject to size constraints as discussed in the next paragraph.) In addition to evaluation of the basic data sets, the sets will be combined in some cases for evaluation of data from a larger area. Combinations will be chosen as indicated by previous results as the evaluation proceeds. Examples of combined sets are all data of the same type in Area IV, all data of the same type in an analysis region, and all data for a screening area with multiple locations.

Data sets containing fewer than 11 values will not be evaluated in this manner unless they can be combined with a set(s) expected to have the same background to form a data set of at least 11 values. The sample sizes for the different data sets are discussed below.

1. Ambient gamma survey data sets will exceed the minimum size for the smallest sets to be evaluated (81 per Area IV survey block, 25 per background location).

2. The number of survey soil samples (and in-soil measurements) in each analysis region was selected as 11 to satisfy the size requirement. The number of background soil samples (and in-soil measurements) at each of the background sites is only five; thus, background data sets will be combined for analysis to provide the minimum data set size.

3. Screening soil sample locations are chosen for coverage of the area involved rather than to provide data for statistical analysis. Most sample sets are large enough to support a cumulative probability plot evaluation, either alone or combined with similar sets. Those for which this does not apply (e.g., SRE Pond water and sediment samples) will be reviewed for evidence of significant contamination.

7.2.3 Comparison of Data Sets to Background

Data sets will be obtained for gamma radiation and soil radioisotope concentrations for background areas and for areas within Area IV. For each of these sets the following analyses will be performed.

1. The Student's t test will be performed to compare pairs of background area data sets to determine whether the different background areas are identical.

2. The Student's t test will be performed to compare each background area to the aggregated set of background measurements to determine whether any area is statistically distinguishable from the aggregate background distribution.

3. The Student's t test will be performed to compare each sample set from Area IV to the aggregate background gamma distribution, to determine whether any area is statistically distinguishable from the aggregate background.

7.2.4 Data Set Comparison to Regulatory Limits

If the Student's t test identifies regions of Area IV which have gamma radiation and/or a radioisotope concentration which is statistically distinguishable from the corresponding background, a comparison to regulatory limits will be performed as described in Section 7.1.4. The mean of the aggregate background area gamma distribution and soil isotopic concentrations will be used as the background. The comparison to regulatory limits will be performed for various groupings of data sets, from that for individual survey blocks (gamma measurements) and analysis regions (soil samples) to aggregates of all Area IV gamma measurements or soil isotopic concentrations (by isotope).

Background-subtracted radioisotope concentrations will be evaluated by statistical analysis of the sums of fractions (SOF) for the isotopes measured in the soil samples of a data set. The value of $(SOF)_j$ will be calculated for each individual soil sample j in a set.

$$(SOF)_j = \sum_{i} \frac{C_i}{L_i} ,$$

where i, C_i, and L_i are defined in Section 7.1.5.2.

The values of SOF will be plotted in a cumulative probability plot. The value of TS will be calculated and compared to the release criterion (namely, 1). If TS < 1, the multi-isotope measurements satisfy the acceptance test, and demonstrate that the annual dose (D) to a residential user would be less than 10 mrem/year. The annual dose to a user may be calculated by

$$D = \overline{SOF} \times 10 \text{ mrem/yr} ,$$

where $\overline{SOF}$ is the mean of the values of SOF_i for individual soil samples.

Appendix A Background Areas

Eight areas outside Area IV will be surveyed to provide the basis for evaluating the results within Area IV to distinguish naturally occurring radionuclides from those which might have originated from Area IV activities. The areas are those sampled as background areas for the Brandeis-Bardin Institute (BBI) multi-media sampling study (Section 4.2.1). The general locations of the background areas are shown in Figure 4-1. Each of the areas is described below and shown in Figures A-1 through A-8.

1. Rocky Peak. The Rocky Peak background sample area is approximately 4.9 miles northeast of SSFL and north of the Route 118 Freeway at the Rocky Peak exit. The sample grid (Figure A-1) was located along the north side of a fire road directly above the parking area. The grid was on a steeply sloping area near its northern edge and on a more level area along its southern margin. It was partially covered by grasses and some shrubs. Numerous sandstone outcroppings and boulders were also exposed along the slope. The grid location was selected because the distance from and height above the freeway was considered sufficient to avoid most chemical deposition from freeway traffic. (This consideration was important for the BBI study because the study included chemical as well as radiological characterization.) The soil collected was silty sand, dark brown to black, fine to medium grained, poorly graded, plastic, moist, and with organic material and roots.

2. Santa Susana Park. Santa Susana Park is located approximately 2 miles south of the Route 118 Freeway and approximately 3 miles north of the SSFL main gate. The sample grid (Figure A-2) was located on a plateau south of the main park area. The plateau was bounded on the north by a short slope and on the south by a gradual hill leading to a steeper hill. The area was partially devoid of grass or plants except around the perimeter. Several trees were present. A small drainage area, which was dry at the time of sampling, appeared to run from the eastern slope through the center of the sampling area. The soil collected was a brown sand, fine to medium grained, poorly graded, and dry.

3. Bell Canyon. The Bell Canyon location is approximately 6.5 miles south of the Route 118 Freeway and approximately 2.5 miles southwest of the SSFL main gate. The area sampled (Figure A-3) was near the top of a hillside, which faced northwest. The antenna at the Santa Monica Mountains Conservancy could be seen in the distance at 10 deg west of north. The hill overlooks Bell Canyon Boulevard. Access to the area was by a fire road that continued up the hill beyond the grid location. Approximately two-thirds of the way down the hillside, a 4- to 6-foot ridge was formed that traversed the sampling area, possibly the result of a landslide. The area was covered with grasses and forbs except along the roadway. A few trees were present southeast of the sampling area. The soil collected was a brown sand, fine to medium grained, poorly graded, and dry.

4. Western Location. The Western Location is approximately 4.5 miles south of the Route 118 Freeway and approximately 2 miles west of a Rocketdyne water tank (a landmark visible from the sampling area). The

sampling area (Figure A-4) was part of a southward-facing slope and adjacent to a barbed-wire fence. The slope was covered predominantly by grasses and was used as a cow pasture. The soil collected was clayey sand, dark brown, medium to fine grained, moist, and with organic material.

5. Happy Camp. The Happy Camp background area is located in Moorpark, approximately 12.5 miles northwest of SSFL. The sampling area (Figure A-5) is a flat area located between two plateaus seemingly created by erosion off the Middle Ridge Fire Road, approximately one mile from the main gate. A stream bed, usually dry, runs through the center of the Happy Camp area and west of the sampling area. The northeast corner of the previous sampling grid was located 60 ft west of a large double-trunked oak tree. The area was sparsely covered by grasses and small shrubs.

6. Santa Monica Mountains National Recreation Area. The Santa Monica Mountains National Recreation Area background area is located in Agoura, approximately 2 miles north of Highway 101, and approximately 4.5 miles southwest of SSFL. The sampling area (Figure A-6) was 20 ft north of the Los Angeles County Class III Landfill. The area was adjacent to and west of the dirt access road and east of a dry creek bed. The sampling grid was located on a flat area covered by grasses and forbs. A few trees were located outside the sampling area. The soil collected was silty sand, dark brown to black, fine to medium grained, poorly graded, plastic, moist, and with organic material and roots.

7. Wildwood Regional Park. The Wildwood Regional Park background area is located 13 miles west of SSFL, approximately 4 miles west of Highway 23. The sampling area is shown in Figure A-7.

8. Tapia County Park. The Tapia County Park background area is located 10 miles south of SSFL, approximately 5 miles south of the Highway 101. The sampling area is shown in Figure A-8.

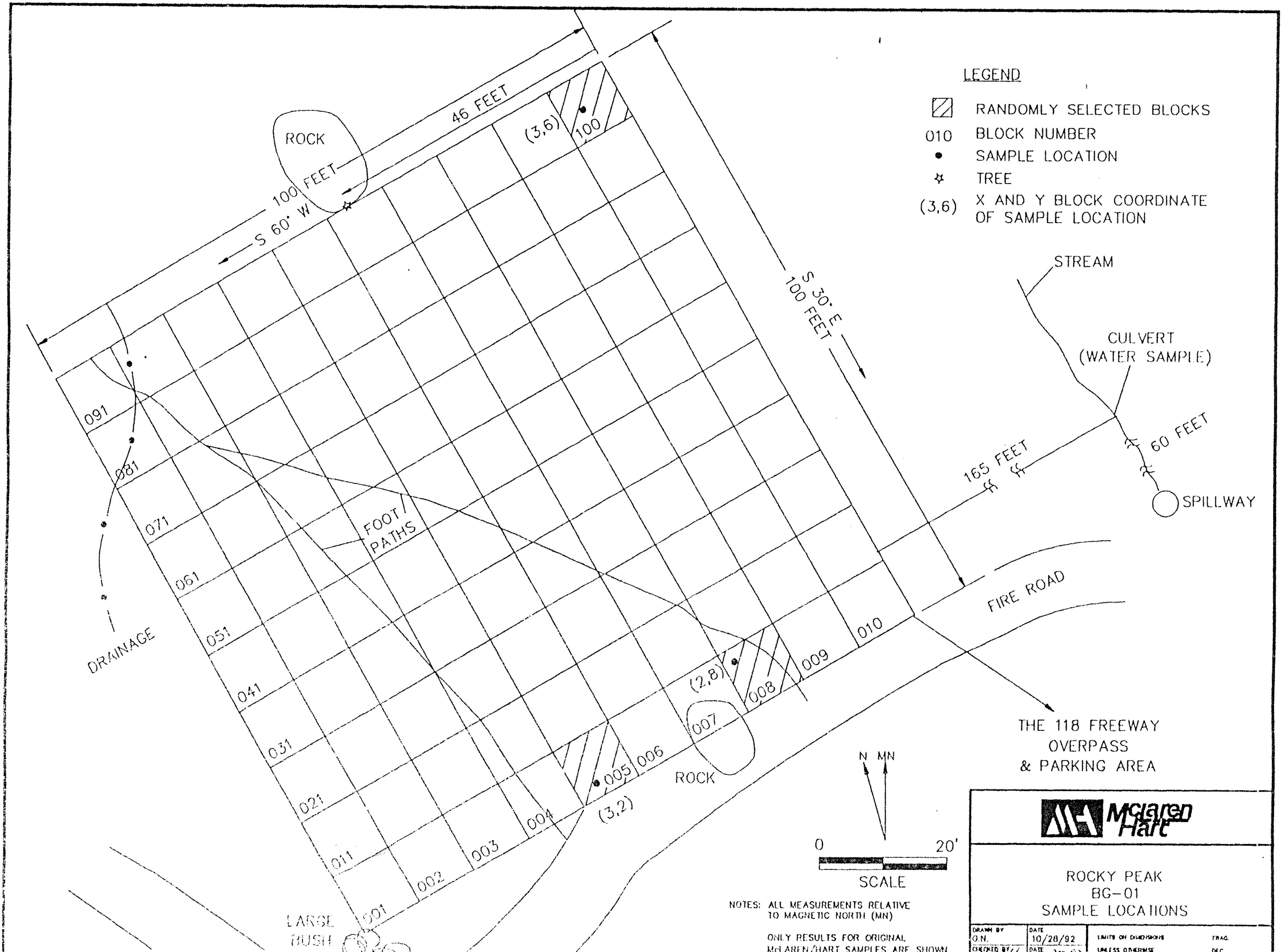


Figure A-1 Rocky Peak Background Area Sampling Locations

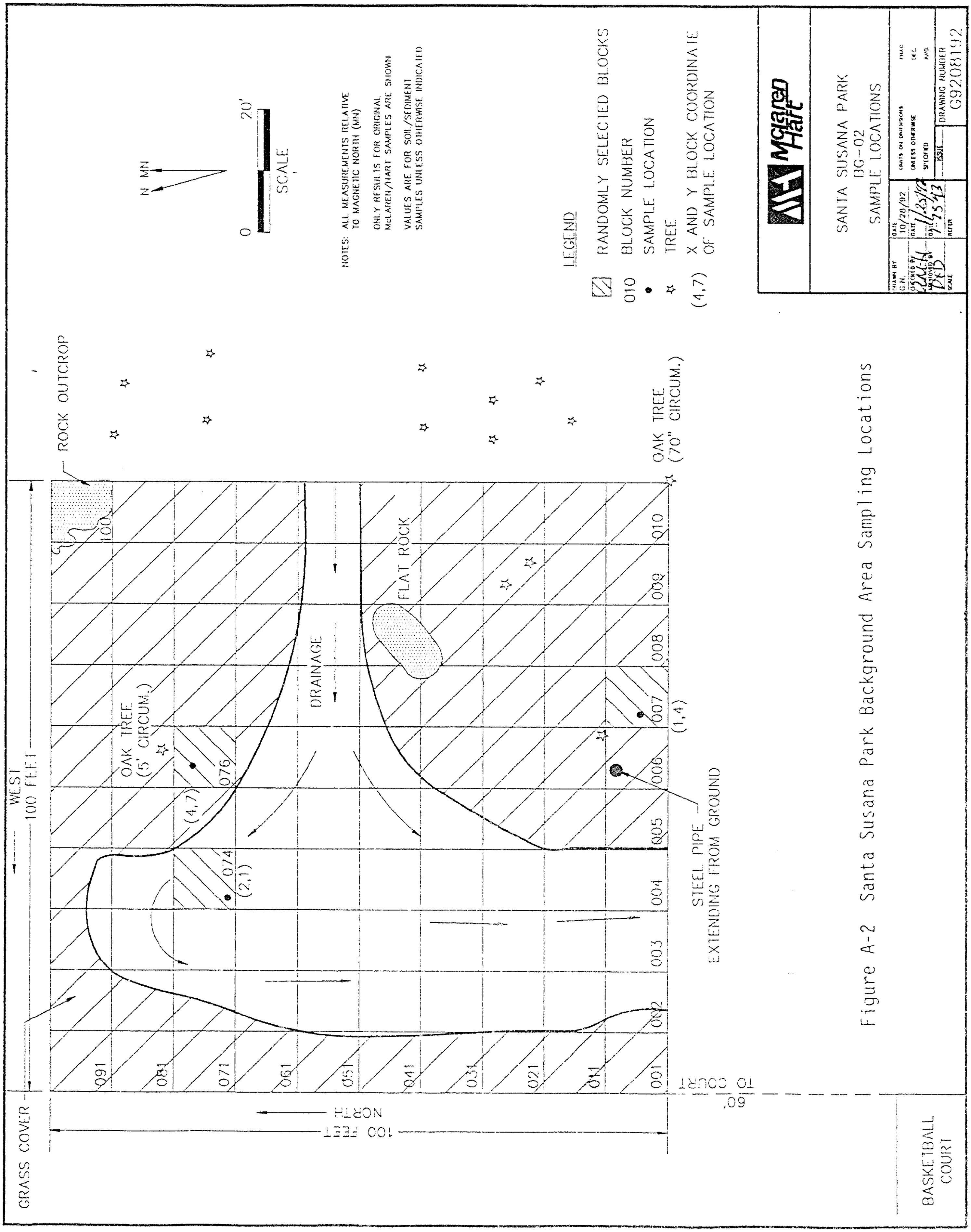


Figure A-2 Santa Susana Park Background Area Sampling Locations

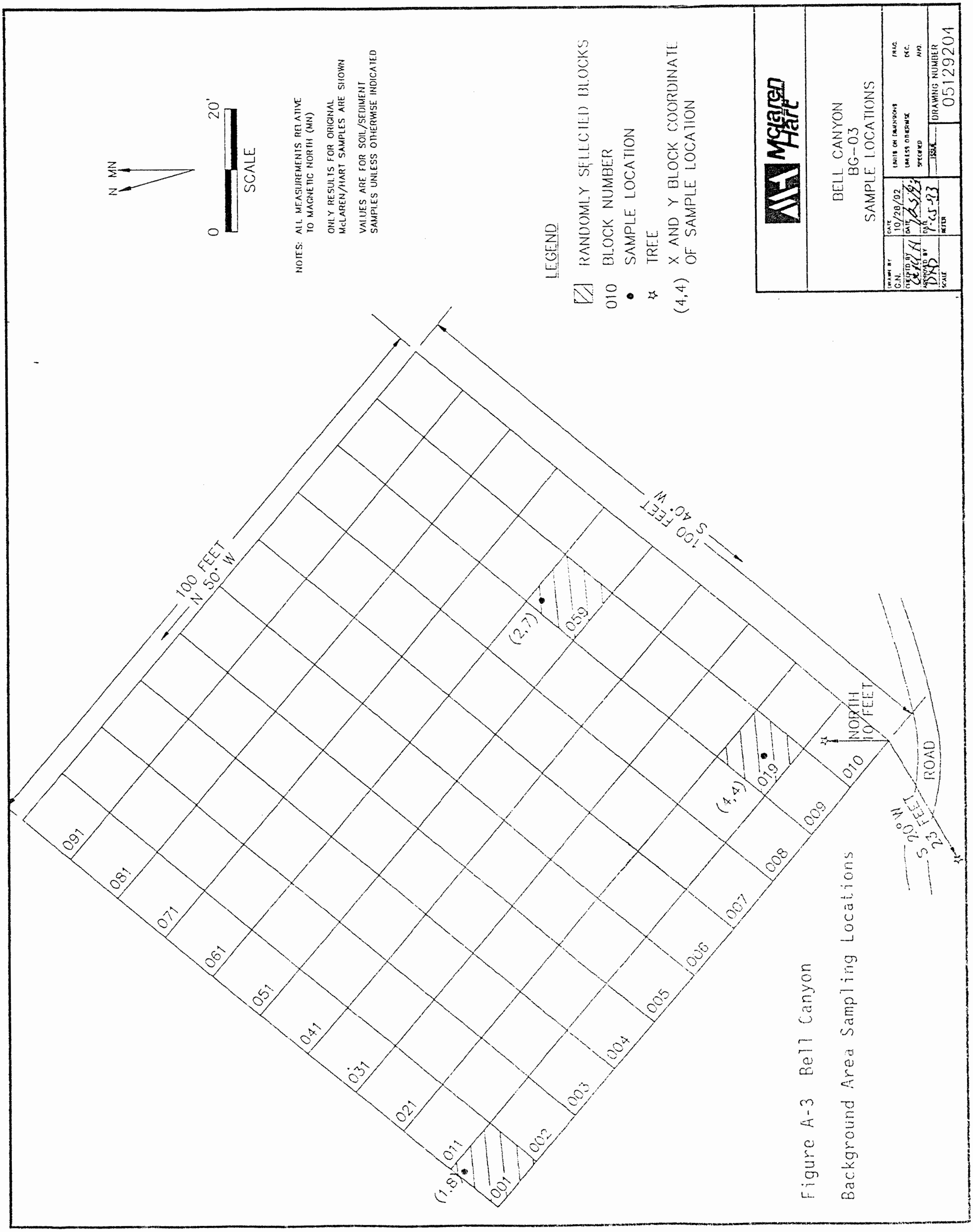


Figure A-3 Bell Canyon

Background Area Sampling Locations

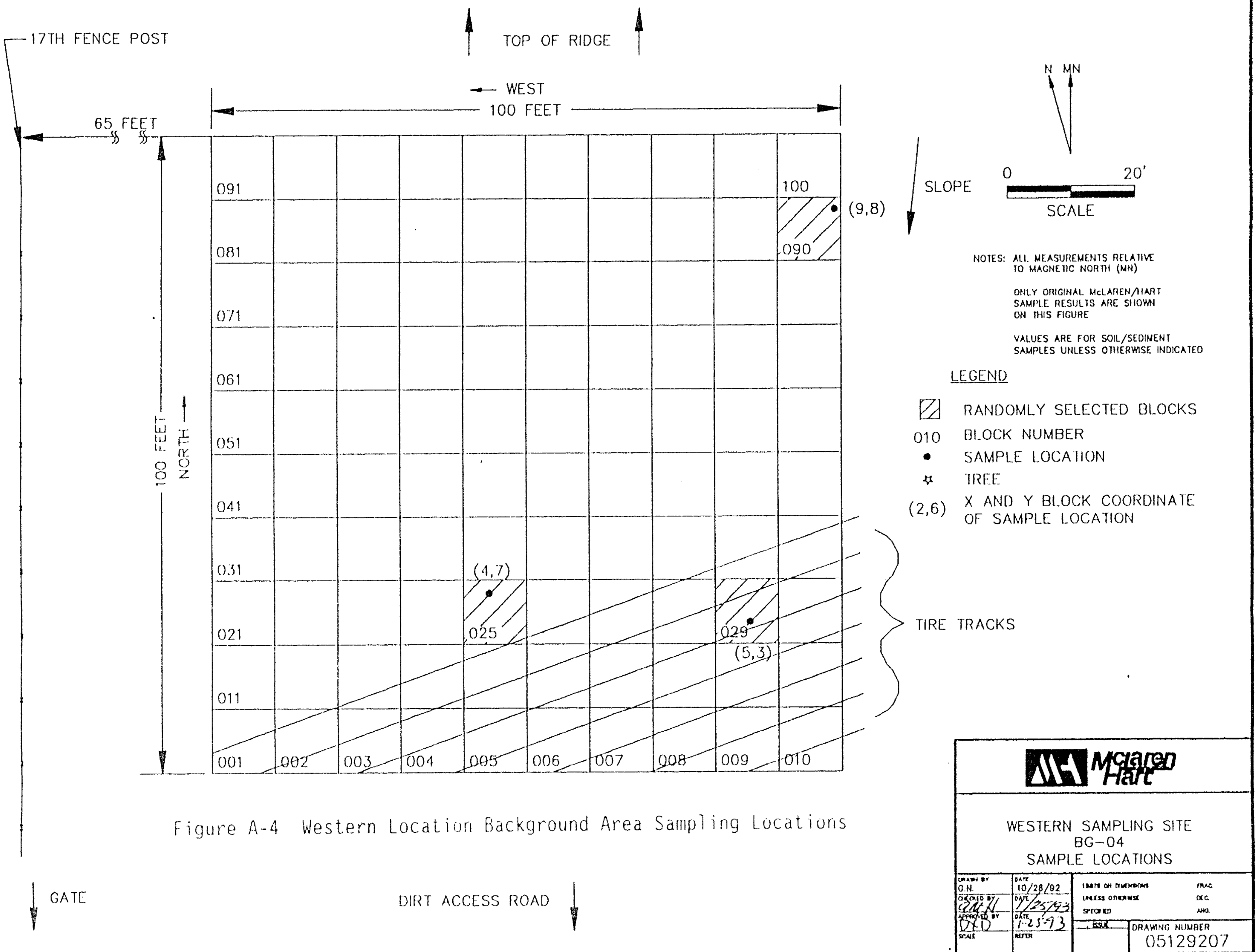
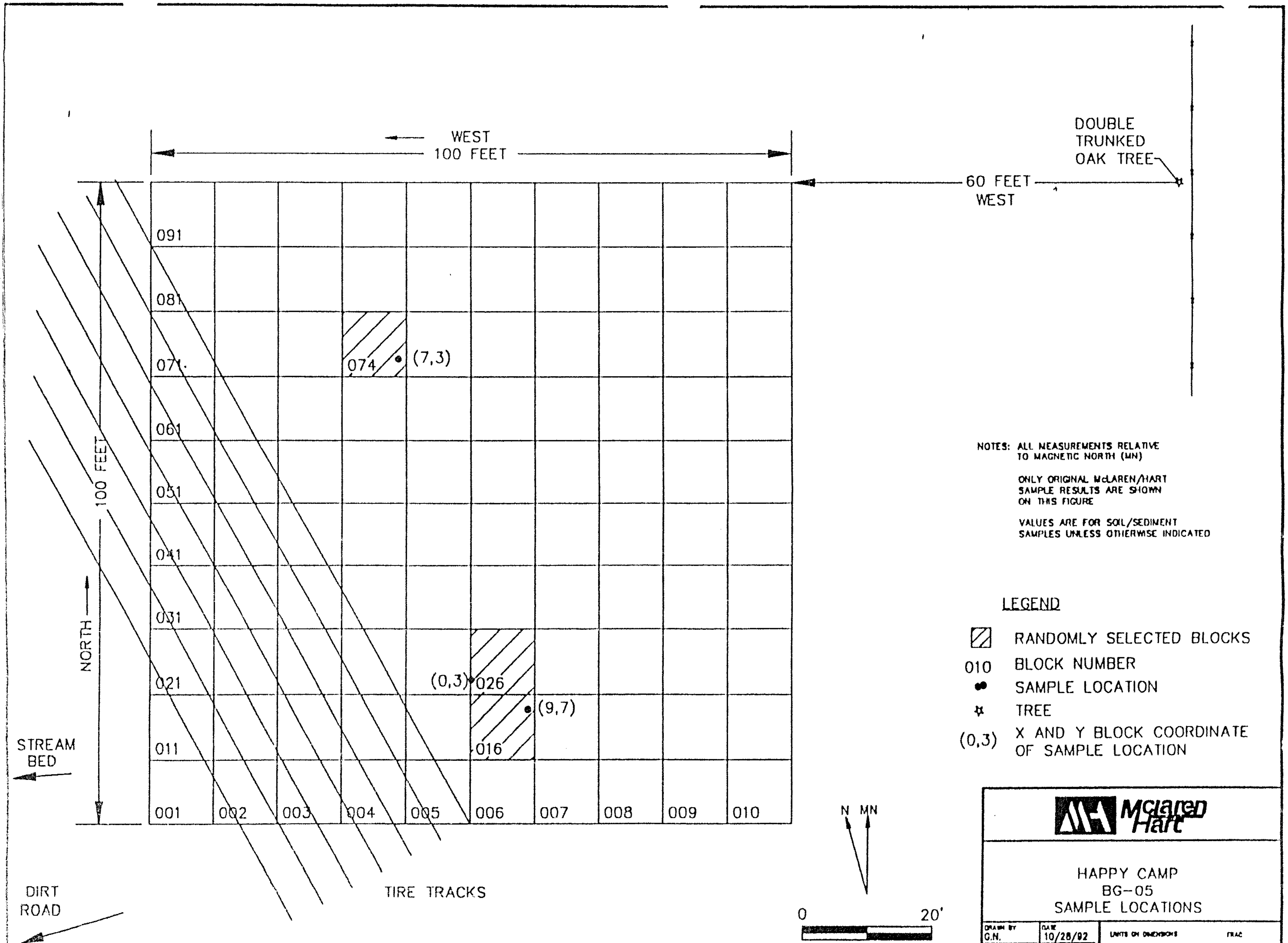


Figure A-4 Western Location Background Area Sampling Locations



McLaren Hart

HAPPY CAMP
BG–05
SAMPLE LOCATIONS

DRAWN BY C.N.	DATE 10/28/92	UNITS OF DIMENSIONS UNLESS OTHERWISE SPECIFIED	FRAC. DEC. ANG.
CHECKED BY	DATE		
APPROVED BY D.D	DATE 7-25-93		DRAWING NUMBER 05139209
SCALE	NOTED		

Figure A-5 Happy Camp Background Area Sampling Locations

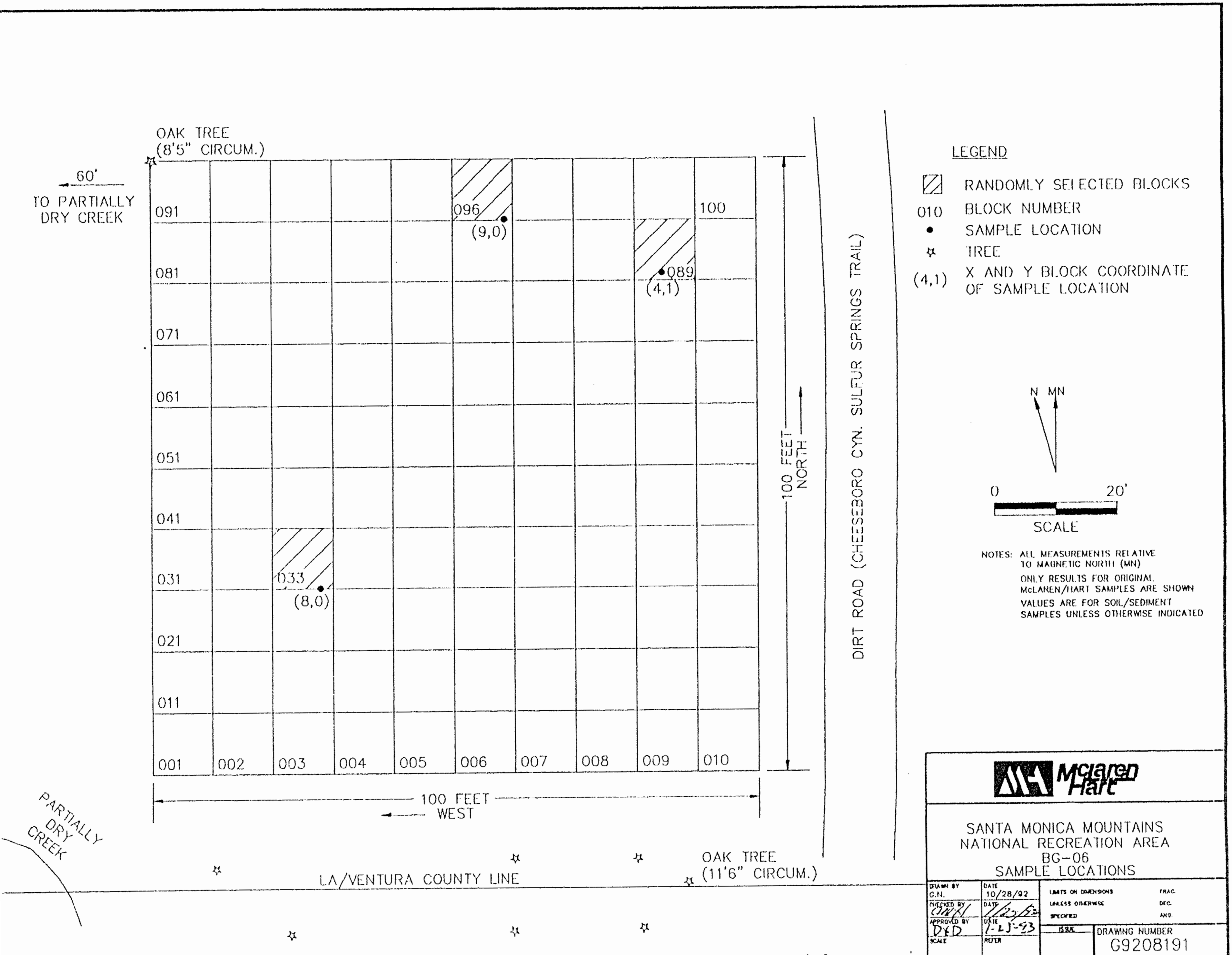


Figure A-6 Santa Monica Mountains National Recreation Area Background Area Sampling Locations

Figure A-7 Wildwood Regional Park Background Area Sampling Locations

TBD pending issue of the report on the BBI followup study.

Figure A-8 Tapia County Park Background Area Sampling Locations

TBD pending issue of the report on the BBI followup study.

Appendix B Area IV Grid Marker Coordinates

This appendix lists in Table B-1 the identification label and coordinates of each Area IV grid marker stake. This information is also marked on the stakes themselves. The locations of the stakes are shown generally in Figure 4-2. The identification label is a letter and a number indicating the east/west and north/south coordinates on whose intersection the stake is located. The coordinates are the distances from the reference point of the federal coordinate system established in 1991. The survey which positioned and installed these markers is described in Reference 3-8.

Table B-1 Area IV Grid Marker Coordinates

Marker Label	Coordinates East/West	Coordinates North/South	Elevation
A8	XXXXXXX.XXXX	XXXXXXX.XXXX	XXXX.XXXX
A9	XXXXXXX.XXXX	XXXXXXX.XXXX	XXXX.XXXX
A10	XXXXXXX.XXXX	XXXXXXX.XXXX	XXXX.XXXX
.			
.			
.			

TBD pending issue of report by surveying contractor to provide the marker coordinates and elevations. Several markers have been set and preliminary coordinates and elevation values have been provided. A typical coordinate pair in the State Plane Coordinate System, North American Datum, 1983, for survey block C10, is 1905200.0000 ft east and 6345400.0000 ft north. Other markers will nominally differ in increments of 200 ft in each direction, except in cases of an obstruction or inaccessible terrain which requires an offset marker location.

Appendix C Selection of Random Soil Sample Locations

This appendix describes the method for selection of soil sampling locations which are to be selected at random within regions of interest (each analysis region and the region identified as the location of a former earth pit south of the former Sodium Disposal Facility). Eleven locations will be selected within each of these regions.

Random soil sampling locations will be defined by their east/west and north/south coordinates in the State Plane Coordinate System, North American Datum 1983. Sets of candidate coordinates will be prepared on the basis of pairs of computer-generated numbers. More than the 11 candidate coordinates will be prepared since some will not be suitable. The candidate coordinates will be screened in accordance with the criteria given in Section 4.6.1.2 until 11 acceptable locations are defined

The process described here for selection of locations for screening is based on the use of the WINGZ spreadsheet program on the Macintosh. Two spreadsheets are used. The first prepares two lists of randomly generated numbers between 0 and 1. As a check that the number selections were random, the spreadsheet also calculates averages and chi-square values of the set. The numbers of the two lists are paired to give a set of location coordinates. The second spreadsheet retrieves from the first spreadsheet the set of location coordinates and the results of the statistical checks, multiplies the sets of numbers by the east/west or north/south range of the rectangle which circumscribes the region of interest, and provides space for identifying the survey blocks in which the locations lie, coordinates of the locations within the blocks, and recording the results of the screening. The spreadsheets available on disk can be used, or they may be replaced by a similar program on a different computer.

A sample of the worksheet for random soil sampling locations is given in Figure D-1. The worksheet is identified as being for the alluvial flats analysis region. The enveloping area specified uses preliminary boundary coordinates, so the worksheet is a sample only.

The procedure and associated considerations for preparing the lists of sampling locations are given below.

1. Prepare the lists of random numbers.

   a. Open spreadsheet file RANDOM.1. The spreadsheet is designed to generate a list of 100 sets of coordinates. This allows for the considerable number of survey soil sample locations expected to fail the screening. The screening area at the former earth pit should have a much larger fraction pass the screening, so the number of candidate locations could be reduced to no more than 25.

   b. Initiate a recalculation of the spreadsheet to obtain a new set of random numbers.

Table C-1

WORKSHEET FOR RANDOM SOIL SAMPLING LOCATIONS

REGION: Alluvial Flats / Disturbed (Figure C-)

Boundary Coordinates	Enveloping Area	Dimension (ft)
x(west)	1782200	3000
x (east)	1785200	
y (north)	265600	600
y (south)	266200	

Random Number Set Characteristics	East/West	North/South
Mean	0.49	0.51
Chi-square	9.4	7.8

The source of the random number set is file RANDOM.1.

Random Numbers		Coordinates		Within	Survey Block					Field Check				Location
						Coordinates of SW Corner		Coordinates in Block						
East/West	North/South	East/West	North/South	Region?	ID	East/West	North/South	East/West	North/South	Paved?	Rock?	Plants?	Other?	Accepted?
0.5597	0.1719	1783879	265703											
0.3605	0.9630	1783281	266178											
0.7647	0.8074	1784494	266084											
0.5899	0.2815	1783970	265769											
0.5075	0.6747	1783723	266005											
0.3274	0.7062	1783182	266024											
0.8677	0.7924	1784803	266075											
0.5727	0.0860	1783918	265652											
0.3488	0.1039	1783246	265662											
0.3457	0.8256	1783237	266095											
0.9477	0.2424	1785043	265745											
0.6221	0.5072	1784066	265904											
0.3090	0.3046	1783127	265783											
0.1215	0.1065	1782564	265664											
0.4808	0.8432	1783642	266106											
0.4168	0.3979	1783450	265839											
0.4870	0.4115	1783661	265847											
0.2130	0.8373	1782839	266102											
0.7055	0.7614	1784316	266057											
0.3675	0.3540	1783303	265812											
0.8736	0.1924	1784821	265715											
0.4046	0.5551	1783414	265933											
0.8751	0.0046	1784825	265603											
0.3676	0.8171	1783303	266090											
0.7718	0.3295	1784515	265798											
0.1596	0.3984	1782679	265839											
0.6651	0.6069	1784195	265964											
0.5235	0.3717	1783770	265823											
0.8791	0.1401	1784837	265684											
0.0465	0.2421	1782339	265745											
0.8348	0.3244	1784704	265795											
0.2245	0.6914	1782873	266015											
0.6948	0.4800	1784284	265888											
0.2430	0.1757	1782929	265705											
0.1296	0.9042	1782589	266143											
0.1998	0.5423	1782799	265925											
0.4978	0.8741	1783693	266124											
0.3631	0.3085	1783289	265785											
0.6231	0.8657	1784069	266119											

c. Verify that the mean (nominally 0.5) and chi-square test values (less than about 15 for a 25-number set or less than a somewhat higher value for a 100-number set, on the basis of 95% confidence) validate the randomness of the sets.

d. Set the file for manual recalculation. The file should not thereafter be recalculated, in order to retain the same number set.

e. Save the file as RANDOM.(), where the () is replaced by an identifier which indicates the region for which the numbers are to be used (chosen for ease of identification).

2. Prepare the location screening worksheet.

a. Open the file SOIL.SAMPLING.

b. Enter the name of the region for which locations are being defined.

c. Enter the State Plane Coordinate System, North American Datum 1983 coordinates of the lines which circumscribe the region. (The regions are, in general, irregular and non-contiguous. Therefore, the smallest convenient rectangular region is used initially to simplify defining candidate locations.)

d. Replace RANDOM.1 with RANDOM.() in the sentence in Cell A12.

e. Revise the file name in the function definitions in the first two columns to specify the file prepared in Step a. (Replace RANDOM.1 with RANDOM.() in Cells A16 and B16, and copy down to the end of the random number sets.)

f. Initiate recalculation of the spreadsheet to retrieve the sets of random numbers and statistical parameters from RANDOM.(), and to calculate the State Plane Coordinate System, North American Datum 1983 coordinates within the ranges of the region spans corresponding to each random number set.

g. Save the file as SAMPLING.(), where the () is replaced by the same identified chosen in Step a.v.

h. Print the file to provide the worksheet for guiding and documenting screening of the candidate locations to define sampling locations. The file is set to print horizontally at 75% of full size to fit on 8-1/2 by 11-in. paper.

3. Screen for location in the region. This first screening is to eliminate those locations which are outside the region of interest, but are included in the list as the result of circumscribing the irregular regions of interest for convenience in preparing the random number sets. Screening will be from the top of the list. Not all locations must be screened, but enough need to pass to result, after later screening, in a set of 11 locations. Locations well within the region can be passed visually from a map. Locations near the region boundary should be checked using the overlay for region boundaries on the CAD-

CAM map of Area IV. Accept only locations which are at least 10 ft inside the boundary, to allow for uncertainty in the transition from one region to the next. Write "Yes" or "No" on the worksheet to document the result of screening.

4. Determine the relative coordinates within survey blocks of the potential sampling locations which pass the screening of Step c.

   a. Determine the survey block in which each potential sampling location occurs. Use the CAD/CAM map and/or the locations of the marker posts. This identification is required for only enough locations to yield a set of 11 locations after the final screening. Start with a small margin and repeat the step as needed.

   b. Enter into the spreadsheet the survey block identification and the coordinates of the survey marker at the southwest corner of the block.

   c. Enter the relative coordinates of the location within the survey block (coordinates 0,0 at the southwest corner) in the spreadsheet by initiating a recalculation. This will subtract the southwest corner survey marker coordinates from the State Plane Coordinate System, North American Datum 1983 coordinates of the locations.

5. Screen for obstacles preventing screening. Review potential sampling locations in the field to verify that samples can be collected there. Write "Yes" or "No" on the worksheet to document the result of screening.

   The set of sampling locations must be the first 11 locations listed in the worksheet which pass the screening. Screening need not be done in the order that locations are listed; however, no potential location listed above an accepted location can be skipped in the screening or excluded if it passes the screening.

   a. Verify that the location is not paved or covered by a structure, unless the paving or structure postdates activities at the location which might have caused contamination.

   b. Verify that the location has soil which is at least 1 foot deep. This depth is based on extending the hole to 1 ft for the in-hole gamma measurement after collection of a soil sample to a depth of 6 in. If the soil depth is not evident from the terrain (obvious presence or absence of rock outcroppings), test the depth using a rod.

   c. Verify that the sample can be collected without threatening endangered or protected plant species.

   d. Review the location generally to identify any other reason for not sampling at the proposed location.

6. Record acceptance of a location by stating "Yes" in the last column of the worksheet. The screening for each region of interest will be complete when there are 11 accepted locations indicated in this column.

Appendix D Soil Sampling Locations

This appendix defines the soil sampling locations. Sampling locations were selected at random (as described in Appendix C) in the survey regions and the former disposal pit in the former Sodium Disposal Area screening area. Sampling locations in the remaining screening areas were selected to provide systematic coverage of the areas. Sampling location coordinates are given in Table D-1 for the survey regions, and in Tables D-2 through D-5 for four screening areas. The figure following each table (Figures D-1 through D-9) show the locations graphically.

The tables and figures included in this appendix are listed below.

TABLES

FIGURES

Table D-1

Soil Sampling Locations
Soil Survey Analysis Regions

Sample No.[1]	Coordinates[2]		Relative Location Within Survey Block[3]			
	East-West	North-South	Block No.	East-West	North-South	Depth
Developed Areas:						
DV-1						Surface
DV-2						Surface
DV-3						Surface
DV-4						Surface
DV-5						Surface
DV-6						Surface
DV-7						Surface
DV-8						Surface
DV-9						Surface
DV-10						Surface
DV-11						Surface
Rock Outcroppings:						
RC-1						Surface
RC-2						Surface
RC-3						Surface
RC-4						Surface
RC-5						Surface
RC-6						Surface
RC-7						Surface
RC-8						Surface
RC-9						Surface
RC-10						Surface
RC-11						Surface
Drainage Areas:						
DR-1						Surface
DR-2						Surface
DR-3						Surface
DR-4						Surface
DR-5						Surface
DR-6						Surface
DR-7						Surface
DR-8						Surface
DR-9						Surface
DR-10						Surface
DR-11						Surface

Table D-1, Soil Sampling Locations, Soil Survey Analysis Regions (continued)

Sample No.[1]	Coordinates[2]		Relative Location Within Survey Block[3]			
	East-West	North-South	Block No.	East-West	North-South	Depth
Alluvial Flats, Undisturbed:						
AU-1						Surface
AU-2						Surface
AU-3						Surface
AU-4						Surface
AU-5						Surface
AU-6						Surface
AU-7						Surface
AU-8						Surface
AU-9						Surface
AU-10						Surface
AU-11						Surface
Alluvial Flats, Disturbed:						
AD-1						Surface
AD-2						Surface
AD-3						Surface
AD-4						Surface
AD-5						Surface
AD-6						Surface
AD-7						Surface
AD-8						Surface
AD-9						Surface
AD-10						Surface
AD-11						Surface
Martinez-Chaparral:						
Mch-1						Surface
Mch-2						Surface
Mch-3						Surface
Mch-4						Surface
Mch-5						Surface
Mch-6						Surface
Mch-7						Surface
Mch-8						Surface
Mch-9						Surface
Mch-10						Surface
Mch-11						Surface

Table D-1, Soil Sampling Locations, Soil Survey Analysis Regions (continued)

NOTES:

(1) The listed numbers are soil survey analysis region location identifiers, which will be used only for survey sampling preparation and data evaluation. The correlation of project sample identification numbers (Section 4.6.3.1.1) and the soil analysis region area location identifiers will be documented in the Sampling Logbook.

(2) Selection of the sampling locations is described in Appendix C. The columns list the coordinates in the State Plane Coordinate System, North American Datum, 1983.

(3) These columns list the sample locations within the identified survey block. The East-West and North-South coordinates are those relative to the basepoint (southwest corner) of the survey block.

Figure D-1 Soil Sampling Locations - Soil Survey Analysis Regions

TBD pending completion of CAD drawing of Area IV map with soil survey sampling locations shown.

Table D-2

Soil Sampling Locations
Areas Around the Former Sodium Disposal Facility

Sample No.[1]	Coordinates[2]		Relative Location Within Survey Block[3]			
	East-West	North-South	Block No.	East-West	North-South	Depth
SDF-1						(4)
SDF-2						(4)
SDF-3						(4)
SDF-4						(4)
SDF-5						(4)
SDF-6						(4)
SDF-7						(4)
SDF-8						(4)
SDF-9						(4)
SDF-10						(4)
SDF-11						(4)
SDF-12						Surface
SDF-13						Surface
SDF-14						Surface
SDF-15						Surface
SDF-16						Surface
SDF-17						Surface
SDF-18						Surface
SDF-19						Surface
SDF-20						Surface
SDF-21						Surface
SDF-22						Surface
SDF-23						Surface
SDF-24						Surface
SDF-25						Surface
SDF-26						Surface
SDF-27						Surface
SDF-28						Surface

Table D-2, Soil Sampling Locations, Areas Around the Former Sodium Disposal Facility (continued)

NOTES:

(1) The listed numbers are screening area location identifiers, which will be used only for screening area sampling preparation and data evaluation. The correlation of project sample identification numbers (Section 4.6.3.1.1) and the screening area location identifiers will be documented in the Sampling Logbook.

Sample Nos. SDF-1 through SDF-11 are in the area of the former pit south of the former Sodium Disposal Facility.

Sample Nos. SDF-12 through SDF-21 are along the south side of the access road to the former Sodium Disposal Facility.

Sample Nos. SDF-22 through SDF-26 are in the ravines west of the former Sodium Disposal Facility.

Sample Nos. SDF-27 through SDF-28 are in the ravine east of the former Sodium Disposal Facility.

(2) These columns list the coordinates in the State Plane Coordinate System, North American Datum 1983.

(3) These columns list the sample locations within the identified survey block. The East-West and North-South coordinates are those relative to the basepoint (southwest corner) of the survey block.

(4) The depth will be the minimum of a debris layer indicating the bottom of the former pit, bedrock, or a depth of 3 ft below the surface.

Figure D-2 Soil Sampling Locations - Areas Around the Former Sodium Disposal Facility

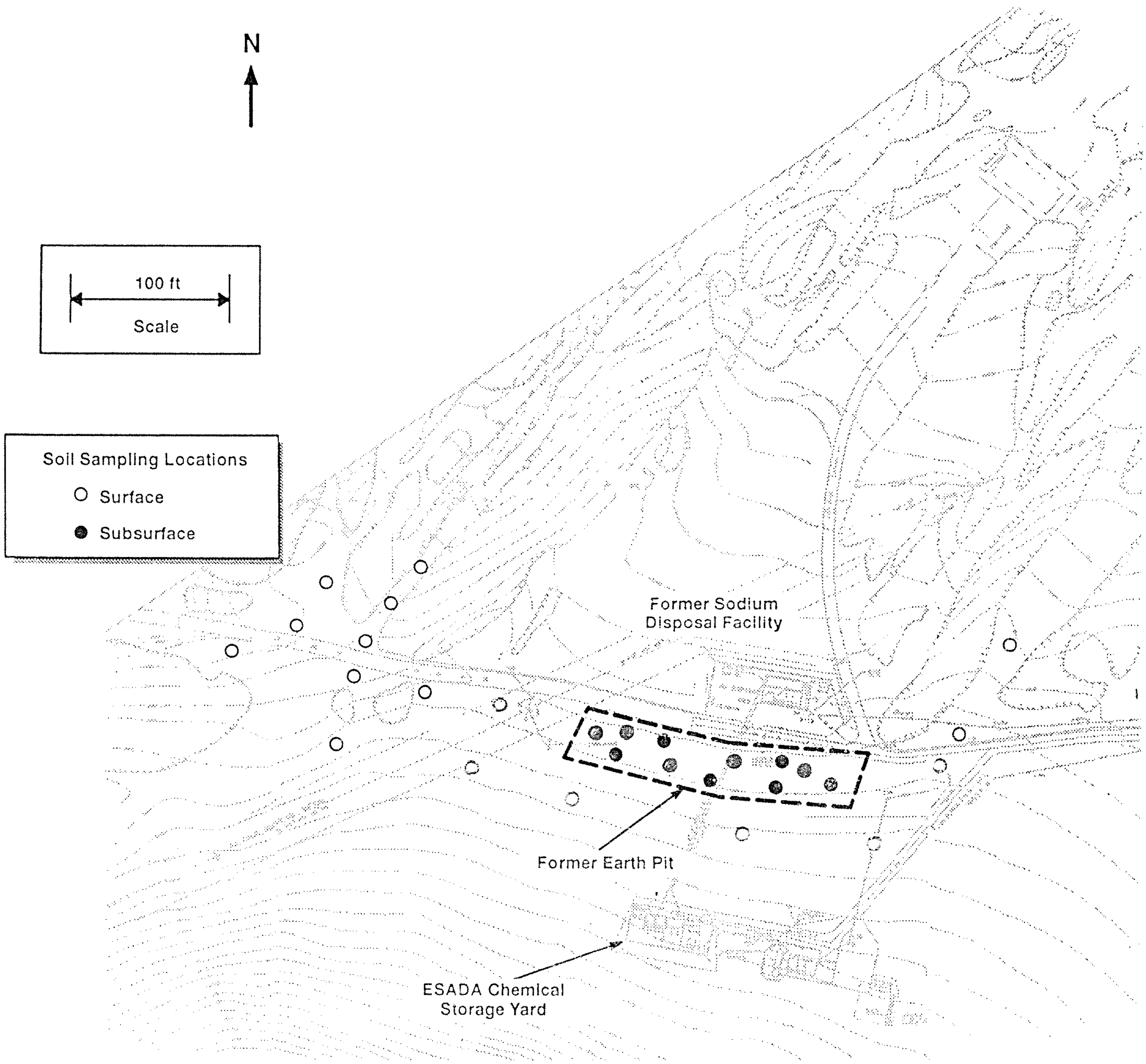


Table D-3

Soil Sampling Locations
Natural Drainage Channels

Sample No.[1]	Coordinates[2] East-West	Coordinates[2] North-South	Relative Location Within Survey Block[3] Block No.	East-West	North-South	Depth
SRE Pond Drainage Channel:						
DSP-1						Surface
DSP-2						Surface
DSP-3						Surface
DSP-4						Surface
DSP-5						Surface
Old Conservation Yard Drainage Channels (North):						
DYN-1						Surface
DYN-2						Surface
DYN-3						Surface
DYN-4						Surface
DYN-5						Surface
DYN-6						Surface
Old Conservation Yard Drainage Channels (South)						
West:						
DYSW-1						Surface
DYSW-2						Surface
DYSW-3						Surface
DYSW-4						Surface
DYSW-5						Surface
DYSW-6						Surface
DYSW-7						Surface
DYSW-8						Surface
DYSW-9						Surface
DYSW-10						Surface
DYSW-11						Surface
East:						
DYSE-1						Surface
DYSE-2						Surface
DYSE-3						Surface
DYSE-4						Surface
DYSE-5						Surface

Table D-3, Soil Sampling Locations, Natural Drainage Channels (continued)

17th Street Drainage Channel:	
D17-1	Surface
D17-2	3-ft
D17-3	Surface
D17-4	Surface
D17-5	Surface
D17-6	Surface
D17-7	Surface
D17-8	3-ft
D17-9	Surface
D17-10	Surface
D17-11	Surface
D17-12	3-ft
D17-13	Surface
Southeast Drainage Channels:	
G Street (East):	
DGE-1	Surface
DGE-2	Surface
G Street (West):	
DGW-1	Surface
DGW-2	Surface
DGW-3	Surface
J Street:	
DJ-1	Surface
DJ-2	Surface
DJ-3	Surface
DJ-4	Surface
DJ-5	Surface
L Street:	
DL-1	Surface
DL-2	Surface
DL-3	Surface
DL-4	Surface
DL-5	Surface
DL-6	Surface
DL-7	Surface

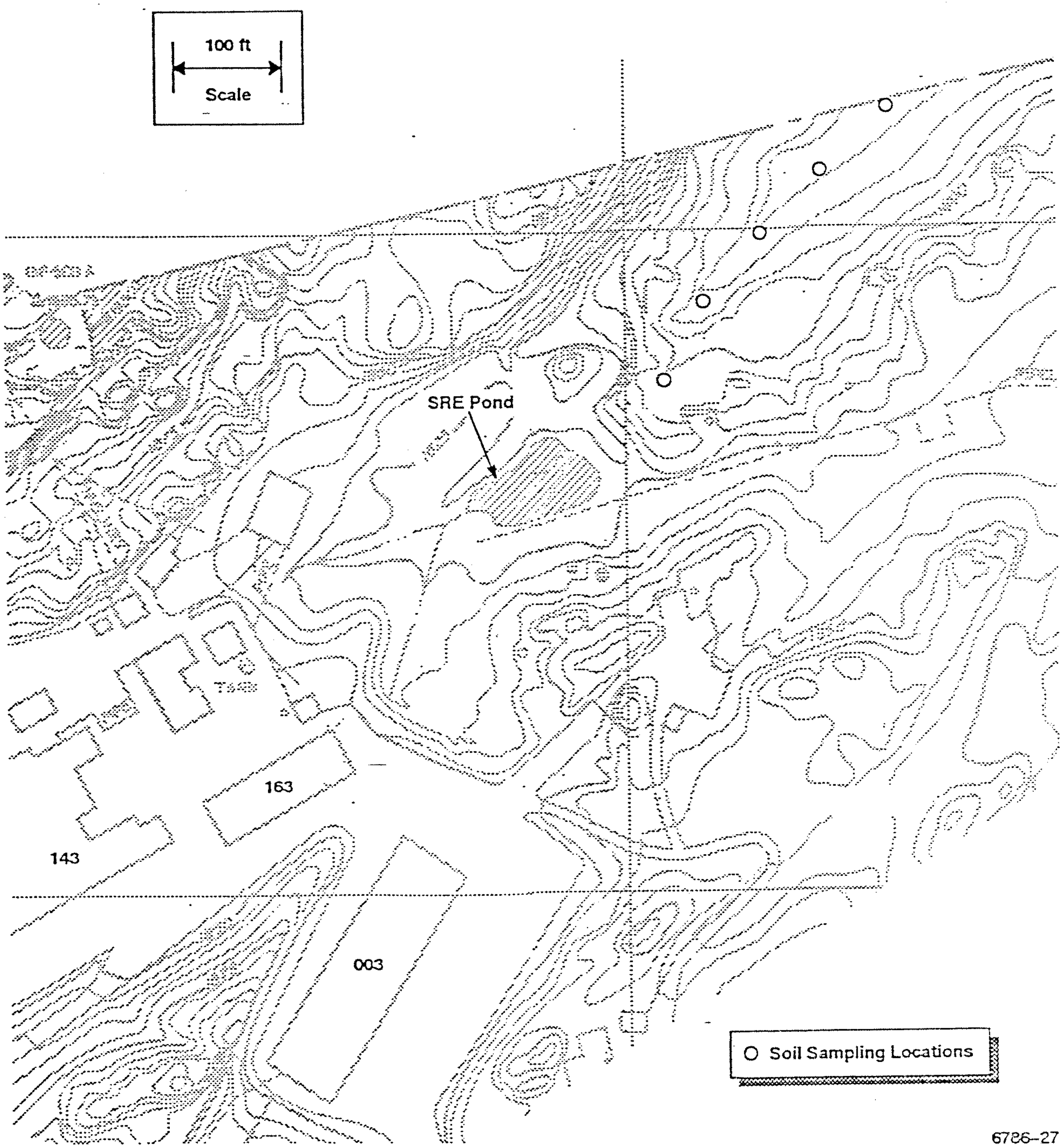
NOTES:

(1) The listed numbers are screening area location identifiers, which will be used only for screening area sampling preparation and data evaluation. The correlation of project sample identification numbers (Section 4.5.3.1.1) and the screening area location identifiers will be documented in the Sampling Logbook. The "D" in the numbers identifies drainage channel samples. The remaining letters and numbers before the hyphen code the drainage channels, as is evident from the subheadings of the channels in the table.

(2) These columns list the coordinates in the State Plane Coordinate System, North American Datum 1983.

(3) These columns list the sample locations within the identified survey block. The East-West and North-South coordinates are those relative to the basepoint (southwest corner) of the survey block.

Figure D-3 Soil Sampling Locations - SRE Pond Drainage Channel



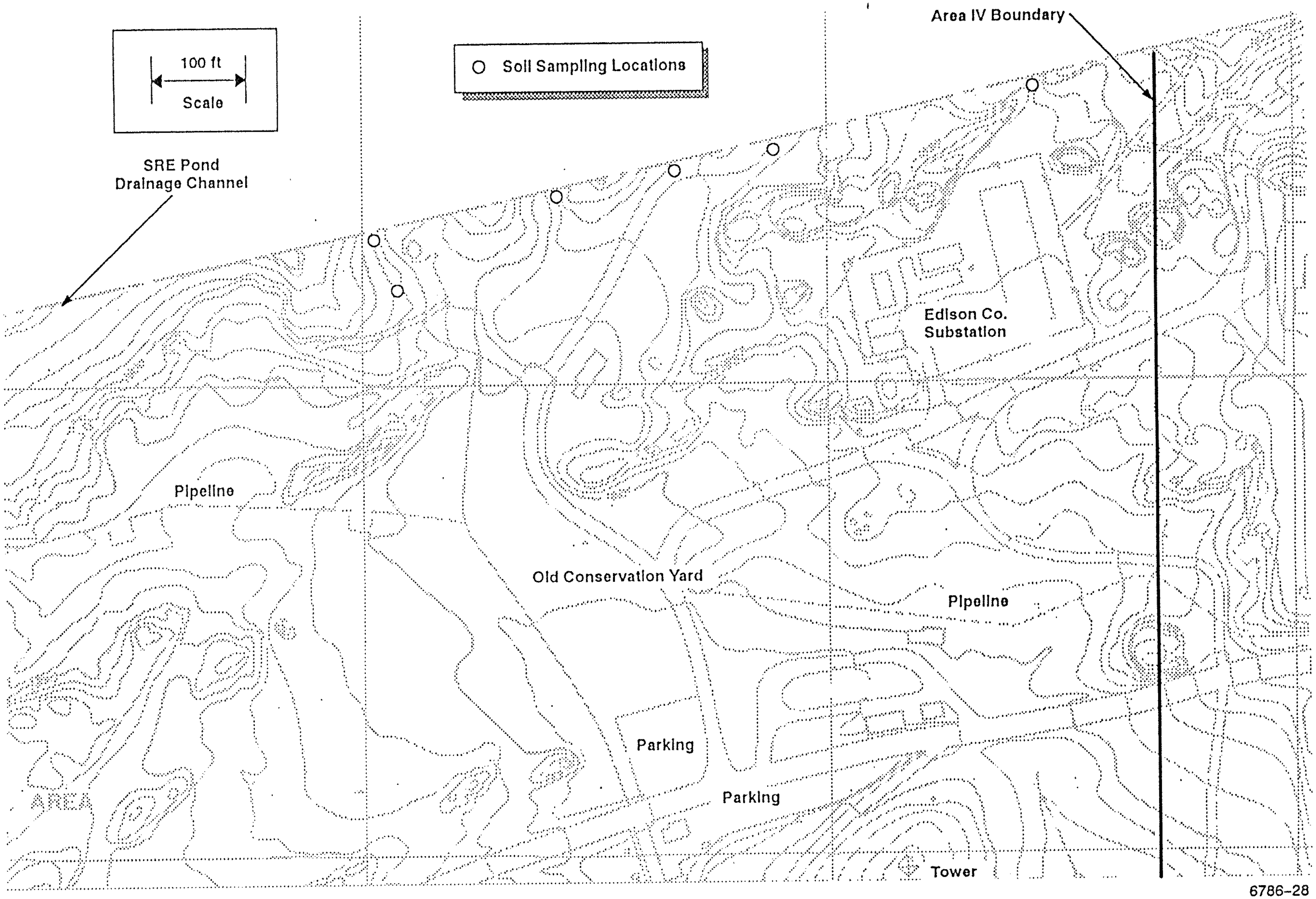


Figure D-4 Soil Sampling Locations - Old Conservation Yard Drainage Channels (North)

Figure D-5 Soil Sampling Locations - Old Conservation Yard South Drainage Channels (South)

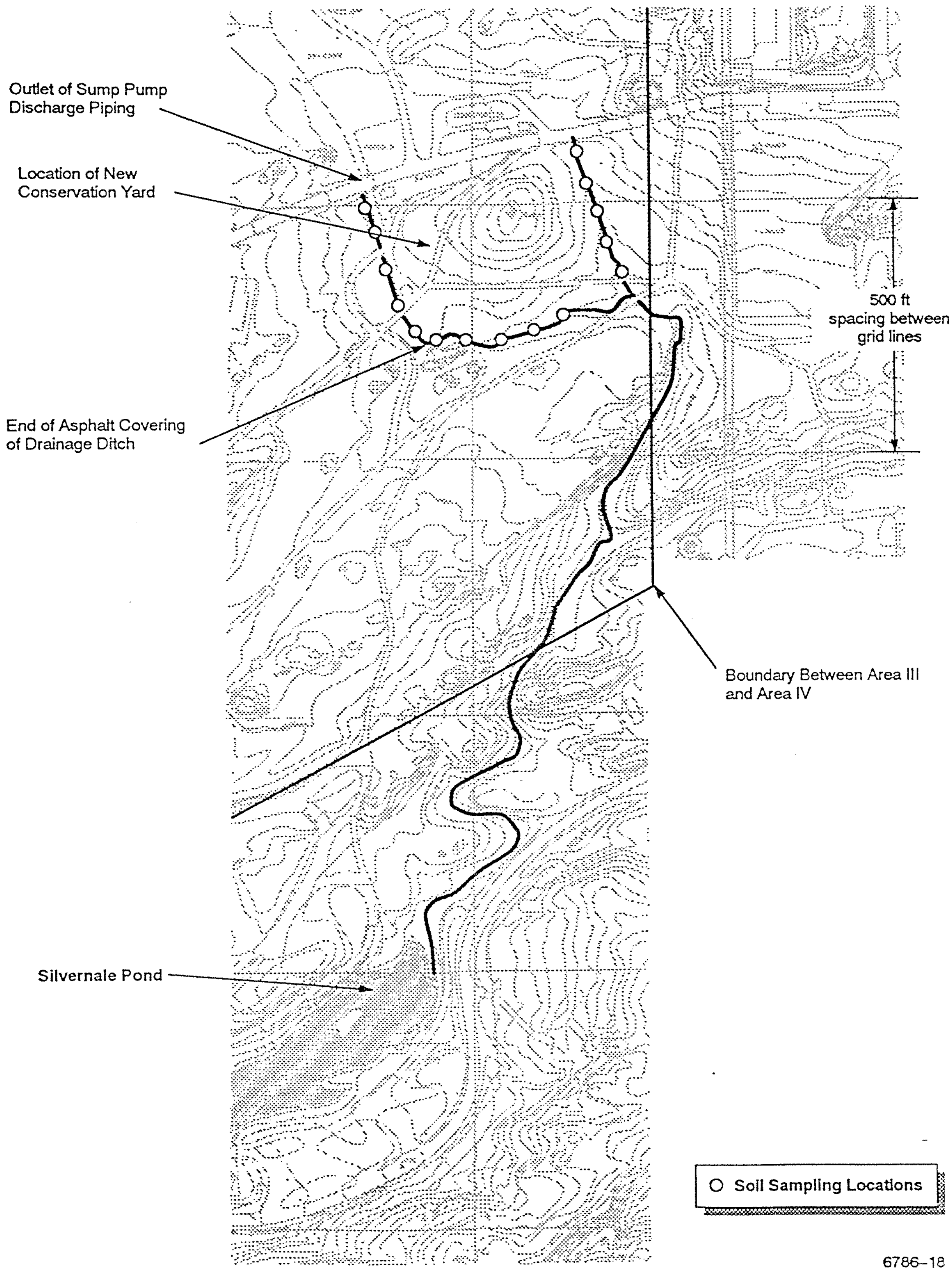
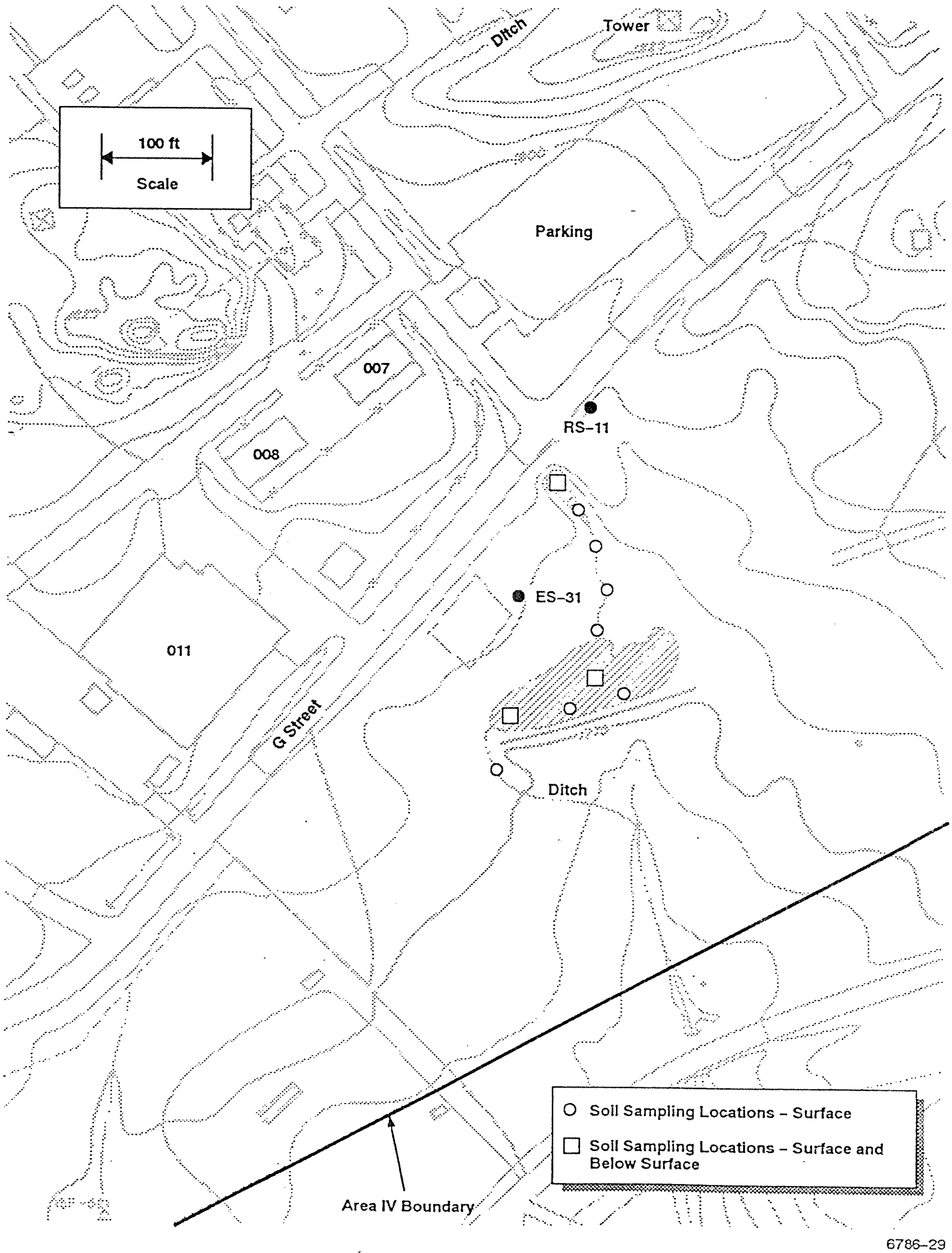


Figure D-6 Soil Sampling Locations - 17th Street Drainage Channel



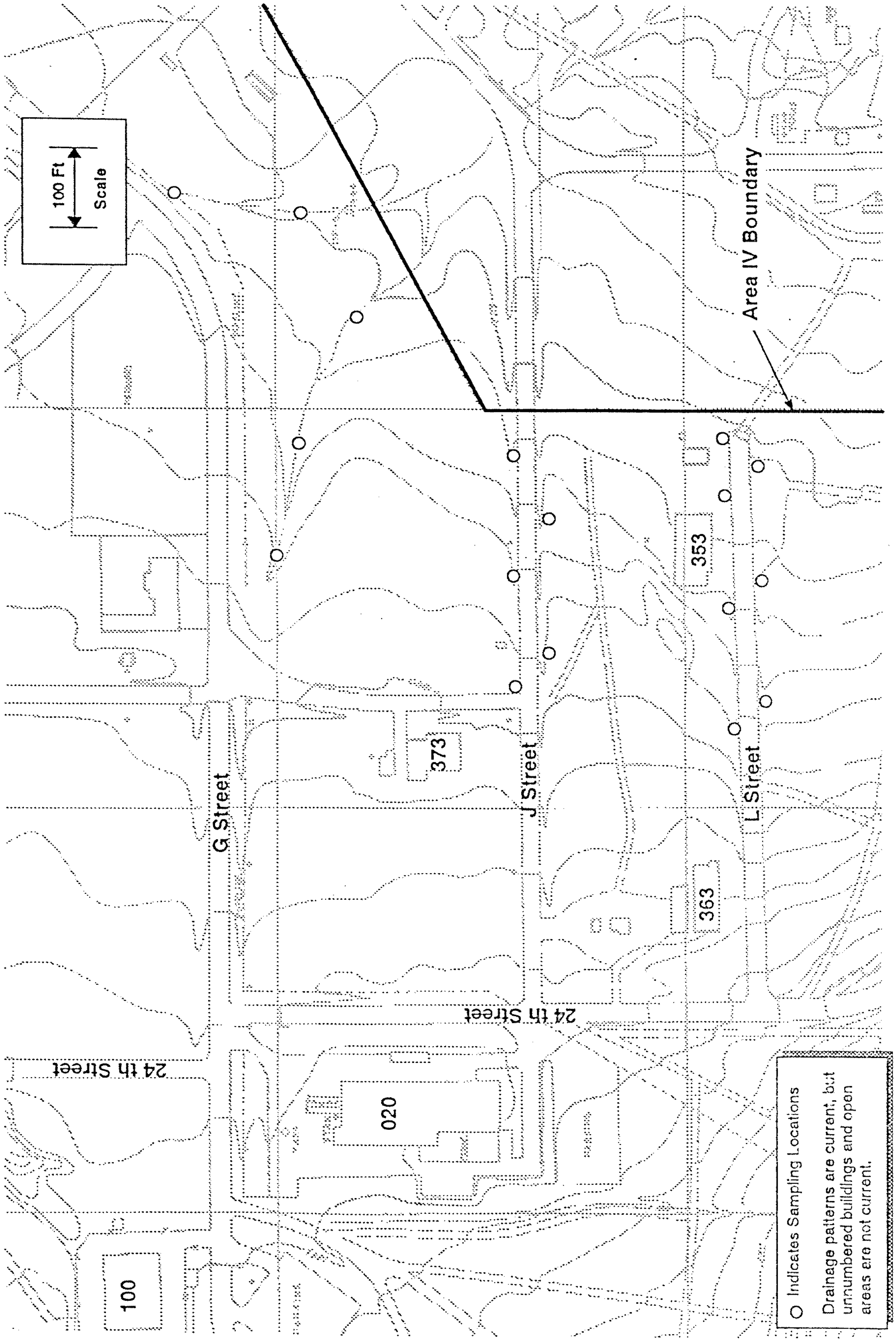


Figure D-7 Soil Sampling Locations - Southeast Drainage Channel

Table D-4

Soil Sampling Locations
Inactive Sanitary Leachfields

Sample No.[1]	Coordinates[2] East-West	Coordinates[2] North-South	Relative Location Within Survey Block[3] Block No.	East-West	North-South	Depth[4]
Building 003/SRE:						
L003-1						
L003-2						
L003-3						
L003-4						
Building 009:						
L009-1						
L009-2						
L009-3						
L009-4						
Building 030:						
L030-1						
L030-2						
L030-3						
L030-4						
Building 064:						
L064-1						
L064-2						
L064-3						
L064-4						
Building 093:						
L093-1						
L093-2						
L093-3						
L093-4						
Building 373:						
L373-1						
L373-2						
L373-3						
L373-4						

Table D-4, Soil Sampling Locations, Inactive Sanitary Leachfields (continued)

NOTES:

(1) The listed numbers are screening area location identifiers, which will be used only for screening area sampling preparation and data evaluation. The correlation of project sample identification numbers (Section 4.6.3.1.1) and the screening area location identifiers will be documented in the Sampling Logbook. The "L" in the numbers identifies leachfield samples. The number before the hyphen identifies the building with which the leachfield is associated.

(2) These columns list the coordinates in the State Plane Coordinate System, North American Datum 1983.

(3) These columns list the sample locations within the identified survey block. The East-West and North-South coordinates are those relative to the basepoint (southwest corner) of the survey block.

(4) Sampling depth is six inches below the leachfield piping.

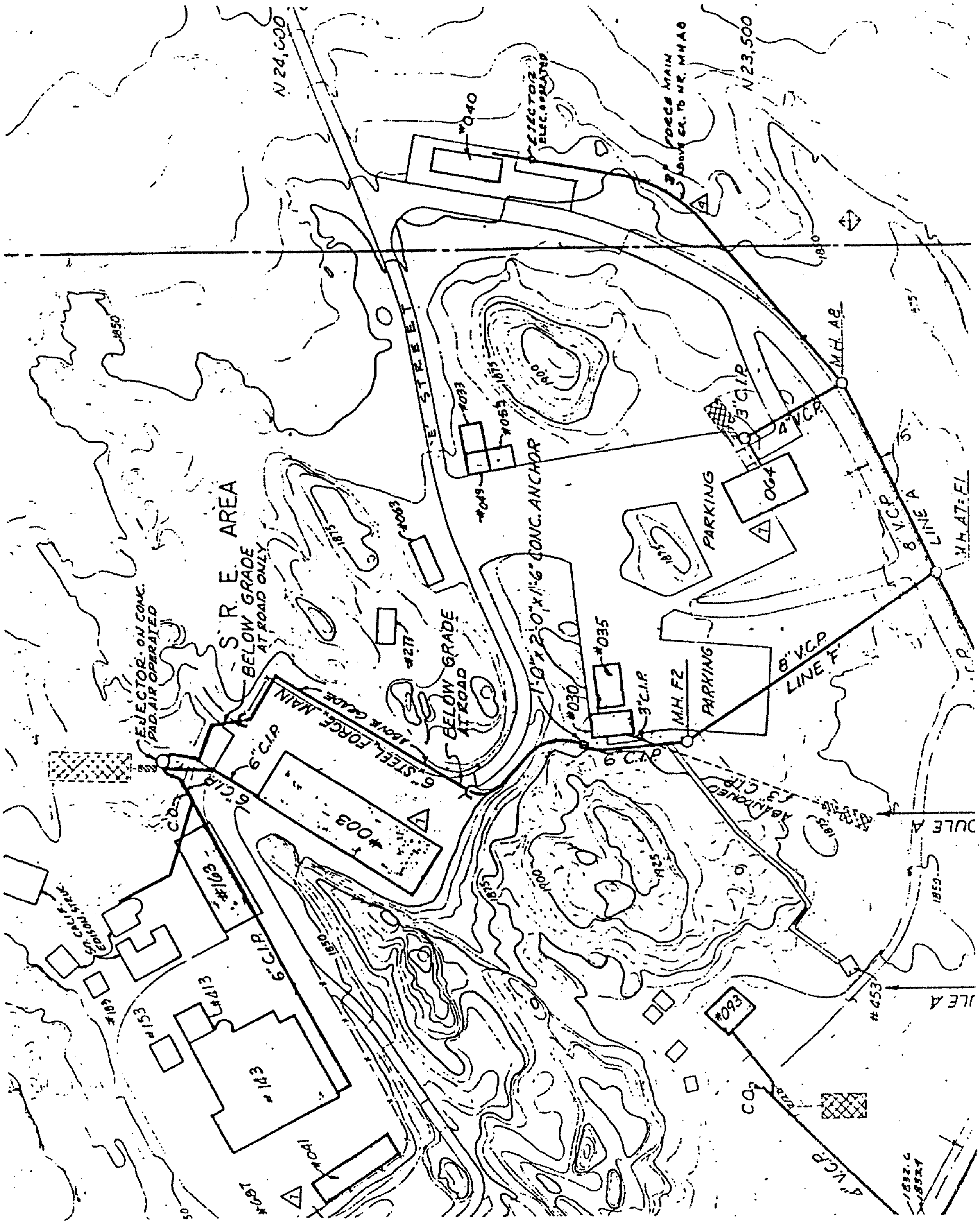


Figure D-8 Soil Sampling Locations - Inactive Sanitary Leachfields for Buildings 003/SRE, 030, 064, and 093

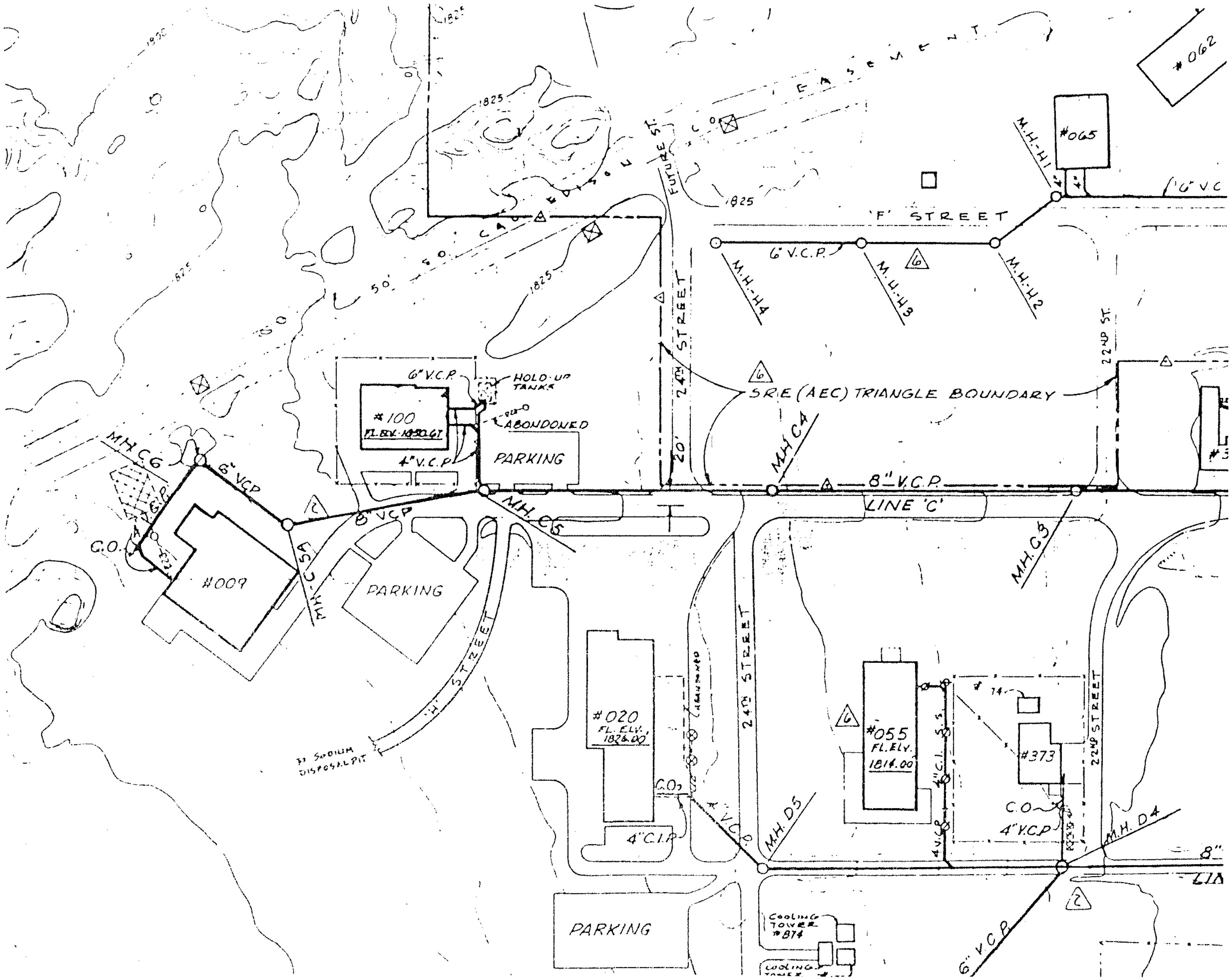


Figure D-9 Soil Sampling Locations of Inactive Sanitary Leachfields for Buildings 009 and 373

Table D-5

Soil Sampling Locations
Areas Around Buildings

Sample No.[1]	Coordinates[2]		Location[3]			
	East-West	North-South	Block No.	East-West	North-South	Depth

TBD pending completion of review of activities in the buildings, prior radiological studies, and a visual inspection of the buildings to identify locations to be sampled.

NOTES:

(1) The listed numbers are screening area location identifiers, which will be used only for screening area sampling preparation and data evaluation. The correlation of project sample identification numbers (Section 4.6.3.1.1) and the screening area location identifiers will be documented in the Sampling Logbook. The "B" in the identifier indicates building area samples. The numbers before the hyphen are the building numbers. The numbers of samples per building are not yet defined. The table is prepared with spaces for three samples. No more than three samples are expected at any building.

(2) These columns list the coordinates in the State Plane Coordinate System, North American Datum 1983.

(3) These columns list the sample locations within the identified survey block. The East-West and North-South coordinates are those relative to the basepoint (southwest corner) of the survey block.

Appendix E Sample Collection Center Desk Instructions

This appendix contains the internal letter (IL 94-026-06-041 dated May 18, 1994, K.T. Knudsen to A. Klein, "Desk Instructions for the Area IV Sample Collection Center") which provided the initial instructions for operations in the Sample Collection Center. It indicates for information the method for processing samples collected in the Area IV Characterization Program. The appendix will not be revised to replace the initial instructions with later revisions unless there is a major revision.

Internal Letter

Rockwell International

Date: May 18, 1994

No: 94-026-06-041

TO: (Name, Organization, Internal Address)
A. Klein
ETEC
D/026, 055-T487

FROM: (Name, Organization, Internal Address, Phone)
K.T. Knudsen
ETEC
D/026, 055-T487
x5158

Subject: **Desk Instructions for the Area IV Sample Collection Center**

The attached instructions should be used by the Area IV Sample Collection Center personnel to receive a soil sample from the field, to ship this sample to the analytic laboratory for analysis, and to receive a soil sample analysis and an analyzed soil sample from the analytical laboratory. Although the Sample Collection Center activities are covered by these instructions and not through a detailed procedure, it is important that all Sample Collection Center personnel be trained on the details of these instructions. Specifically, personnel should be trained on how to fill out the Chain of Custody form, the shipping form, and the Sample Collection Center Log, as well as how to package and ship the soil samples to the analytical laboratory.

K.T. Knudsen

K.T. Knudsen
Systems Engineering

cc:

M.W. McDowell	T487
L.A. Mountford	T487
G.G. Gaylord	T038
R.I. Jetter	T487
P.H. Horton	T009
R.D. Rutherford	T100
S. Reeder	T038

Sample Collection Center Custodian Desk Instructions

Figure 1 shows simplified flow diagrams for receiving a soil sample from the soil sampling Crew Leader and then shipping this sample to a laboratory for analysis and for receiving a soil sample analysis and a soil sample from the laboratory.

Note 1

Prior to entering the Sample Collection Center in Building T009, all soil samples will have been scanned in the field using a Ludlum 12 gamma detector. This gamma scan is performed to ensure that all soil samples entering the Sample Collection Center are below 21,500 cpm per the requirements of ETEC document A4CM-SP-0002, "Area IV Characterization Project - Soil Sampling Procedure". Those samples with counts higher than 21,500 cpm, will remain at the sampling site until direction is given by the Sampling Manager or RP&HPS.

Note 2

Prior to entering the Sample Collection Center all soil sample containers will have been properly sealed and labeled per ETEC document A4CM-SP-0002, "Area IV Characterization Project - Soil Sampling Procedure".

The desk instructions for the Sample Collection Center Custodian follow.

I. Receiving a Soil Sample at the Sample Collection Center:

1. As the soil sampling Crew Leader brings soil samples into the Sample Collection Center, take physical custody of these soil samples by signing the Chain of Custody forms (see A4CM-SP-0002, "Area IV Characterization Project - Soil Sampling Procedure") accompanying the samples.

2. Document the receipt of all soil samples in the Sample Collection Center Logbook (see Figure 2 for format), by noting the soil sample ID number, the date and time the sample was received, the name of the person who delivered the soil sample, the date and time the soil sample was collected, and the soil sample gamma measurement (from the Field Datasheet).

3. Make a copy of the Chain of Custody form and then file this copy in the filing cabinet located inside the Sample Collection Center.

4. Store all soil samples, along with their respective original Chain of Custody forms, in the designated storage area of the Sample Collection Center. Note: Whenever the Sample Collection Center is unmanned, all entrances to this center must be locked and properly secured to preclude access to the soil samples by unauthorized personnel.

5. After direction is given from the Sampling Manager to ship specific soil samples to the analytical laboratory for analysis, prepare the specified soil samples for shipment by placing them in the laboratory supplied shipping containers. Place the original Chain of Custody form inside the respective shipping container and prepare the shipment paperwork per the laboratory's instructions. After packaging, conduct a gamma scan of the package to ensure that the package is non radioactive.

6. Document the shipment of the soil samples in the Sample Collection Center Logbook. Note the date and time of the shipment along with the shipper number.

II. Receiving a Soil Sample Analysis at the Sample Collection Center:

1. The results of the soil sample analyses performed by the analytical laboratory will be received, either directly or as a copy from the recipient, by the Sample Collection Center Custodian. Receipt of the soil sample analyses will be recorded in the Sample Collection Center Logbook by noting the date and time the analysis was received, the lab analysis report number (including the analysis transmittal number), and the status of soil sample.

2. Forward copies of the analysis reports to the Sampling Manager and to the manager of Radiation Protection and Health Physics Services.

III. Receiving a Returned Soil Sample at the Sample Collection Center:

1. After the analytical laboratory has analyzed the soil samples, these soil samples may be returned to ETEC. Receipt of these returned soil samples will be recorded in the Sample Collection Center Logbook, noting the date and time of receipt, the name of the person and company making the delivery, and the soil sample ID number.

2. Take physical custody of all returned soil samples by signing the Chain of Custody form accompanying the returned soil sample.

3. All returned soil samples will be stored in a post-analysis storage area of the Sample Collection Center until authorization is given for shipment or disposal. Soil samples returned from analysis must be stored in a location different from the soil samples which have yet to be analyzed.

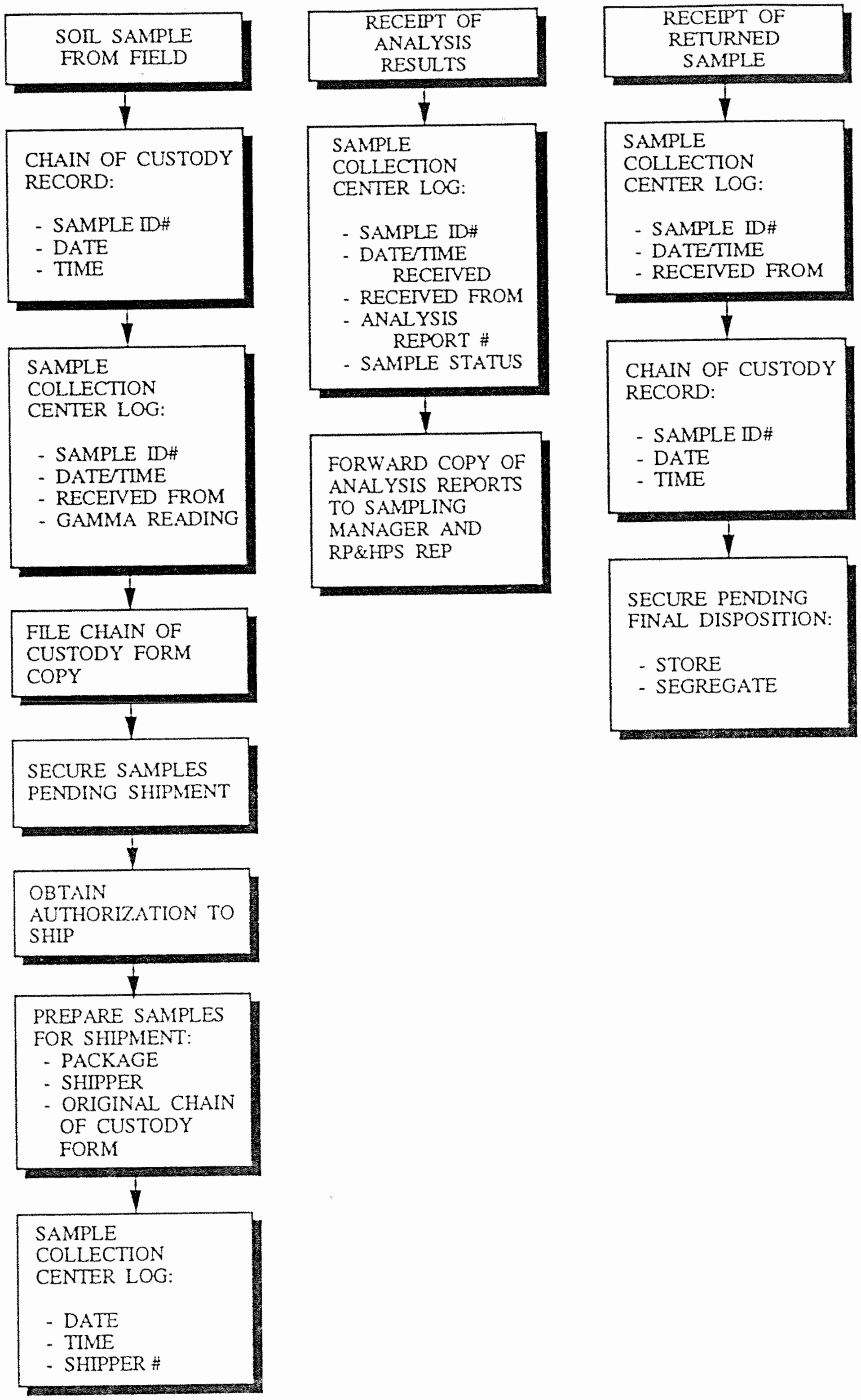


Figure 1. Sample Collection Center Desk Instructions Flow Diagrams

Soil Sample ID Number	Date/Time Sample Received	Sample Delivered By	Date/Time Sample Collected	Sample Gamma Reading (cpm)	Date/Time Sample Sent To Lab	Shipper Number	Date/Time Lab Report Received	Lab Analysis Report Number	Soil Sample Status After Analysis and General Comments
AC4M-94-8888	4/27/94 3:30 PM	A. Klein	4/27/94 10:00 AM	1200	5/23/94 12:35 PM	RI-234-K	6/1/94 2:30 PM	RA-987-K	Soil sample returned with lab report and is being stored pending disposal requirements.
AC4M-94-9999	4/29/94 3:45 PM	A. Klein	4/29/94 1:35 PM	1350	5/23/94 12:35 PM	RI-234-K	6/8/94 1:55 PM	RA-995-K	Soil sample remains at lab pending ETEC direction.

Figure 2. Sample Collection Center Logbook Format With Sample Entries

Appendix F Quality Assurance Samples

This appendix defines the positions of quality assurance samples in each set of soil samples collected.

There are three types of quality assurance soil samples, as described in Section 4.6.4.1. Each is associated with a particular regular soil sample in each collection set. Field duplicate samples are splits of regular samples. Matrix spike samples are regular samples defined as this type of quality assurance sample to specify additional analysis following the normal analysis. Rinseate samples are samples of rinse water after decontamination of sampling equipment following the collection of a regular sample.

Each group of up to 20 soil samples will have one of each of the three types of quality assurance samples. The positions in the sampling order of the regular samples with which the quality assurance samples are associated have been selected randomly using the WINGZ spreadsheet program. The formula for each position (P) is the following:

P = round((rand()*N) + 0.5, 1),

where N = number of samples in the set,

rand() = returns a number selected randomly from a uniform distribution between 0 and 1,

round(...) = returns the value of the adjusted number rounded to one decimal place.

The adjusted number is the random number multiplied by N to spread the range of the random number to cover the number of samples in the set, and increased by 0.5 to avoid values of 0 when rounded. This can also result in the occasional occurrence of values of N+1; however, the random sets defined here do not exceed the number of samples in the set.

The sets of quality assurance sample positions are given in Table F-1 for soil sample sets of 10 to 20 samples. The nominal batch size for laboratory analysis is 20. It is expected that most sets collected will be of this size. Therefore, 15 sets of quality assurance sample locations are defined. These provide margin in coverage of the expected 200 regular samples. It is expected that there will be some sets smaller than 20 samples, although the numbers and sizes are uncertain. Table F-1 includes five sets for each size from 10 through 19 samples. This is more than the number expected for sets of each of these sizes, so the specified sets of positions should be sufficient. The absence of any groups with fewer than ten samples is based on grouping a set potentially smaller than ten with a full set, in order to have at least ten in each set. If additional sets of quality assurance sample positions are needed they may be generated by the same method as those in Table F-1.

The sample manager will specify the positions of quality assurance samples in each batch by using the sets in Table F-1 in the sequence listed for the appropriate sample size.

Table F-1

Quality Assurance Samples

Sample Collection Group	Location in Group Collection Sequence: Field Duplicates	Matrix Spikes	Rinseate
Groups of 20 samples			
1	3	1	10
2	13	16	4
3	18	15	8
4	15	14	19
5	10	19	1
6	7	14	2
7	6	6	20
8	4	3	3
9	2	20	6
10	10	1	11
11	7	15	13
12	13	3	20
13	16	13	12
14	15	6	19
15	12	18	9
Groups of 19 samples			
1	13	4	13
2	16	13	5
3	13	16	9
4	16	3	19
5	5	7	8
Groups of 18 samples			
1	17	17	1
2	18	3	10
3	16	17	12
4	16	11	3
5	17	16	16
Groups of 17 samples			
1	9	2	1
2	13	7	10
3	6	10	10
4	4	6	12
5	9	10	4
Groups of 16 samples			
1	2	8	2
2	3	10	9
3	3	10	10
4	10	11	2
5	10	16	14

Table F-1, Quality Assurance Samples (continued)

Sample Collection Group	Location in Group Collection Sequence: Field Duplicates	Matrix Spikes	Rinseate
Groups of 15 samples			
1	6	6	14
2	15	9	6
3	11	9	2
4	8	6	4
5	9	1	11
Groups of 14 samples			
1	10	7	11
2	12	10	9
3	8	1	10
4	11	12	7
5	6	8	10
Groups of 13 samples			
1	8	12	3
2	10	12	11
3	4	9	13
4	2	11	3
5	13	7	11
Groups of 12 samples			
1	2	7	2
2	6	1	4
3	11	3	2
4	11	7	10
5	8	3	7
Groups of 11 samples			
1	10	8	10
2	3	5	11
3	10	6	3
4	5	4	4
5	5	1	2
Groups of 10 samples			
1	8	9	8
2	3	5	9
3	6	10	5
4	4	5	7
5	3	10	3

Appendix G Statement of Work for Radiochemical Analysis

This appendix contains the Statement of Work for Radiochemical Analysis which defines Area IV Characterization Program sample analysis requirements to serve as the basis for selection of the radiochemistry laboratory to be contracted for the analysis.

ATTACH TO
REQ 50018226

STATEMENT OF WORK

SANTA SUSANA FIELD LABORATORY

AREA IV

RADIOCHEMISTRY LABORATORY ANALYSIS SERVICES

PREPARED BY: W.R. CASTLE

Revised: March 1, 1994

TABLE OF CONTENTS

PART 1.0 INTRODUCTION

1.1 Purpose of the Work

The purpose of this Statement of Work (SOW) is to procure radiochemical analytical laboratory services for the analysis of the Buyer's environmental soil and water samples for specified substances. The samples will be taken from sources that may be radioactive, at low specific activity. The soil and water samples will be transported, by the Buyer, to the Seller's laboratory. The analysis will be used to characterize the Buyer's site and define the nature and extent of contamination.

1.2 Location

The site containing the soil and water samples is Area IV of the Santa Susana Field Laboratory (SSFL), in the Simi Hills, Ventura County, approximately 8 miles west of Canoga Park, CA. Area IV encompasses approximately 290 acres in the northwest section of the SSFL.

1.3 Definitions

The following definitions and acronyms have been used in this SOW.

(a)	SOW	Statement of Work
(b)	SSFL	Santa Susana Field Laboratory
(c)	Buyer	Rockwell International, Rocketdyne Division
(d)	Seller	Radiochemistry laboratory
(e)	EPA	Environmental Protection Agency

PART 2.0 SCOPE

2.1 Work to be Performed By Seller

The Seller shall perform analyses of soil and/or water samples supplied by the Buyer. The methods for particular analyses shall be such that the Required Detection Limits listed in Table 1 are achieved. The analyses shall be conducted under a documented quality assurance/quality control program.

2.2 Work to be Performed By Buyer

The Buyer shall collect and package the soil and water samples in sample transport containers supplied by the Seller, prepare sample transmittal and chain-of-custody forms, and transport the sample transport containers and documentation to the Seller's facility.

The Buyer shall identify a representative who is the authorized individual representing the Buyer. The representative will be the sole Seller contact for technical aspects of this SOW.

The Buyer shall prescreen all samples for radiation levels prior to being shipped off plant-site and shall apprise the Seller of any samples showing elevated radiation levels.

2.3 Equipment/Materials Provided by Seller

The Seller shall furnish all labor, laboratory materials, and equipment required for the analysis of samples. The Seller shall provide the Buyer with all sample transport containers, labels, sample transmittal and chain-of-custody forms.

2.4 Equipment/Materials Provided by Buyer

The Buyer shall provide samples in the Seller provided sample transport containers. Each sample shall be labeled with the field-assigned sample number, date, and time of collection. All samples shall be accompanied by an analysis request form provided by the Seller. The form shall include a signoff to show approval by the Buyer to incur the costs of processing the sample.

PART 3.0 TASKS

3.1 General Requirements

(a) The Seller shall allow a Buyer's representative to perform on-site audits of Seller's facilities, equipment, and analytical procedures used to provide the analytical radiochemistry services specified herein.

(b) The Seller shall currently be participating in inter-laboratory performance evaluation sample analysis program recognized by the EPA or DOE, e.g. Environmental Monitoring Systems Laboratory - Las Vegas (EMSL) or DOE's Environmental Monitoring Laboratory (EML).

3.2 Sample Receipt and Control

(a) The Seller shall designate a sample custodian responsible for receiving all samples.

(b) The sample custodian shall inspect the condition of the shipping containers, sample bottles, and custody seals upon receipt.

(c) The sample custodian shall check for the presence or absence of the required documentation accompanying the sample shipment.

(d) The sample custodian shall sign and date all forms (e.g., custody records and airbills) accompanying the samples at the time of sample receipt.

(e) The Seller shall contact the Buyer to resolve discrepancies and problems such as absent documents, conflicting information, broken custody seals, and unsatisfactory sample conditions (e.g., leaking sample bottle).

(f) The Seller shall maintain records documenting all phases of sample handling from receipt to final analysis. The records shall include documentation of the movement of samples and prepared samples into and out of designated laboratory storage areas.

3.3 Sample Analysis

(a) The Seller shall specify the minimum amount of soil or water material required to perform each of the analyses specified in Table 1.

(b) The Required Detection Limits required for each analyses shall meet or exceed those specified in Table 1.

(c) The Seller shall extract (if applicable) and analyze the Buyer's samples within EPA-recommended holding times.

(d) The Seller shall limit batch sizes to 20 samples or less and shall group the Buyer samples together within each batch. To ensure there is no instrument carry-over, the Seller shall insert and analyze a method blank prior to analyzing each batch of Buyer samples.

3.4 Analyses Results and Documentation

(a) The Seller shall provide a Sample Analysis Report within 30 days after validated time of sample receipt of last sample in the sample delivery group/batch. The report shall be transmitted by letter and include:

(1) Name and address of Buyer

(2) Date and time the sample was taken (provided by the Buyer)

(3) Date analysis was performed

(4) Type of sample (soil or water)

(5) Field-assigned Sampling number (provided by the Buyer)

(6) Methods used

(7) Analytes

(8) Method detection limits (MDL)

(9) Results or findings including (among other things):

(a) Measured analyte values (even when less than the detection limit or MDL) *

(b) Bias values for each analyte *

(c) Precision of each analyte *

(d) Random component of the accuracy of each analyte *

(10) Chain-of-custody form

(b) The Seller shall provide a Batch Quality Control Report within 30 days after validated time of sample receipt of last sample in the sample delivery group/batch. The report shall include (as applicable):

(1) Laboratory extraction/digestion sheets

(2) Summary table of method blank results and reporting detection limits for each parameter and analysis

(3) Summary table of surrogate percent recovery

(4) Summary table of laboratory control standards for Buyer supplied field replicate samples with the calculated percent recovery for each parameter

(5) Summary table of results for Buyer supplied field replicate samples with the calculated relative percent difference for each parameter, where applicable

* Definitions of MDL, bias, precision, and accuracy are found in the definition section of Reference 1 (Part 1 - Section 5.0)

(6) Date analyzed and batch number for each summary table

(c) The Seller shall retain a Supporting Documentation Package to be completed no later than 30 days after the validated time of sample receipt of the last sample in the sample delivery group/batch. The supporting documentation package shall consist of the following:

(1) Sample receipt, storage, tracking, document control, and chain-of-custody documents.

(2) Logbooks

(3) Instrument run logs and maintenance logs

(4) Calculated Minimum Detectable Activities

(5) Signature list for all laboratory personnel working on the project

(6) Document inventory list for each sample delivery group/batch

This documentation shall be maintained in an organized manner allowing for retrieval and reproduction of any of these items. Such retrieval and reproduction will be necessary to perform data review and validation functions and to respond to requests for production of documents for use in legal proceedings.

(d) The Seller shall provide verbal or telefax notification of laboratory results when requested to do so.

(e) The Seller shall provide documentation of participation in inter-laboratory comparison programs such as those sponsored by the US DOE Environmental Measurements Laboratory (EML), the US EPA Quality Assurance programs, local state certification programs, or others which are considered equal. If a subcontractor is to be used, it is the responsibility of the Seller to ensure that the subcontractor also participates in a qualified comparison program. The subcontracted laboratory must be pre-approved by the Buyer.

3.5 Storage

The Seller shall provide long-term storage, not required to exceed one year from the end of the analytical services agreement, of the Buyer's analytical data and records. The Seller shall retain all samples for a period of three months after issuance of the analysis results or until instructed by the Buyer to release the samples for disposal. The Seller shall be responsible for the legal disposal of all samples. The Buyer shall be notified prior to disposal of any samples. It may be requested that some samples be held and not analyzed until directed by the Buyer.

3.6 Points of Contact

The Seller is to accept samples for analyses from only Rocketdyne personnel. The sample analysis request and chain-of-custody form must be signed by an authorized Rocketdyne representative. Copies of the required reports and chain-of-custody data shall be sent to:

Rockwell International Corporation
Rocketdyne Division
6633 Canoga Avenue
P.O. Box 7922
Canoga Park, CA 91309-7922
Attention: TBD
Fax No: TBD

PART 4.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality Assurance and Quality Control measures for each method will include, at a minimum (as applicable):

(a) Five-point calibration curves

(b) Daily calibration checks

(c) Instrument sensitivity checks and mass calibration

(d) Continuing calibrations

(e) Internal calibration standards

(f) Calibration blanks

(g) Method blanks (at least one per batch)

(h) Surrogates

(i) Matrix duplicates (at least one per batch)

(l) Laboratory control standards (at least one per batch)

If a quality control sample or surrogate recovery falls outside EPA Contract Laboratory Program guidelines, the Seller shall re-analyze the sample at no cost, provided holding times have not been exceeded and there is sufficient sample volume remaining. If the sample cannot be re-analyzed, the seller shall qualify the data as either "suspect" or "estimated". In either event, the Seller shall include with the analytical and batch QC reports a case narrative describing the nature of the problem and corrective action(s) taken.

If a reported result appears to be unrealistic, the Buyer may request a repeat analysis, provided that adequate sample material remains on-hand. If the result disagrees with the prior result, this repeat analysis will be performed at no cost to the Buyer.

PART 5.0 REFERENCES

SW-846, "Test Methods for Evaluating Solid Waste", US-EPA (Office of Solid Waste and Emergency Response), 1990 Edition

PART 6.0 ATTACHMENTS

Table 1 Soil and Water Sample Analyses, Required Detection Limits

TABLE 1

SAMPLE RADIOCHEMICAL ANALYSES

REQUIRED DETECTION LIMITS FOR SOIL

ANALYTE	REQUIRED DETECTION LIMITS (pCi/gram)	EPA METHOD NUMBER(1)
Gamma-Emitting Radionuclides	0.02	901.1
Radionuclide Strontium-90	0.01	905.0
Plutonium Isotopes	0.01	907.0
Uranium Isotopes	0.01	907.0
Thorium Isotopes	0.10	907.0
Tritium	0.50	906.0

(1) or equivalent, as adapted to analysis of soil, with respect to accuracy, sensitivity, and freedom from bias and interference. EPA method numbers are from Reference 1.

REQUIRED DETECTION LIMITS FOR WATER

ANALYTE	REQUIRED DETECTION LIMITS (pCi/L)	EPA METHOD NUMBER
Gamma-Emitting Radionuclides	5.00	901.1
Radionuclide Strontium-90	0.50	905.0
Plutonium Isotopes	0.10	907.0
Uranium Isotopes	0.50	907.0
Thorium Isotopes	0.50	907.0
Tritium	500.0	906.0