SOIL SAMPLING PLAN FOR THE TRANSURANIC STORAGE AREA SOIL OVERBURDEN

AND

FINAL REPORT
Soil Overburden Sampling at the RWMC Transuranic Storage Area

Prepared for:

U.S. Department of Energy
Assistant Secretary for Environmental Management
Under DOE Idaho Operations Office
Idaho Falls, Idaho 83415
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March 1990

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U.S. Department of Energy
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Idaho Falls, Idaho 83415
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Waste Management Department
Waste Management Construction Programs
EG&G Idaho, Inc.
Idaho National Engineering Laboratory

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ACRONYMS

AA	Atomic Absorption
ARDC	Administrative Records and Document Control
BSC	Below Screening Criteria
CERCLA	Comprehensive Environmental Response, Compensation and
COC	Chain-of-Custody
DCQAP	Data Collection Quality Assurance Plan
DIRC	Data Integrity and Review Committee
DOE	Department of Energy
DOP	Detailed Operating Procedure
DQO's	Data Quality Objectives
EPA	Environmental Protection Agency
ERP	Environmental Restoration Program
GC	Gas Chromatograph
GM	Geiger-Mueller
HDPE	High Density Polyethylene
HNO_3	Nitric acid
HP	Health Physics Technician
ICP	Inductively Coupled Plasma
IH	Industrial Hygienist
INEL	Idaho National Engineering Laboratory
LLW	Low Level Waste
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethylene
PID	Photo-ionization Detector
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RE	Radiological Engineer
RI/FS	Remedial Investigation/Feasibility Study
RML	Radiation Measurements Laboratory
RWMC	Radioactive Waste Management Complex
SDA	Subsurface Disposal Area
SOP	Standard Operating Procedure
SSP	Soil Sampling Plan
TCL	Target Compound List
TCA	1,1,1-trichloroethane
TCE	Trichloroethylene
TRU	Transuranic
TSA	Transuranic Storage Area
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
WM	Wide-mouth
WMCP	Waste Management Construction Programs

ABBREVIATIONS

Ci	Curie
°C	degrees centigrade
dpm	disintegrations per minute
g	gram
ml	milliliter
ppb	part per billion
ppm	part per million
pH	potential of hydrogen

SOIL SAMPLING PLAN
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SOIL OVERBURDEN

1. INTRODUCTION

This Soil Sampling Plan (SSP) has been developed to provide detailed procedural guidance for field sampling and chemical and radionuclide analysis of selected areas of soil covering waste stored at the Transuranic Storage Area (TSA) at the Idaho National Engineering Laboratory's (INEL) Radioactive Waste Management Complex (RWMC). The format and content of this SSP represents a complimentary hybrid of INEL Waste Management--Environmental Restoration Program, and Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Remedial Investigation/Feasibility Study (RI/FS) sampling guidance documentation.

This sampling plan also functions as a Quality Assurance Project Plan (QAPP). The QAPP serves as a controlling mechanism during sampling to ensure that all data collected are valid, reliable, and defensible. This document outlines organization, objectives and quality assurance/quality control (QA/QC) activities to achieve the desired data quality goals. The QA/QC requirements for this project are outlined in the Data Collection Quality Assurance Plan (DCQAP) for the Buried Waste Program (EG&G, 1988). The DCQAP is a program plan and does not outline the site specific requirements for the scope of work covered by this SSP.

1.1 Background Information

Since 1970 the RWMC (Figure 1-1) has accepted over 2.3 million cubic feet of defense generated and other transuranic (TRU) waste for interim 20-year retrievable storage. Waste is stored on adjoining, above ground asphalt pads at the Transuranic Storage Area of the RWMC (Figure 1-2), with the pads being composed of several cells. There are eight cells in TSA-1 and three cells in TSA-2, while one cell comprises TSA-R pad.

ARA	Auxiliary Reactor Facility
ANLW	Argonne National Laboratory West
CFA	Central Facilities Area
EBR I	Experimental Breeder Reactor I
EBR II	Experimental Breeder Reactor II
ICPP	Idaho Chemical Processing Plant
IET	Initial Engineering Test
LOFT	Loss-of-Fluid Test (Facility)
NRF	Naval Reactor Facility
PBF	Power Burst Facility
RWMC	Radioactive Waste Management Complex
TAN	Test Area North
TRA	Test Reactor Area
TREAT	Transient Reactor Test (Facility)
TSF	Test Support Facility
WMO	Waste Management Operations
WRRTF	Water Reactor Research Test Facility
ZPPR	Zero Power Physics Reactor

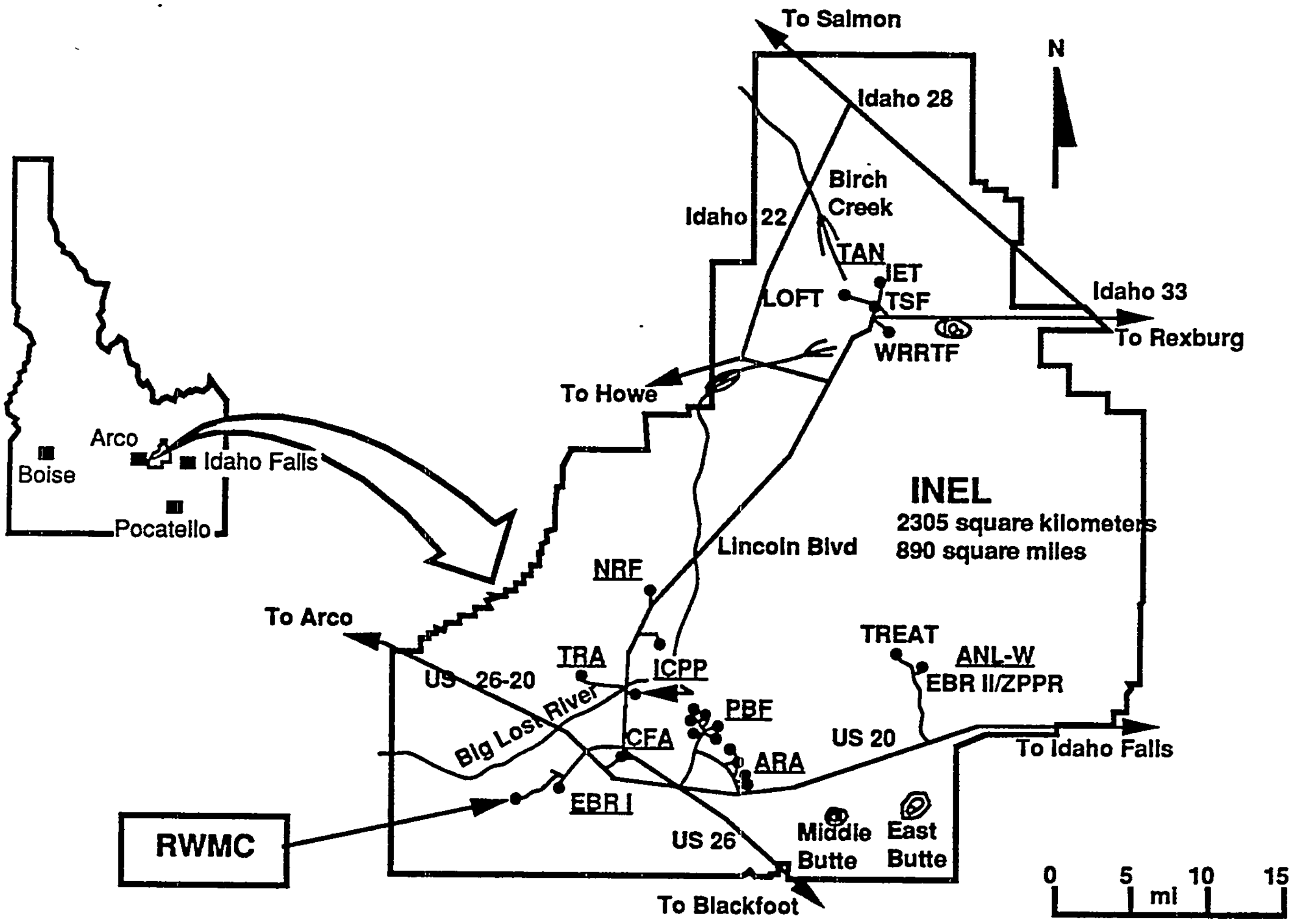


Figure 1-1.. Map of the INEL showing the location of the RWMC.

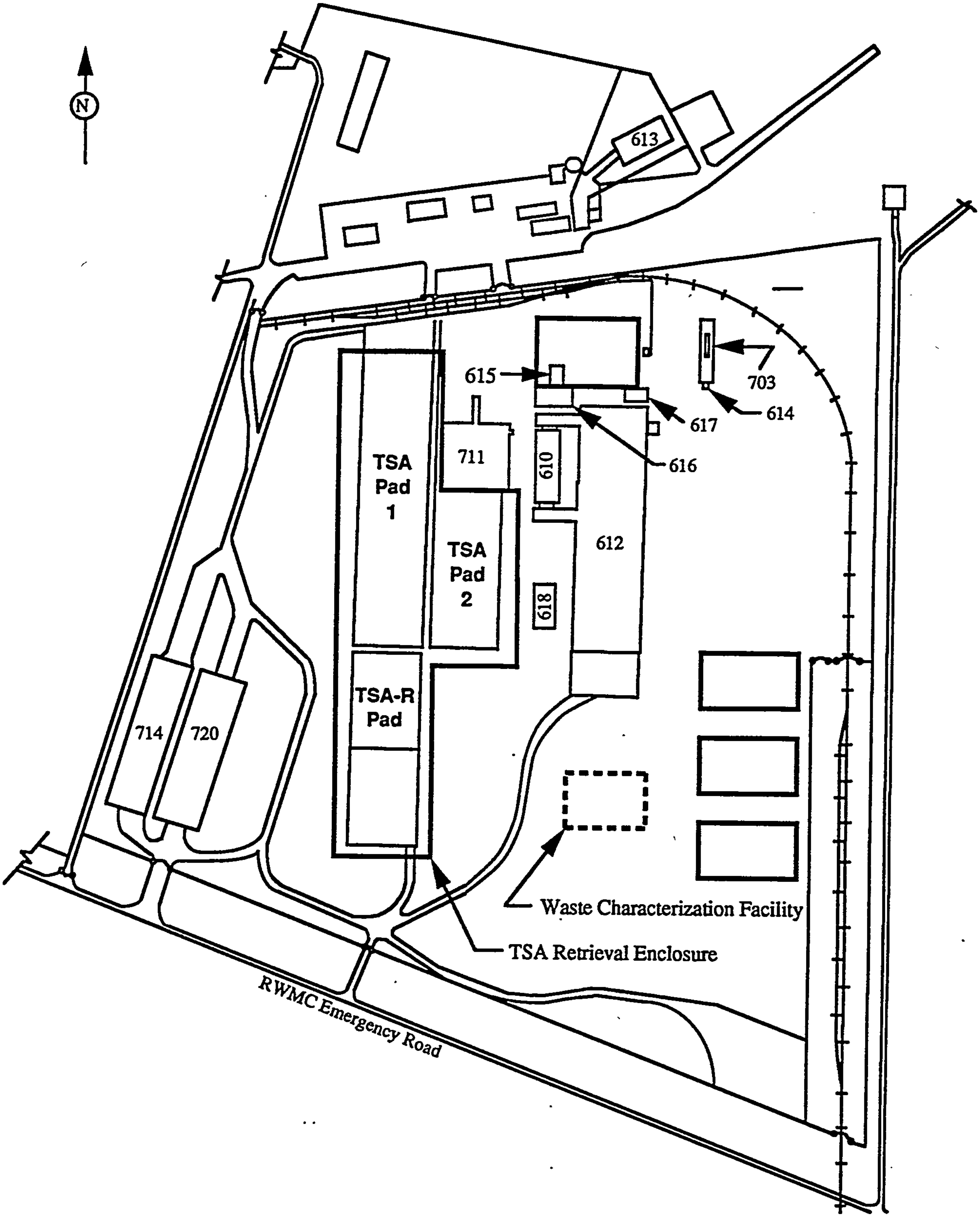


Figure 1-2. Map of the RWMC showing the location of the TSA Pads.

Once a cell reached its volume limit, the waste containers were topped by plywood and polyvinyl sheeting followed by approximately four feet of soil cover. To reduce grade angle, sideburden soil depths average approximately sixteen feet at the edge of the buried cargo containers. There is a potential that some breaching of waste containers has occurred with the possibility for contaminant migration into the overburden soil due to decay in the overlying plywood and plastic sheeting materials. Contamination due to lateral migration of waste material is also possible. The underlying soil is protected by asphalt pads that drain into collection areas. To date, no indications of any hazardous waste spills have been detected from containers in the cell areas overlain by soil. However, leaks from containers stored on TSA-R pad are known to exist. The area of the TSA-R cell where these containers lie is overlain only by plywood and plastic sheeting and does not fall within the sampling breadth of this SSP.

1.2 Objectives of the Sampling Effort

Because of the interim nature of the retrievable storage area and the threat of hazardous waste leakage and subsequent contamination of the surrounding area, DOE has initiated plans to help rectify the current storage situation at the TSA pads. Foremost of these is the erection of a large retrieval enclosure building over the entire storage area. The building will control climatological events and mitigate any potential contamination from escaping the TSA pads. This building will be constructed prior to the removal of overburden soil from TSA-1 and TSA-2 so that environment and contamination can be controlled during the removal operation.

The ultimate Program objective is to characterize, retrieve, and dispose of overburden soil on a per cell basis. However, budgetary constraints limit the scope of this SSP to the characterization of overburden soils in TSA-R pad, the approach ramp area south of TSA-2, and around the perimeter of the proposed retrieval enclosure building. If time and budget allow, other areas of the TSA have been prioritized for sampling and analysis. The characterization of the soil along the margins of the enclosure building foundation will ensure worker health and safety during construction of the retrieval building and will also reduce the risk that contaminated soil will be removed and improperly disposed of during preparatory foundation work. Overburden soil on TSA-R will be sampled and analyzed because the overburden from this cell will be removed prior to initiation of construction. Access ramp soil in the southern area of TSA-2 will also be sampled and consequently removed, although it does not overlie any hazardous waste materials. Upon completion of the retrieval enclosure building, prioritized soil removal will proceed from south to north, from TSA-1, cell 1 through TSA-1, cell 8 and then from TSA-2, cell 1 to TSA-2, cell 2.

A flow chart depicting generalized sampling and analysis procedures for TSA overburden sampling is shown in Figure 1-3. The initial phase of retrieval involves screening of the TSA soil overburden for radiological and chemical contaminants. Phase 1 of the sampling will involve field screening of the soil with portable radiation detection instruments and analysis using a field gas chromatograph (GC). Field screening of the soil with portable radiation detection instruments should locate any potential zones of surface radiological contamination. If radiological contamination is detected, these areas will be selected as biased sample locations. Samples will also be collected and analyzed for Volatile Organic Compounds (VOC's) using a field GC. Volatile compounds have the highest potential for migration from the storage cells to surrounding overburden. Because transport mechanisms such as movement of water and mixing of soil are not thought to occur at the TSA pads, metals, polychlorinated biphenyls (PCB's) and radionuclides are not expected to have migrated into the overlying soil. The occurrence of VOC's is more likely as the gaseous phase of these compounds can travel more readily through soil interstitial spaces. However, since mercury does have a vapor pressure, it is possible that mercury has moved into the overburden.

After phase 1 sampling and analysis has been completed and the data has been reviewed, phase 2 sampling and analysis will commence. Phase 2 overburden sampling and analysis will consist of verification sampling. If no VOC's are detected, using the field GC, the assumption will be made that no other hazardous waste materials are present, as other transport mechanisms are much less active as compared to those of VOC's. However, as a means

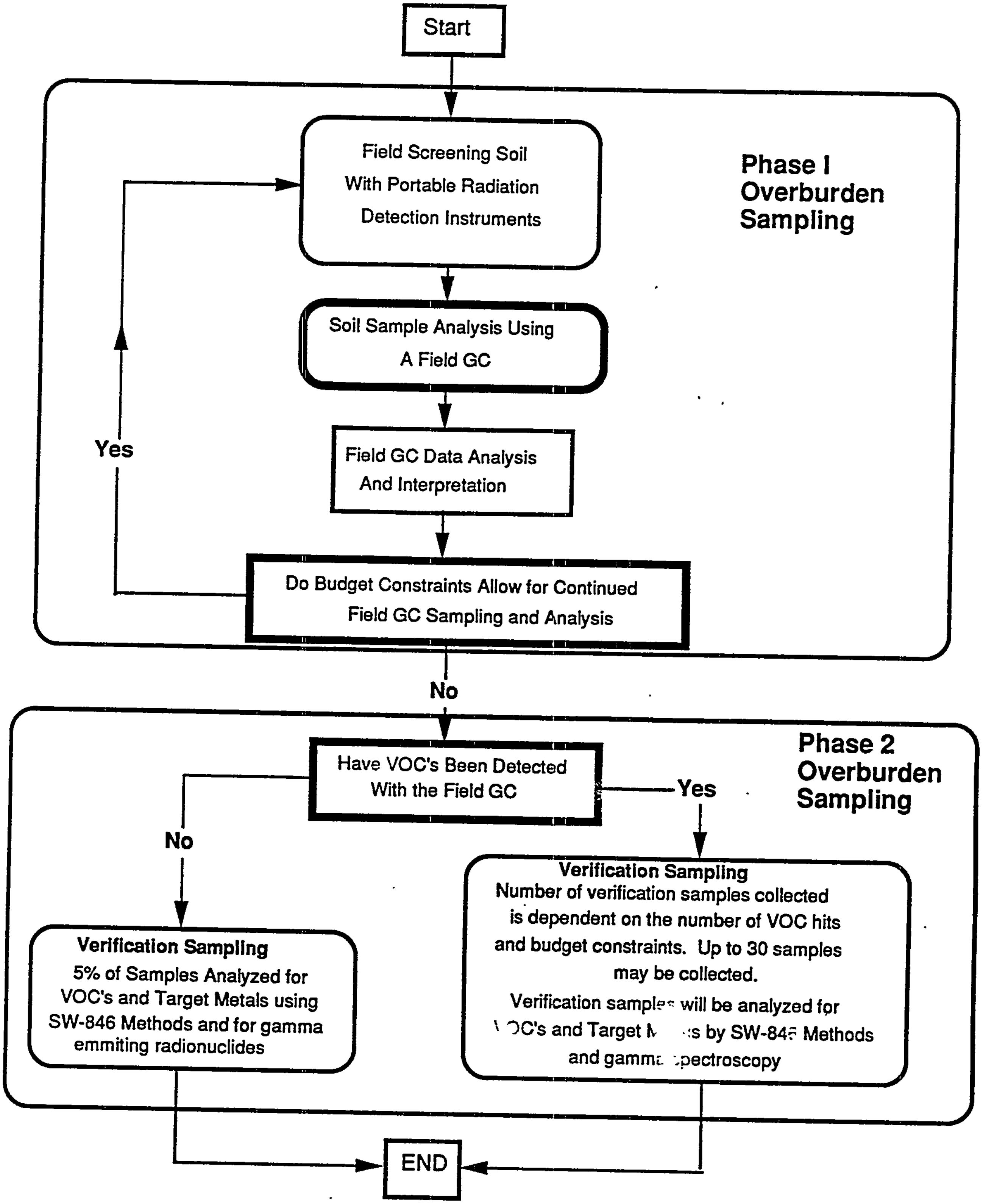


Figure 1-3. Flow chart outlining sampling and analysis procedures for the TSA Soil Overburden Sampling Plan.

of verification, 5% of the samples will be analyzed for VOC's, target metals and PCB's using EPA SW-846 methods and for gamma emitting radionuclides by gamma spectroscopy.

In addition to gamma spectroscopy used as verification, soil samples will be surveyed by RWMC HP's using techniques to determine gross alpha and beta. In the event that VOC's are detected, verification samples will be analyzed for VOC's, target metals, and PCB's using SW-846 Methods and for gamma emitting radionuclides by gamma spectroscopy. In this case, the number of verification samples will vary, dependent upon the total number of VOC hits and budget constraints, but up to 30 samples may be collected for verification.

Gamma spectroscopy will be used as a preliminary analysis to determine the presence of gamma emitting radionuclides (including ^{241}Am). Evaluation of the gamma spectroscopy data may produce information about alpha and beta emitters based on the presence and activity per unit mass of specific gamma emitters. For example, the presence of ^{241}Am is a good indication of other transuranics and ^{137}Cs is indicative of ^{90}Sr. Since determination of alpha and beta emitting radionuclides in soils is time consuming and expensive, screening the samples using gamma spectroscopy (non-destructive) is consistent with the goals of this sampling activity.

The primary objective of TSA Soil Overburden Sampling is to characterize overburden which will initially be impacted by construction of the foundation of the Retrieval Enclosure building to maintain worker health and safety during enclosure building construction. Analytical Level II and III data will be collected to characterize the overburden. This data quality level is adequate to assure worker health and safety during overburden removal and transport. Soil overburden characterized as being non-contaminated will qualify for soil removal operations detailed in the <u>TSA Retrieval Process</u> document. Areas considered to be contaminated may require further characterization to establish effective remedial response.

2.0 PROJECT DESCRIPTION

2.1 Analysis of Existing Data

Existing data are limited to records of chemical waste stored on the TSA pads. These records indicate date of storage, waste type and matrix, and waste container. Data are also available regarding potential radiological contamination at the TSA-R spill site. From this data, the following TSA specific analyte (target) list has been developed:

Target Organic Compounds:

Carbon tetrachloride
Methylene chloride
Nitrobenzene
1,1,2,2-tetrachloroethylene (PCE)
1,1,1-trichloroethane (TCA)
Trichlorethylene (TCE)
1,1,2-trichloro-1,2,2-triflouroethane
Xylene
Polychlorinated Biphenyls (PCBs)

Target Metals:

Beryllium
Cadmium
Chromium
Lead
Mercury

2.2 Data Quality Objectives

The Sampling and Analysis Plan is based upon Data Quality Objectives that were developed as outlined below.

2.2.1 Information Required to Make Decision

The soil overburden removal status for the TSA pads will be based upon the presence or absence of contaminants in the overburden and sideburden. Contamination due to volatile organic compounds, metals, PCB's or radionuclides may be present. Soil will be screened as hazardous, radioactive, mixed, or below screening criteria (BSC). To make soil removal decisions, contaminant levels in soils will be compared to action limits. Action levels for metals are determined from concentrations in background samples. Action levels for Target Organic Compounds are set at three times the Method Detection Limit (MDL). Action levels for radionuclides are set by using EG&G Idaho Criteria for Decontamination and Decommissioning of Nuclear Facilities. Action levels are discussed in greater detail in Section 4.3. If volatile organics are not detected in the soils, it is assumed that metals and radionuclides are not present in the soils. Verification of this hypothesis by analysis for metals and gamma emitting radionuclides will be performed on a limited number of samples.

It is not the objective of this sampling plan to determine the concentration of all metals and radionuclides, but to use target analytes and indication radionuclides to make an estimate of concentrations. The budget and time constraints of this project do not allow for determination of all radionuclides at detection limits equal to or less than the radiological release criteria. Evaluation of the gamma spectroscopy data (Section 2.1) will produce indications of alpha and beta emitting radionuclides.
If contaminant levels exceed action limits, measures will be taken to ensure proper removal, transport, and disposal of contaminated soil. Soil categorized as non-contaminated may be used as RWMC backfill. Action levels, as described in this paragraph, are to be used as concentrations that trigger further evaluation. Final disposition of the overburden material may be based

on separate criteria, yet the action levels provide a conservative basis for decisions.

2.2.2 Potential Consequences of Inadequate Environmental Data

Environmental data that is not truly representative of either TSA soil overburden or background soils could lead to incorrect soil removal decisions. Data that indicates the presence of soil contamination when none actually exists would unnecessarily trigger phase II sampling and analysis and more extensive soil removal and disposal practices. The result would be and over-expenditure of available human and financial resources. Conversely, data that incorrectly indicated a lack of contamination would result in the premature removal, and consequent spreading into uncontaminated areas, of the overburden soil as well as a failure to address an existing contamination problem.

It is important to note that this sampling and analysis effort is a screening effort only. Field screening techniques combined with analysis is used to gain information about the analytes of interest and to infer the presence or absence of materials that have similar transport mechanisms.

2.2.3 Specific Environmental Data Required

2.2.3.1 Levels of Metals in Background Soils.

Representative, undisturbed surface soils from the general source area of soil overburden will be sampled and analyzed to determine naturally occurring levels of target metals. The concentrations of these metals in background samples provide a basis for evaluating contaminants in the overburden soils. Background samples will be collected only if phase I sampling data warrant phase II overburden analysis for target metals.

2.2.3.2 Contaminant Levels in Site Overburden.

Statistically representative samples of soils must be analyzed to determine contaminant concentrations. Concentrations of contaminants are compared to action levels to demonstrate the presence or absence of contamination.

Specific analyses of the soils will consist of methods outlined in Section 8.0 of this SSP: metals (beryllium, cadmium, and chromium) by inductively coupled plasma (ICP) emission spectroscopy (EPA Method 6010); mercury by cold vapor atomic absorption (AA) spectroscopy (EPA Method 7471); lead by furnace AA (EPA Method 7421); PCB's (EPA Method 8080); and gamma-emitting radioisotopes by gamma spectroscopy. Gamma spectroscopy will be performed by the Radiation Measurements Laboratory (RML) at INEL. Target Volatile Organic Compounds will be analyzed for using a field gas chromatograph. Verification sampling for VOC's will use EPA Method 8240 or 8260 to support the results obtained by the field GC unit.

2.2.4 Domain of Decision

The Sampling Plan specifically addresses the Transuranic Storage Area. Actions resulting from evaluation of data will impact the TSA pads. Should data from sampling efforts indicate contamination above action levels, land adjacent to these areas may be impacted during removal of contaminated soil.

2.2.5 Information to be Derived from Environmental Data

Laboratory data resulting from the analysis effort will be evaluated to determine if contamination exceeds action levels, with the information being used to determine soil removal options.

2.2.6 Identification of Primary and Secondary Data Users

The primary data user is the RWMC, with whom decisions regarding TSA soil overburden management practices rest. Secondary data users may include other Waste Management Programs and regulatory agencies including DOE-ID, the EPA, and the State of Idaho.

2.2.7 Identification of Analytical and Quality Assurance Levels

All TSA soil overburden analysis, performed in Phase I will be EPA Analytical Level II. Level II data is used as a site screening/characterizing tool, providing qualification and quantification of specific analytes. Data quality is dependent upon QA/QC steps employed. Data Quality Objectives (DQO's) outlined in Section 2 will be followed to ensure that valid data results

2.2.8 Summary

Table 2-1 summarizes the Data Quality Objectives (DQOs) for this sampling and analysis effort.

Table 2-1. TSA Overburden Data Quality Objectives.

Sample Locations:	TSA Overburden and Sideburden	Verification Samples	Background Samples
ACTIVITY	Obtain subsurface soil samples and analyze for VOC's using a field GC.	Obtain subsurface soil samples and analyze for VOC's, Target Metals, PCB's and gamma emitting radionuclides.	Obtain biased composite surface soil samples from the source location of TSA overburden.
OBJECTIVES	Health and safety screen of overburden and sideburden for VOC's prior to construction of the enclosure building foundation.	Verify results of portable GC screening, determine levels of Target Metals, PCB's and gamma emitting radionuclides in the overburden and sideburden.	Determine background levels of Target Metals for comparison with potentially contaminated overburden and sideburden.
PRIORITIZED DATA USE	Ensure worker health and safety, prevent improper disposal of contaminated soil during foundation construction.	Ensure worker health and safety, prevent improper disposal of contaminated soil during foundation construction. Verify field GC results.	Provide a basis for evaluating Target Metal contamination in TSA sideburden and overburden.
APPROPRIATE ANALYTICAL LEVELS	Level II	Level III	Level III
CONTAMINANTS OF CONCERN	VOC's	VOC's, Target Metals, PCB's, radionuclides	Target Metals
LEVEL OF CONCERN	VOC's: 3 x MDL	Metals: 95% upper one-tailed tolerance limit. VOC's: 3 x MDL Radionuclides: greater than D&D Release Criteria. PCB's: 3 x MDL	N/A
CRITICAL SAMPLES	90% Completeness Criteria	90% Completeness Criteria	90% Completeness Criteria

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

Figure 3-1 presents the TSA soil overburden sampling task organization chart. Responsibilities are summarized below.

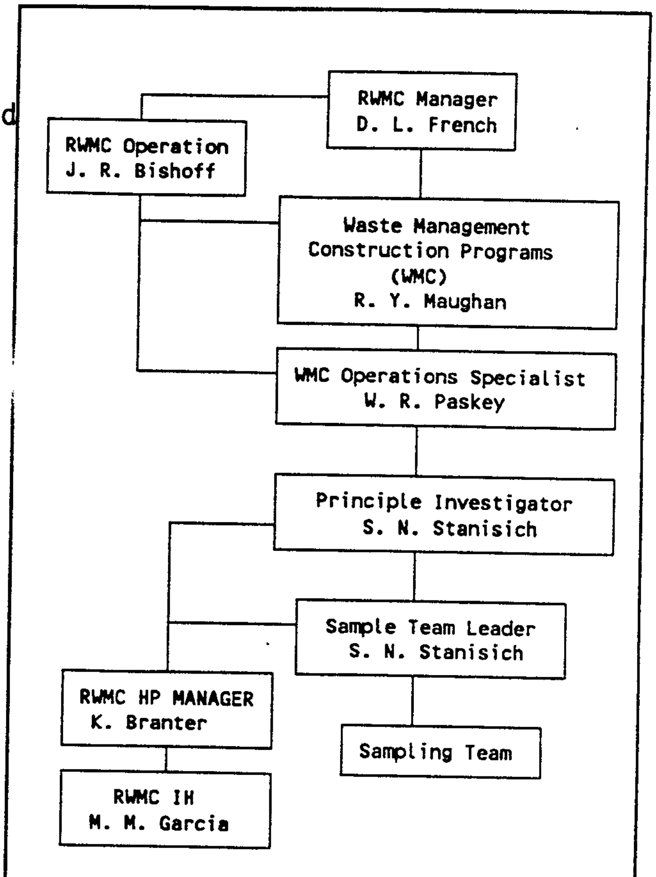


Figure 3-1. TSA Soil Overburden Sampling Task Organization Chart.

3.1 RWMC Manager

The RWMC Manager, D. L. French, is responsible for the safe completion of all operations within the RWMC.

3.2 RWMC Operations Manager

The RWMC Operations Manager, J.R.Bishoff, is responsible for the coordination of all operational personnel within the RWMC.

3.3 Waste Management Construction Programs (WMC) Manager

The Waste Management Construction Programs (WMC) Manager, R. Y. Maughan, is responsible for the safe completion of all TSA retrieval operations including overburden sampling. The WMC Manager is also responsible for ensuring that all required documentation is in place prior to operations.

3.4 WMCP Operations Specialist

The WMCP Operations Specialist, W. R. Paskey, will serve as the interface between retrieval operations, including sampling, and upper management.

3.5 Principal Investigator

The Principal Investigator, Scientist, S. N. Stanisich, is responsible for identifying data needs and organizing and coordinating the sampling effort required to meet those needs.

3.6 Sample Team Leader

The Sample Team Leader, S. N. Stanisich, is responsible for overseeing the soil sample collection effort, and ensuring that collection procedures as provided in this document and relevant RWMC Detailed Operating Procedures (DOP's) are followed. The Sample Team Leader is also responsible for sample packaging and transport.

3.7 Sampling Team

The Sampling Team is responsible for collecting soil samples as specified and ensuring that proper equipment decontamination procedures are followed. The sampling team will strictly adhere to safety precautions as outlined in the Health and Safety Plan within this SSP and in RWMC safety documentation under the direction of an on-site Health Physics Technician (HP) and Industrial Hygienist (IH).

3.8 Radiological Engineer

The Radiological Engineer (RE) will be the primary source of information and guidance for the monitoring and screening of overburden soils for radiological contamination. A Health Physics (HP) Technician, as assigned by K. Branter (HP Manager), will be present during all TSA overburden sampling activities.

3.9 Industrial Hygienist

The Industrial Hygienist (IH), M. M. Garcia, will be the primary source of information regarding non-radiological chemical hazards at the sampling site. The IH, or designated alternate, will be available during all TSA overburden sampling activities.

4.0. SAMPLING AND ANALYSIS STRATEGY

4.1 Purpose

The sampling and analysis strategy has been designed to cost effectively characterize TSA overburden and sideburden material. A combination of field screening equipment and analytical laboratory equipment will be employed to analyze overburden samples. Field screening with a field Gas Chromatograph (GC) can provide data of an acceptable quality level (Data Quality Level II) for health and safety screening of the overburden, with a rapid turn-around time for analysis, furnishing a maximum amount of information at a minimal cost. Verification sampling of field GC results will be made using Methods described in Test Methods For Evaluating Solid Waste (SW-846) (EPA, 1986). Verification sampling will be used to confirm or refute the presence of elevated levels of VOC's, as well as ascertaining the presence or absence of target metals, PCB's and radionuclides in TSA overburden. A combination of systematic, random, and biased sampling will be employed to characterize overburden and sideburden at TSA.

4.2 First Priority Sample Locations

The areas to receive the highest sampling priority are the cell margin sideburden on the west edge of TSA, sideburden to the east and north of cells 1 and 2 of the TSA-2 Pad, sideburden to the east of TSA-1 Pad, Cells 4 through 8, the Approach Ramp Area located at the south end of TSA-2 Pad; the Caisson Area located between TSA pads 1 and 2, and the section of TSA-R Pad which is covered with overburden (See Figure 4-1). Sideburden material receives first priority sampling because it will be removed during foundation construction operations for the enclosure building. Overburden at the TSA-R Pad will be removed prior to enclosure building construction as well as the Approach Ramp Area in order to decrease ramp grade.

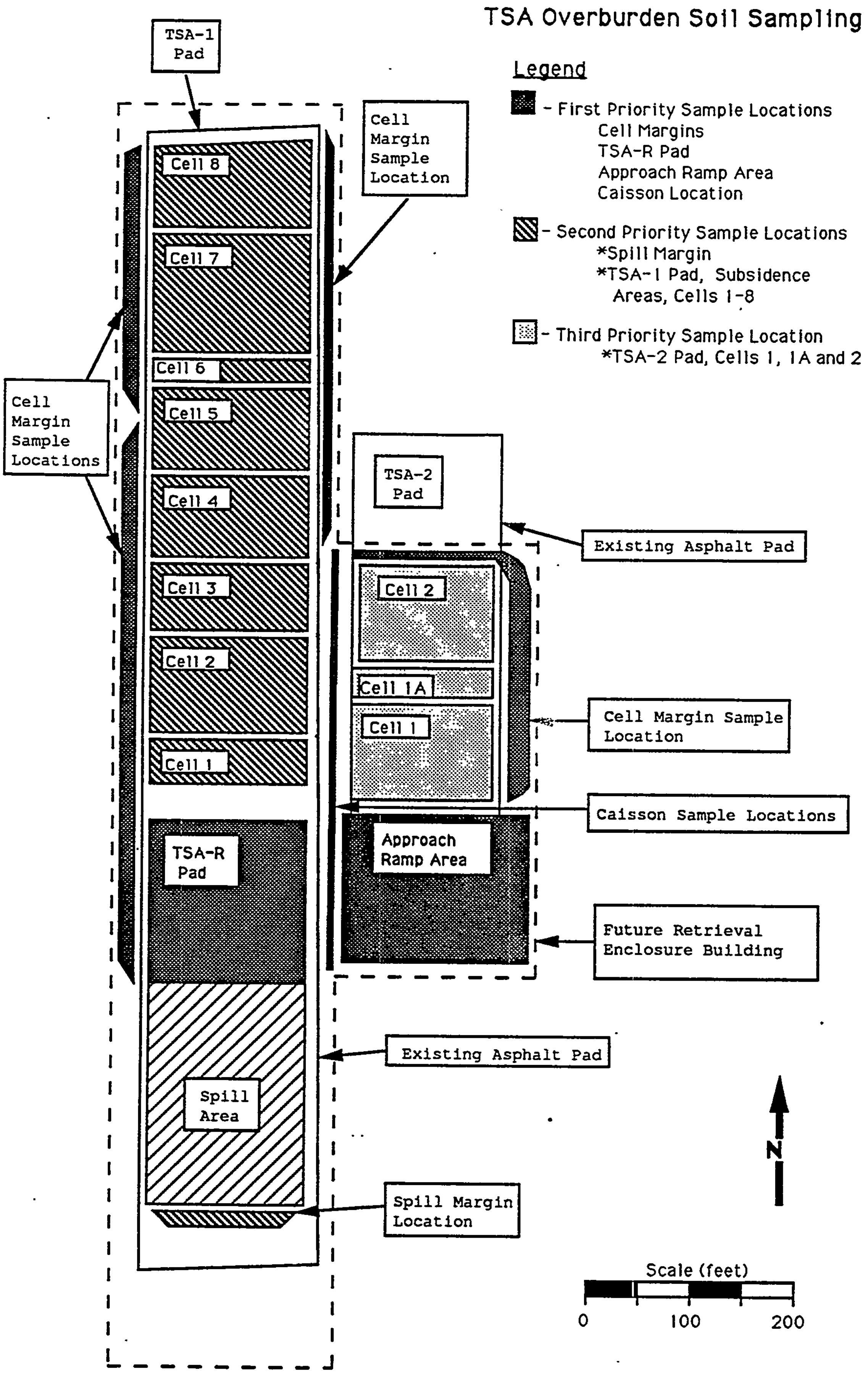


Figure 4-1. Diagram of the TSA pads depicting prioritized soil overburden sampling strategy.

4.2.1 Approach Ramp Area Samples

Systematic and random samples will be used to characterize the Approach Ramp Area (Table 4-1). Systematically located samples will be collected from two transects located along the northern and western margins of the Approach Ramp Area. Storage cells are not located beneath the approach ramp area. The approach ramp area consists of soil graded to facilitate vehicle access to TSA. Assuming the contaminant source term is the storage cells, volatile organic contaminants, if present, should be most concentrated adjacent to TSA-2 Pad, Cell 1 and TSA-R Pad, hence, the systematic samples will be located adjacent to these two storage areas. Eight samples spaced at 20 foot intervals will be collected from a transect placed adjacent to TSA-2 Pad, Cell 1 and seven samples spaced at 20 foot intervals will be collected from a transect placed adjacent to TSA-R Pad. Additionally, ten randomly placed samples will be collected from a grid system (see Section 5.2) placed over the Approach Ramp Area. All samples will be collected at a depth to be determined from surveys which establish the grade for the enclosure foundation. All samples collected below the overburden surface will use procedures described in Section 5.

4.2.2 TSA-R Pad Samples

A combination of random and biased samples will be used to characterize the overburden above TSA-R Pad. All samples will be collected from the contact between the overburden and the plastic sheeting covering the storage cell. In general, the overburden above the storage cells is thought to be about four feet thick. Soil vapor concentrations of volatile organic compounds should be highest at the contact. Twenty sample locations will be randomly selected from a grid system placed over the TSA-R Pad. Section 5.2 describes how the grid will be created and how samples will be randomly selected from the grid. Additionally, up to five biased samples may be collected from the TSA-R Pad. Samples will be collected at the discretion of the Field Team Leader if visual surface indications of contamination exist.

Table 4-1. Sample Analysis Summary for the TSA Pads.

						Analysis by EPA Methods Number					
Location	Sampling Priority	Depth	Number	Type	Field GC	8240/8260 VOA's	8080 PCB's	6010 ICP	7471 Hg	7421 Pb	Gamma Spectroscopy
I-Chem Jar Size					40 ml	150 ml	500 ml		250 ml		500 ml Squat
Loading Ramp Area	1	2 m	15	Systematic, Soil	15						
		2 m	10	Random, Soil	10						
TSA-R Pad	1	Interface	20	Random, Soil	20						
		Interface	5	Biased, Soil	5						
West Margin of TSA-1 Pad	1	2 m	35	Systematic, Soil	35						
East Margin of TSA-1 Pad	1	2 m	20	Systematic, Soil	20						
East Margin of TSA-2 Pad	1	2 m	12	Systematic, Soil	12						
North Margin of TSA-2 Pad	1	2 m	8	Systematic, Soil	8						
Caisson	1	2 m	16	Systematic, Soil	16						
Cells 1 - 8 TSA-1 Pad	2	Interface	20	Biased, Soil	20						
Cells 1, 1A and 2, TSA-2 Pad	3	Interface	10	Biased, Soil	10						
Background		Surface	10	Biased, Soil					10		
Verification, No VOC's Detected		2 m or at Interface	8	Biased, Soil		8	8		8		8
Verification, VOC's Detected		2 m or at Interface	30	Biased, Soil		30	30		30		30
Totals			219		171	38	38		48		38

4.2.3 Cell Margin Sample Locations

Systematic samples will be collected from sideburden along the margins of the storage cells. Health and safety screening is necessary in areas where sideburden material will be moved to facilitate foundation construction of the enclosure structure. Samples will be collected from linear transects placed approximately equidistant between the edge of the storage cells and the proposed location of the enclosure building foundation. Thirty-five systematic samples will be collected at a sampling interval of 20 feet from the sideburden along the west margin of TSA-1 Pad. Twenty systematic samples will be collected at a sampling interval of 20 feet from the sideburden along the east margin of TSA-1 Pad. Eight systematic samples will be collected at a sampling interval of 20 feet from the sideburden along the north margin of Cell 2, TSA-2 Pad. Finally, twelve samples will be collected at 20 foot intervals from the sideburden along the east margin of Cells 1 and 2, TSA-2 Pad. Procedures for selection of systematic sample locations are described in Section 5.3. According to engineering drawings of the facility (EG&G, 1990), sideburden material is approximately 12 feet thick along the cell margins where sample collection is proposed. Sideburden samples will be collected at a depth to be determined by surveys which determine the grade for the enclosure foundation.

4.2.4 Caisson Sample Locations

The caisson samples will be located between TSA-1 and TSA-2 Pads to the west of Cells 1 and 2 and the Approach Ramp Area on TSA-2 Pad. Caissons will be installed at 25 foot intervals to support the roof of the retrieval enclosure building. The samples will be collected to health and safety screen overburden material which will be disturbed during caisson installation. Samples will be collected from a linear transect placed at the proposed location of the caissons. Procedures for selection of systematic sample locations are described in Section 5.3. A total of 16 samples spaced at 25 foot increments will be collected at a depth to be determined by surveys which determine the grade for enclosure foundations.

4.3 Second Priority Sample Locations

Second priority sample locations are placed in areas that will not be directly affected by construction of the enclosure building or its foundation. The purpose of these samples is to collect baseline information which will affect future overburden removal decisions and to concentrate samples in areas where contaminants are most likely to be encountered. Second priority samples will be collected from Cells 1 through 8 of TSA-1 Pad, contingent upon time and budget constraints. As stated below, the number of samples to be collected is an estimate. Actual numbers of samples collected may vary, as data needs are determined from evaluating Phase I Sampling.

4.3.1 Biased Subsidence Area Sample Locations

Twenty biased samples will be collected from Cells 1 through 8 of TSA-1 Pad. These samples will be collected from known subsidence areas. Sample locations will be selected at the discretion of the Field Team Leader and after consultation with personnel familiar with the site. Target volatile organic compounds in significant concentrations are most likely to be found in areas of overburden subsidence. Subsidence areas are associated with a failure in the integrity of the plastic liner and plywood covering the storage cells. This failure in structural integrity will create a pathway for volatile organic migration if containers in the storage cells are leaking. The sampling depth in the subsidence areas will vary according to magnitude of the subsidence and method of waste storage. A nondestructive sampling method will be used to prevent damage to storage containers (see Section 5.1.1).

4.4 Third Priority Sample Locations

Third priority samples will be collected, time and budget allowing, from TSA-2 Pad, Cells 1, 1A and 2. Up to 10 biased samples may be collected from subsidence areas. Sample locations will be selected at the discretion of the Field Team Leader and after consultation with personnel familiar with the site. The sampling depth in the subsidence areas will vary according to magnitude of the subsidence and method of waste storage. A nondestructive sampling method will be used to prevent damage to storage containers (see Section 5.2).

4.5 Verification Samples

Verification samples will be collected to support results of field GC screening and determine levels of Target Metals, PCB's and gamma emitting radionuclides in the overburden and sideburden. Two general scenarios for verification sample collection are presented (see Figure 1-3). If no Target Volatile Organic Compound hits are obtained during phase I sampling with the field GC, approximately 5% of the samples (8) will be recollected. If Target Volatile Organic Compounds are detected with the field GC up to 30 of these sample locations will be resampled. The number of locations to be resampled depends on the number of hits and budget constraints. Verification samples will be analyzed for: beryllium, cadmium and chromium by inductively coupled plasma emission spectroscopy (ICP) (EPA Method 6010), mercury analysis by cold vapor atomic absorption spectroscopy (AA) (EPA Method 7471), lead by furnace AA (EPA Method 7421), and gamma-emitting radionuclides by gamma spectroscopy. Volatile organic compounds will be analyzed for using EPA Methods 8240 and 8260, and PCB's will be analyzed for using EPA Method 8080.

4.6 Quality Control Samples

Table 4-2 describes the numbers and types of field Quality Control (QC) samples to be collected during TSA overburden sampling. For the verification samples analyzed according to SW-846 Methods, rinsates (equipment blanks), field blanks, trip blanks and field replicates will be collected. Sections 10.1 and 11 describe project QC samples in more detail.

Field Quality Control (QC) samples will also be collected for the screening samples analyzed using the field GC. Field blanks and field replicates will be collected.

4.7 Action Levels

Action levels for contaminants in the soils at the TSA pads define specific criteria for organic compounds, metals, and radionuclides. The action level for Target Volatile Organic Compounds will be set at the Contract Required Detection Limit (CRDL), as specified in EPA Statement of Work for volatile organics (7/87).

To perform action level comparisons for Target Metals, valid tolerance limits must be determined. The action level for metals will be defined as the one-sided upper tolerance limit corresponding to the 95th percentile of the background population with 95% confidence. This means that the calculated action level will be greater than 95% of the values in the background population with 95% confidence. This limit, U, is calculated from the mean, x, and the standard deviation, s, of the background samples as $U = x + ks$, where k is the tabled value corresponding to the 95th percentile with 95% confidence. A loose interpretation of this statistic is that if a sample value exceeds the value of U, then there is less than a 5% chance that the sample is from background, and hence, likely to be contaminated.

If inorganic constituents detected during TSA soil overburden sampling and analysis are found to be below the one-sided upper tolerance limit, then the site will be considered uncontaminated for the particular analyte.

Table 4-2. QC Sample Analysis Summary for the TSA Pads.

				Analysis by EPA Methods Number					
QC Sample Type	Number	Matrix Type	Field GC	8240/8260 VOA's	8080 PCB's	6010 ICP	7471 Hg	7421 Pb	Gamma Spectroscopy
I-Chem Jar Size			40 ml	150 ml	500 ml	250 ml[a]			500 ml Squat[b]
Field GC Quality Control Samples									
Field Blanks	10	Water	10						
Replicates	10	Soil	10						
SW-846 Field QC Samples[c]									
Field Blanks	2	Water				2			
Replicates	2	Soil		2	2	2			2
Rinsates	2	Water		2		2			2
Trip Blank	2	Water		2					
Totals	28		20	6	2	6			4

a. Aqueous samples for analysis by EPA Methods 6010, 7470 and 7421 placed in 500 ml HDPE containers.

b. Aqueous samples for analysis by gamma spectroscopy placed in 540 ml HDPE containers.

c. Since SW-846 field QC samples are collected at a frequency of 1 in 20, only one on each type QC sample will be collected if fewer than 20 samples are collected. The number of trip blanks is dependent on the number coolers containing samples for VOC analysis sent to the laboratory.

Detections found to be above these action limits would indicate that additional sampling to improve site characterization may be required.

Action levels for radionuclides in soils can be established by using "Radiological Release Criteria for Soils" as presented in the Development of Criteria for Release of Idaho National Engineering Laboratory Sites Following Decontamination and Decommissioning (EG&G, 1986). Table 4-3 lists concentrations in soil for various radionuclides that will be used as action levels. The levels are considered conservative because it is assumed that decommissioned sites will be returned to an agricultural land use. The radionuclides listed in Table 4-3 are a subset with additional radionuclides presented by the ERP Target Radionuclide List (Table 4-4) which delineates radionuclides produced or used during research activities at the INEL. These radionuclides have the potential to be released to the environment as a result of site activities. Most of the radionuclides on the ERP Target List are

Table 4-3. Radiological action levels.

Radionuclide	Concentration (pCi/g)[a] In Soil Corresponding to an Effective Dose Equivalent of 100 mrem in First Year After Release
Manganese-54	1×10^1
Cobalt-57	2×10^2
Cobalt-58	3×10^1
Cobalt-60	4×10^0
***Strontium-90**	5×10^1
Ruthenium-106	6×10^1
Antimony-125	2×10^1
Iodine-129	2×10^2
Cesium-134	6×10^0
***Cesium-137**	1×10^1
Cerium-144	3×10^2
Europium-152	1×10^1
Europium-154	7×10^0
Europium-155	4×10^2
Actinium-227	7×10^0
Uranium-232	3×10^0
Uranium-233	4×10^2
Uranium-234	4×10^2
Uranium-235	6×10^1
Uranium-238	2×10^2
***Plutonium-238**	3×10^2
***Plutonium-239**	3×10^2
***Plutonium-240**	3×10^2
Plutonium-241	1×10^4
***Americium-241**	8×10^1

a. Assumes uniform contamination of an area adequate for subsistence farming and the behavior and consumption patterns specified in the farming scenario.

b. Radionuclides with an asterisk are thought to be most abundant based on records of wastes.

Table 4-4. ERP target radionuclide list.

Radionuclide	Half-Life
Actinium-228	6.13 h
*Americium-241	458 y
Antimony-125	2.7 y
Bismuth-212[a]	60.6 min
Bismuth-214[a]	19.8 min
Cerium-144	284 d
Cesium-134	2.05 y
*Cesium-137	30.2 y
Cobalt-60	5.27 y
Europium-152	12 y
Europium-154	16 y
Europium-155	1.81 y
Lead-212[a]	10.6 h
Lead-214[a]	26.8 min
Manganese-54	303 d
*Plutonium-238[b]	87.7 y
*Plutonium-239[b]	24,000 y
*Plutonium-240[b]	6580 y
Protactinium-234[a]	6.7 h
Radium-226[a]	1600 y
Silver-110[a]	253 d
*Strontium-90[b]	28.8 y
Thallium-208[a]	3 min
Thorium-234[a]	24.1 d
Uranium-234[b]	2.5×10^5 y
Uranium-238[b]	4.5×10^9 y
Zinc-65[a]	245 d

Note: Thorium-234, protactinium-234, uranium-234, radium-226, lead-214, and bismuth-214 are decay products (daughters) of the natural uranium series decay chain. Actinium-228, lead-212, bismuth-212, and thallium-208 are decay products (daughters) of the natural thorium series decay chain. The long half-lives of the parent activity should be considered when examining the half-lives of the daughter activities.

a. Radionuclides with no radiological release criteria guidelines.

b. To be determined by radiochemical techniques and methods. All others listed are determined by gamma spectrometric techniques.

c. Radionuclides marked with and asterisk are thought to be most abundant based on records of waste.

given specific action levels for the radiological release criteria (Table 4-3). A number of radionuclides on the ERP Target List do not have specific release criteria action levels.

5.0 SAMPLING PROCEDURES

5.1 Sample Collection Methods

5.1.1 Auger Sampling for Gas Chromatograph Samples

All samples collected for VOC analyses using a field GC unit, whether systematic, biased, or random, will be obtained in a similar manner, excepting depth of sample collection. Grab samples taken from the approach ramp area and the pad margins will be collected at a depth of 2 m. Sampling depths within the TSA-R cell will vary depending upon overburden depth, as the grab samples will be collected at the interface between soil and oak plank decking. Cells 1 through 8 within TSA-1 pad and cells 1, 1A and 2 in TSA-2 pad may be sampled pending review of budgetary allowances.

Subsurface samples will be collected from TSA overburden and sideburden soil using hand corers or hand augers. Sampling device descriptions and procedures for their use are described in the DOE Environmental Survey Manual (DOE, 1989a). A "Little Beaver" powered auger may be used to reach the desired sampling depth in the approach ramp area and cell margins. Only hand augers will be used for samples collected above the storage cells in recognition of the containerized materials underlying this sampling area. Although "Little Beaver" may be used to auger through the first 1 to 2 feet of sediment if it has been compacted by vehicle travel, or experience proves there is no possibility of encountering the plastic liner. Extreme care will be taken to insure that no containers are breached or the plastic liner punctures during collection procedures. A stainless steel hand auger will be used for sampling to ensure that a discrete sample is collected. Hand augers can be used without puncturing the plastic liner above the waste. Hand augering will cease upon meeting resistance that may indicate encountering the lining. The first two hand auger lifts will be discarded to prevent cross contamination from power auger cuttings.

Samples for volatile organic analysis (VOA) require special handling in order to minimize the loss of volatile compounds. VOA samples are removed directly from the stainless steel hand auger and placed immediately into a 40 ml vial. All samples will be radiologically screened using portable survey instrumentation prior to containerization. The vial will be filled approximately one half full to provide enough headspace for analysis of VOC's. The soil sample is then prepared and a gaseous sample is removed from the headspace and injected into the field GC for analysis.

5.1.2 Background Sampling

Ten background surface composite samples will be collected from the general source area of soil overburden in order to define action levels for the TSA site. The background surface samples will be analyzed for lead (EPA Method 7421), mercury (EPA Method 7471), and ICP metals (cadmium, beryllium, and chromium) (EPA Method 6010). Surface samples will be spatial composites of five subsamples collected with a hand auger, DOE Procedure E5.2.3 (DOE, 1989a). Samples will be collected from 3 x 3-ft plots to a depth of 6 inches. Subsamples will be collected at the four corners and the center of the plot. Each subsample will be sieved, using a stainless steel spoon, through a 2-mm mesh stainless steel screen into an aluminum pan. This procedure will be conducted at each of the five subsample points. Following collection of all subsamples, the soil in the aluminum pan will be thoroughly mixed with the stainless steel spoon and placed into the sample container. Background samples will be collected at 10 foot intervals from a 100 foot transect.

5.1.3 Collection Methods for Verification Samples

The total number of verification samples collected may vary contingent upon number of VOC hits and budget constraints. Sample collection methods will differ slightly from those for field GC analyses, as the samples will be analyzed using EPA SW-846 methods and gamma spectroscopy. Samples overlying containers will be collected at the overburden/oak decking contact, while all others will be taken at a depth of 2 m.

Verification samples will not be collected from the same auger holes the corresponding field GC samples were collected from. Instead, they will be collected from adjacent auger holes (collocated) separated by a distance of approximately 2 feet. Collocated samples will be used for verification because of the time interval between field GC sampling and verification sampling. Between field GC sampling and verification sampling, the integrity of the auger hole will deteriorate and volatile organic compounds will diffuse to the ambient atmosphere. Hence, it is thought that collocated samples will produce more representative results.

Collection procedures using hand augers will follow methods described in Section 5.1.1. All samples will be sieved, except those specified for VOA, using a stainless steel spoon, through a 2-mm mesh stainless steel screen into a disposable aluminum pan. Following sample collection, the soil in the aluminum pan will be thoroughly mixed with the stainless steel spoon and surveyed with radiation instruments. From this mixture, the 500 ml plastic sample jar (for gamma spectroscopy analysis) will be filled to the ridge below the screw top lid, and will not be packed tightly. The soil sample for lead, mercury, and ICP target metals will also be collected from this mixture and placed into a 250 ml glass jar. Samples for VOA (EPA Method 8240 and 8260) will be collected directly from the hand auger and placed into a 250 ml glass jar without any prior screening. Samples to be analyzed for PCB's (EPA Method 8080) will be placed into 500 ml jars. The jar will be completely filled. Sample material left over will be returned to the sample hole from which it was collected.

5.2 Procedures for Selection of Random Sample Locations

For the random samples to be collected from the Approach Ramp Area and the TSA-R Pad it is assumed that the area covered is rectangular and oriented along a north-south line (these assumptions are only made to simplify the explanation of the sampling strategy; the methods have obvious adaptations to the true orientation and shapes of the cells and deviations from the assumptions do not invalidate any of the statistical properties of the samples obtained).

The locations for obtaining soil samples will be randomly selected from points on a grid with 10 foot spacings. The placement of the starting point for the grid will also be randomly selected. This will insure that every location in the cell has an equal probability of being selected for sampling.

To ensure a random sample, the method for selecting sample locations should be consistent with the following procedure. Let l (length) be the maximum east-west length of the cell rounded down, if necessary, to the nearest 10 feet (e.g. anything greater than 50 but less than 60 rounds down to 50). Similarly let w (width) be the maximum north-south length, also rounded down to the nearest 10 feet. Using a random number table or other means, randomly select two distances between 0 and 10 feet. Call these two numbers a and b. The point a feet west and b feet north of the southeast corner of the cell represents the starting or reference point for the grid (but is not an actual sampling location). Next, select at random a number c from the numbers 0, 10, 20, . . ., $l - 10$, and another number d at random from the numbers 0, 10, 20, . . . $w - 10$. The first sample location is c feet west and d feet north of the starting point. Continue selecting pairs of random numbers in the same manner as c and d to get each additional sampling location. (Note that the starting point, determined by a and b is the same for samples in the cell.) If any sampling location falls outside of the boundaries of the cell (due to irregular shape, etc.), or if it should be a point already selected, just discard that point and generate another. This will not affect the randomness of the sample.

As an example, suppose a cell measures 106′ in the east-west direction and 50′ in the north-south direction. In this case, $l = 100$ and $w = 50$. Selecting randomly between 0 and 10 feet we get $a = 6.2$ and $b = .8$. The starting point for the grid is located 6.2 foot west and 0.8 foot north of the southeast corner of the cell. Next, selecting randomly from 0, 10, 20, . . ., 90, we get $c = 40$. Similarly, selecting at random from 0, 10, 20, 30, 40, we get $d = 70$. So, the first sampling point is located 40 feet west and 70 feet north of the reference point. (Or, equivalently, 46.2 feet west and 70.8 feet north of the cell's southeast corner.) Additional locations are selected by redrawing values for *c* and *d* and then measuring again from a point 6.2 feet west and 0.8 feet north of the southeast corner.

5.3 Procedures for Selection of Systematic Sample Locations

Procedures have also been developed to select the starting point for the collection of systematic samples. The placement of the starting point for the transect will be randomly selected. This will insure that every location along the transect has an equal probability of being selected for sampling. All systematic samples will be collected from linear transects placed at the locations described in Section 4.

The following procedure should be followed to insure that every location along the transect has an equal probability of being selected. First, the position of the transect has to be determined. Let *m* be the maximum north-south length of the transect rounded down if necessary, to the nearest 10 feet. In the case of the transect located to the north of Cell 2, TSA-2 Pad, *m* will be the maximum east-west length of the transect. Using a random number table, or other means, a number between 0 and *m* will be selected. This number, call it *n*, will be used to establish the starting point for selection of systematic sample locations. The northern or western most boundary of the transect will be located in the field. From this point the distance *n* will be measured to the south or east. To either side of this point, samples will be located in 20 foot increments. Systematic samples collected from the caisson are spaced at 25 foot intervals. Locations outside the boundaries of the sampling unit will not be used.

5.4 Sample Locations

Sample locations will be determined as described in the above Sections 5.2 and 5.3. Sample locations will be surveyed and staked prior to sampling activities. Drawings will be developed which will include coordinates of each sampling location and illustrate sample points on a per cell basis.

5.5 Decontamination Procedures

To prevent cross contamination of samples all onsite sampling equipment will be decontaminated. Decontamination will be performed throughout the work day as equipment is used and clean equipment supplies are depleted. Sampling equipment decontamination procedures are as follows:

- wash and scrub equipment with non-phosphate detergent
- rinse with tap water
- rinse with deionized water
- rinse with pesticide grade methanol
- collect equipment blank (rinsate) from last water rinse (when needed)
- air dry all sampling equipment (if possible) prior to sample collection
- wrap in aluminum foil

5.6 Disposal of Contaminated Materials

Materials and equipment known or suspected to be contaminated and for which decontamination or treatment is not feasible, shall be properly disposed of. Waste Management Construction will provide the necessary containers to containerize contaminated materials for disposal. These materials may include disposable clothing, tools or other equipment, as well as contaminated overburden from drilling and/or sampling activities. All project personnel will be responsible for using the appropriate waste container for the type of contamination encountered (radiological, hazardous and/or mixed waste). Waste Management Programs will be responsible for final disposition of all wastes. It is the responsibility of all site personnel to minimize waste generation where possible.

6.0 DOCUMENT MANAGEMENT AND SAMPLE CONTROL

The following sections summarize document management and sample control. Documentation includes all field documents used to record field data collected and document sampling procedures. Sampling documents include chain-of-custody forms and sample container tags and labels. Sample identification codes are explained in this section. The section on sample handling procedures outlines the sample containers and preservatives that will be used and discusses chain of custody, screening for radioactivity, and packaging and transportation of samples to the laboratory.

6.1 Documentation

The field document control coordinator is responsible for the control and maintenance of all field documents and records and ensuring that all required documents are submitted to Administrative Records and Document Control (ARDC) (see Section 9). All entries will be made in permanent black ink. Any errors will be corrected by drawing a single line through the error and then the correct information will be entered. All corrections will be initialed and dated. The serial number or ID number and disposition of all controlled documents (e.g., sample container tags and chain-of-custody forms) will be recorded in the document control logbook. If any documents are lost, a new document will be completed. The loss of a document and an explanation of how the loss was rectified will be recorded in the document control logbook. The serial number and disposition of all damaged or destroyed field documents will also be recorded. All voided documents will be maintained in a file.

6.1.1 Sample Container Labels

Waterproof, gummed labels containing preprinted information concerning the sample ID number, the name of the project area, and the analysis type will be used instead of the I-Chem container labels included with sample containers. In the field, labels will be completed and placed on the containers, prior to collecting the sample. Information concerning sampling date and time, and field measurements of hazards will be filled out during field sampling. Clear plastic tape will be placed over the label to protect it from damage. Figure 6-1 contains an example of a label.

Preprinted labels will not have a serialized number. The preprinted sample ID number will serve as a unique label identifier. Tags and labels will be distributed daily, and remain in the custody of the field document control coordinator when not in use.

6.1.2 Sample Container Tags

A tag will be attached in the field to each sample container using rubber bands. Preprinted sample tag information includes the project area name, project area code, sample ID number, analysis type and preservation type. The date and time of sampling are recorded in the field. Figure 6-2 contains an example of a tag.

6.1.3 TSA Soil Overburden Sample Numbering Scheme

A systematic 8 and 9 character code will be used to number the samples (Tables 6-1 and 6-2). The first 3 digits of the code, "TSA," refer to the facility name. The next two digits are specific to the sample collection location. The following two numbers refer to the sample number for each particular analysis. The eighth character refers to a particular class of analyses, "M" for metals (EPA method number 6010), "V" (soils) and "C" (aqueous) for volatile organic compounds (EPA method 8240), "B" for PCB's, "G" for gamma spectroscopy, and "GC" for gas chromatography. For QA/QC samples, a ninth character is added as follows: "T" for trip blanks, "F" for field blanks, and "R" for rinsates. Data from gross alpha and beta screens, performed by RWMC HP's, will be entered in "special logbooks" described in Section 6.1.5.2. Gross alpha and beta information will be entered in the logbook by location.

TSA SOIL OVERBURDEN SAMPLING	
SAMPLE ID NUMBER: TSA0101M	TIME:
DATE(ddmmyy):	SAMPLER:
ANALYSIS: Metals	
FIELD MEASUREMENT/HAZARDS:	

Figure 6-1. Sample container label.

TSA SOIL OVERBURDEN SAMPLING		
AREA: TSA		
ANALYSIS: Metals	DATE(ddmmyy):	TIME:
SAMPLE ID NUMBER: TSA0101M		

Figure 6-2. Sample container tag.

Table 6-1. Sample numbers for the TSA Pads.

				Analysis by EPA Methods Number					
Location	Depth	Type	Portable GC	8240/8260 VOA's	8080 PCB's	6010 ICP	7471 Hg	7421 Pb	Gamma Spectroscopy
Loading Ramp Area	2 m	Systematic, Soil	TSA0101GC-TSA0115GC						
	2 m	Random, Soil	TSA0201GC-TSA0210GC						
TSA-R Pad	Interface	Random, Soil	TSA0301GC-TSA0320GC						
	Interface	Biased, Soil	TSA0401GC-TSA0405GC						
West Margin of TSA-1 Pad	2 m	Systematic, Soil	TSA0501GC-TSA0535GC						
East Margin of TSA-1 Pad	2 m	Systematic, Soil	TSA0601GC-TSA0620GC						
East Margin of TSA-2 Pad	2 m	Systematic, Soil	TSA0701GC-TSA0712GC						
North Margin of TSA-2 Pad	2 m	Systematic, Soil	TSA0801GC-TSA0808GC						
Interior Caissons	2 m	Systematic, Soil	TSA0901GC-TSA0916GC						
Cells 1 - 8 TSA-1 Pad	Interface	Biased, Soil	TSA1001GC-TSA1020GC						
Cells 1, 1A and 2, TSA-2 Pad	Interface	Biased, Soil	TSA1101GC-TSA1110GC						
Background	Surface	Biased, Soil				TSA1301M-TSA1310M			
Verification, No VOC's Detected	2 m or at Interface	Biased, Soil		TSA1401V-TSA1408V	TSA1401B-TSA1408B	TSA1401M-TSA1408M			TSA1401G-TSA1408G
Verification, VOC's Detected	2 m or at Interface	Biased, Soil		TSA1501V-TSA1530V	TSA1501B-TSA1530B	TSA1501M-TSA1530M			TSA1501G-TSA1530G

Table 6-2. Sample numbers for QA/QC samples at the TSA Pads.

			Analysis by EPA Methods Number					
QC Sample Type	Matrix Type	Field GC	8240/8260 VOA's	8080 PCB's	6010 ICP	7471 Hg	7421 Pb	Gamma Spectroscopy
I-Chem Jar Size		40 ml	150 ml	500 ml	250 ml[a]			500 ml Squat[b]
Field GC Quality Control Samples								
Field Blanks	Water	TSA1601GCF-TSA1610GCF						
Replicates	Soil	TSA1701GC-TSA1710GC						
SW-846 Field QC Samples[c]								
Field Blanks	Water				TSA1801MF-TSA1802MF			
Replicates	Soil		TSA1901V-TSA1902V	TSA1901B-TSA1902B	TSA1901M-TSA1902M			TSA1901G-TSA1902G
Rinsates	Water		TSA2001VR - TSA2002VR		TSA2001MR-TSA2002MR			TSA2001GR-TSA2002GR
Trip Blank	Water		TSA2101VT - TSA2102VT		TSA2101MT-TSA2102MT			

a. Aqueous samples for analysis by EPA Methods 6010, 7470 and 7421 placed in 500 ml HDPE containers.
b. Aqueous samples for analysis by gamma spectroscopy placed in 540 ml HDPE containers.
c. Since SW-846 field QC samples are collected at a frequency of 1 in 20, only one on each type QC sample will be collected if fewer than 20 samples are collected. The number of trip blanks is dependent on the number

6.1.4 Grid Sample Numbering Scheme

A grid system will be established across the cells being randomly sampled at the TSA. The grid nodes will be assigned cartesian coordinate labels, in meters, describing the nodes in relation to the cell grid. For example, the origin of the main cell grid would be assigned the label "0,0" if it was sampled. From the grid system, sampling locations will be randomly selected from each cell. Random samples will be collected at each location and assigned labels which correspond to the grid node from which they were taken.

6.1.5 Field Logbooks

Field logbooks will be used to record information necessary to interpret the analytical data. Procedures or SOPs used in the sampling process will be recorded into the logbooks. All field information pertaining to the sampling team's activities will be entered into the logbooks. Entries will be dated and signed by the individual making the entry. All logbooks will be checked daily for accuracy and completeness by the principal investigator or an alternate.

6.1.5.1 Sample logbooks.

Sample logbooks will be used by the field teams. Each logbook will contain copies of the team activity log sheet to maintain a chronological record of the team's daily activities, and a sample log sheet to record specific sample collection information (Figures 6-3 and 6-4). Soil samples will be described and logged in the sample logbook using ASTM D2487 as guidance. The date, time, sample ID number, and collection method used for all samples, including QA samples, will be recorded. The cover of the logbook will display the titles "TSA OVERBURDEN INVESTIGATIONS" AND "Sample Logbook" as well as the sampling time-frame, site name, logbook number, and the name of the person to whom the logbook was assigned.

SAMPLE LOGBOOK

Date (dd/mmm/yy): __ __/__ __ __/__ __

Field Team Members:

_________________________ _________________________

_________________________ _________________________

_________________________ _________________________

_________________________ _________________________

_________________________ _________________________

Weather: ____

____

Narrative (description of field sampling activities with time and location, description of sampling point, and samples collected.):

____

____

____

____

____

____

____

____

____

____

____

____

____

RECORDED BY: ____________ (Signature) QA CHECK BY: ____________(Signature)

Figure 6-3. Sampling team activity sheet.

SAMPLE LOGSHEET

SAMPLE ID NUMBER												CONTAINER		ANALYSIS	PRESERVATIVE
												VOLUME	TYPE		TYPE/VOLUME

RECORDED BY: ______________________________ QA CHECK BY: __________________

Figure 6-4. Sample log sheet (page 1).

SAMPLE LOGSHEET

DATE(DD/MMM/YY): __ __/__ __ __/__ __ LOCATION: ____________________

SAMPLE TYPE: (0) Normal (1) Equip. Blank (PRIOR) (2) Trip Blank (3) Replicate (4) Split (5) Equip. Blank (POST) (6) Spike (7) Other ______________

ID NO.:	CODE	ID NO.:	CODE	ID NO.:	CODE

SPECIFIC SAMPLING POINT(S)/LOCATIONS AND DEPTH:	POINT (LOCATION)	DEPTH FROM	TO	(UNITS) BELOW SURFACE

SAMPLE METHOD: CODE: (_____)
(0) Grab (1) Spatial Comp. (2) Time Comp. (3) Other __________

SAMPLE DESCRIPTION: CODE (_____)

SOIL/ROCK
(00) Surf. Soil
(01) Sub. Surf. Soil
(02) Basalt
(03) Sediment Interbed
(04) Other

SEDIMENT/SLUDGE
(05) Pond/Impoundment
(06) Drum/Tank
(07) Other

AIR/GAS
(15) Soil Gas
(16) Other

LIQUIDS
(08) Pond/Impoundment
(09) Drum/Tank
(10) Plant Discharge
(11) Spring/Seep
(12) Perched Aquifer
(13) Regional Aquifer
(14) Other

Other: ____

FIELD MEASUREMENTS: (list field measurements of the samples)

	Units	Instr. Make/Model	Instr. No.:
pH:			
temperature:			

SAMPLING AND ANALYSIS PLAN FOLLOWED: NO (___) YES (___) IF NO EXPLAIN DEVIATIONS:
____
____

RECORDED BY: ____________________ QA CHECK BY: ______________

Figure 6-4. Sample log sheet (page 2).

SAMPLE LOGBOOK

MAP OF SAMPLING LOCATION:
(include location of sampling points and reference points)

RECORDED BY: ____________________ QA CHECK BY: ____________________

Figure 6-4. Sample log sheet (page 3).

6.1.5.2 "Special" Logbooks.

In-situ measurements that do not involve sample collection, such as geophysical or field radiation surveys, will be recorded in a "special" logbook. A complete description of measurement location, instrumentation, calibration, and data obtained will be included in this logbook. The cover of the logbook will display the title "TSA Soil Overburden" sampling organization (Environmental Technology Unit), and a two-digit logbook number. Data from gross alpha and beta screens will be recorded in this logbook. The gross alpha and beta information will be recorded by location.

6.1.5.3 Field Team Leader's Daily Logbook.

A project logbook will be maintained by the field team leader. This logbook will contain an daily summary of all the team's activities, problems encountered, and site contacts. The field document control coordinator will have custody of this logbook when it is not in use.

6.2 Sample Handling

Tables 6-3 and 6-4 outline the typical requirements for containers, preservation methods, sample volumes, and holding times for solid and aqueous samples. It should be noted that not all the analytes listed in the tables are applicable to this SSP. All containers will be precleaned and obtained from I-Chem, an EPA-approved supplier for Superfund sites. Extra containers will be available in the event of breakage, contamination, etc.

No contaminated sample containers will be reused. They will be disposed of onsite or at the laboratories. Onsite disposal will be coordinated with site waste disposal personnel.

Chain-of-custody (COC) procedures will begin immediately after sample collection. Sample bottles will be stored in the field in a secured area accessible only to the field team members. Before mobilization of the

Table 6-3. Typical sample requirements - soils/sediments/sludge/biota (DOE, 1989a).

Analytical Parameter	Container		Preservative	Holding Time[a]	Sample Volume
	Size	Type			
Volatile Organics/Hydrocarbons	150 mL	(WM) Glass Jar	4°C	14 days	50 g (minimum headspace)
Semivolatile Organic/Anions/ TCLP Semivols/PCB/Pesticide	250 mL	(WM) Glass Jar	4°C	Ext. Org.-14 days TCLP-28 days Sulfides-7 days Pest-7 days	150 g
High Explosives	250 mL	(WM) Glass Jar	4°C	NA	200 g
CLP Metals/ICP Metals/Cations/	250 mL	(WM) Glass Jar	4°C	6 months	75 g
Cyanide/TCLP Metals/ Pb/Hg/Cr/Cr^{+6}/As/Tl/Sn				Cyanide-28 days	
Gamma Analysis/Gross A&B Analysis Total Pu/H/Total U/Th/Sr-90/Am/ Ra-226/Cs137	500 mL	Plastic Squat Jar	None	1 year	fill to top
Environmental Asbestos/Bulk	500 mL	Glass (WM)	4°C	None	500 ml
Asbestos Soil gas		Canister	4°C	6 weeks	variable

[a] Holding times are from the date of collection as referred to in Federal Register Vol. 49, No. 209, October 26, 1984.

Table 6-4. Typical sample requirements - aqueous samples (DOE, 1989a).

Analytical Parameter	Container		Preservative	Holding Time[a]	Sample Volume
	Size	Type			
~~Volatile Organics~~	~~450 mL~~	~~Glass Vial~~	~~4°C~~	~~14 days~~	~~120 mL/3 40 mL~~
Semivolatile Organics/TCLP Semivol.	2360 mL	Amber Glass	4°C	Extract 7 days	vials 2 L
Org. or PCBs/Pesticides Anions	125 mL	Jugs HDPE (NM)	4°C	analyze 40 days 48 hours--	100 mL
				NO_3, PO_4, All others 28 days	
ICP Metals/Cations/Hg/Pb/TCLP metals	500 mL	HDPE (NM)	pH<2, HNO_3	6 months	500 mL
High Explosives	2360 mL	Amber Glass	4°C	NA	2 L
Cyanide	1000 mL	HDPE (NM)	pH>12, NaOH	14 days	1000 mL
Gross alpha, beta screen	125 mL	HDPE (NM)	pH<2 HNO_3	Screen immediately	100 mL
Gamma Analysis or Screen	540 mL	Plastic	pH<2 HNO_3	1 year	500 mL
Rad. Analysis/Total U	2-1/2 gal	Plastic collapsible	pH<2 HNO_3	1 year	2-1/2 gallons
Suspended Particles	250 mL	HDPE (WM)	4°C	14 days	250 mL
Environmental Asbestos	500 mL	HDPE (NM)	None	--	--
Sr-90	1000 mL	HDPE (NM)	pH<2 HNO_3	--	1000 mL
Tritium (HT)	125 mL	HDPE (NM)	None	1 year	100 mL
Organophosphorus Pesticides/ Organochlorine Herbicides	2360 mL	Amber Glass	4°C	Extract 7 days analyze 40 days	2 L

a. Holding times are from the date of collection as referred to in Federal Register Vol. 49, No. 209, October 26, 1984.

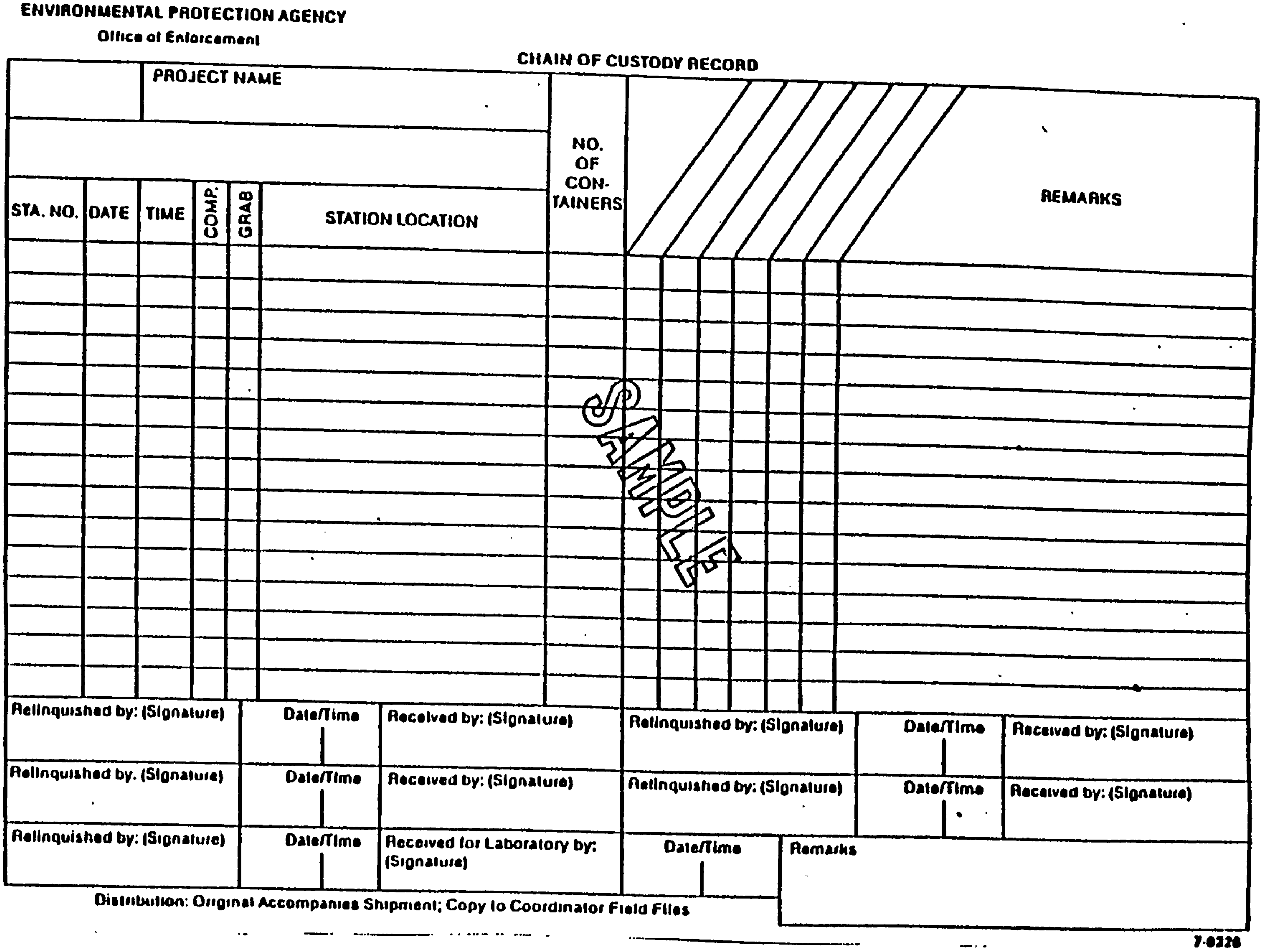
sampling team, sample bottles will be stored in a secured room, with custody seals placed on the outside of each box of containers. COC procedures will be followed, as outlined in Section 4.6.3 of the A Compendium of Superfund Field Operations Methods (EPA, 1987c). Chain-of-custody forms (Figure 6-5) will be initiated the day of sample collection. Parafilm will be wrapped around the neck and lid of the container to secure the lid. The secureness of the lids on the containers will be checked in the field at least 15 minutes after the sample is collected, and/or prior to shipping the container to the analytical laboratory.

6.2.1 Sample Preservation

Preservation of all environmental samples will be performed immediately upon sample collection following the recommendations given in Tables 6-3 and 6-4. Each field team will be equipped with field sample preservation kits required for sampling, which may include nitric acid, sulfuric acid, hydrochloric acid, sodium hydroxide, and pH indicator paper.

Ice chests will be used to chill samples during field sampling, packaging, and shipment. A refrigerator or cooler will be provided in the site office for samples requiring overnight refrigeration. A log of refrigerator or cooler temperature will be kept by the field team leader and recorded in the project logbook. Thermometers will be placed in the coolers used to transport samples from the field to the shipping area. The cooler temperature will be checked twice daily and recorded in the logbook.

No reagents or ice will be used with any high-concentration, hazardous samples because of the potential for preservatives to react with the sample constituents. High-concentration samples are those with concentrations from 15% to 100% of any single contaminant. High-concentration samples can be identified by knowledge of the source of the sample or by field measurements. Sources of these samples include surface impoundments, tanks, drums, spills, and direct discharges.



ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement

CHAIN OF CUSTODY RECORD

	PROJECT NAME

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS							REMARKS

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

7-0228

SAMPLE

Figure 6-5. Waste Management Chain-of-custody form.

6.2.2 Transportation of Samples

All short-holding-time samples will be shipped "priority one/overnight" via Federal Express through the Federal Express Office, in accordance with the regulations issued by the Department of Transportation (49 CFR Parts 171 through 178), EPA sample handling, packaging, and shipping methods (40 CFR 261.C.3C.3), and procedures outlined in ERP Program Directive 6.1 (EG&G, 1989b).

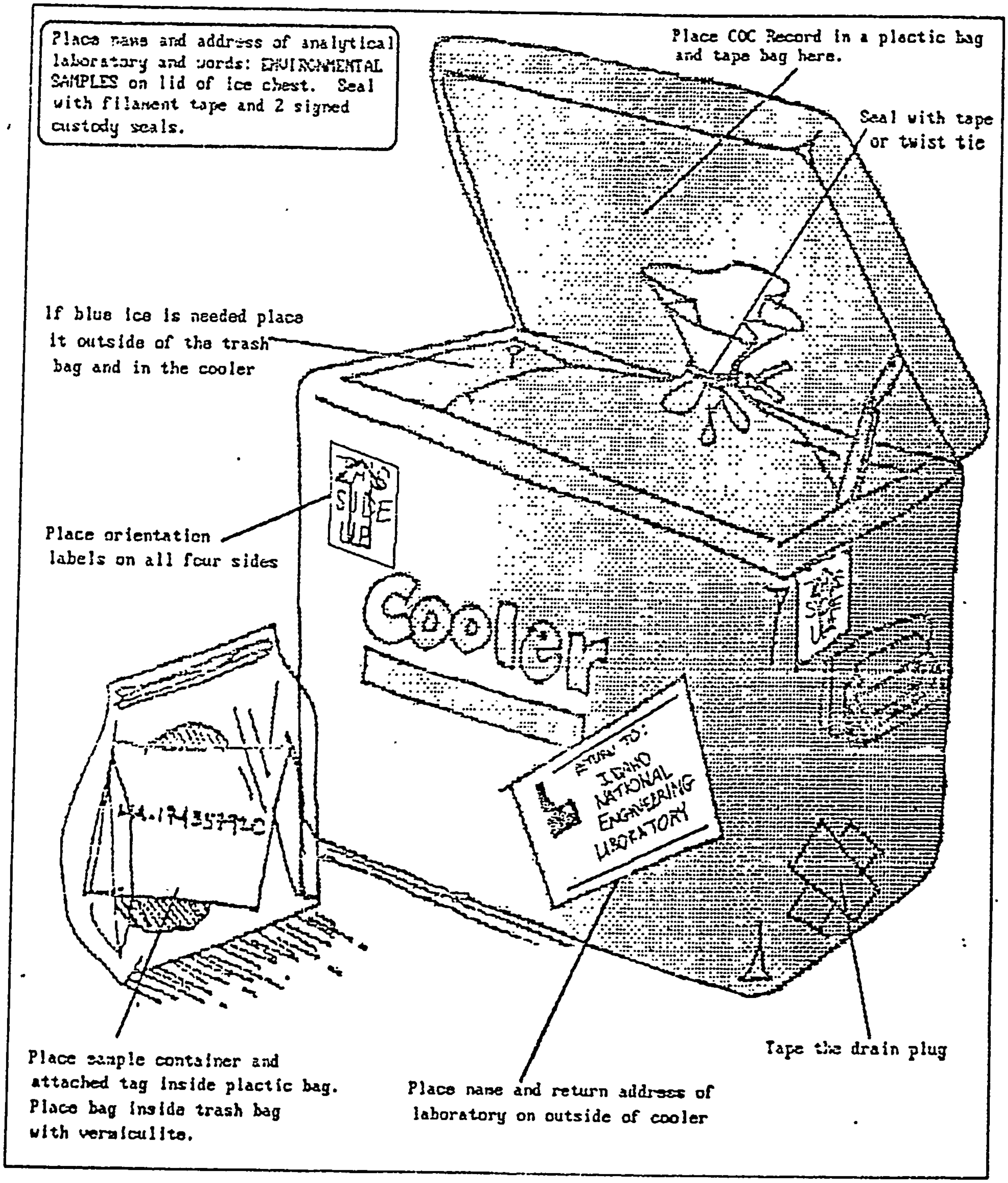
All samples will be packaged and transported in a manner that protects the integrity of the sample and prevents sample leakage. Packaging procedures will vary, depending on the suspected sample concentrations and DOT hazard class. Figure 6-6 depicts a properly packaged and labeled cooler for shipment to the analytical laboratory. The temperature of each batch of coolers (i.e., those arriving at the same time) will be checked. One cooler per batch will be opened, a thermometer will be placed inside and allowed to equilibrate, and the temperature will be recorded in a logbook by personnel at the analytical laboratory. The laboratory will communicate these temperatures to the field to ensure that adequate coolant is used to cool the samples during shipment.

6.2.2.1 Field Radiation Screening Procedures

Qualified EG&G Idaho personnel will perform sample radiation screening in the field for shipping purposes. Sample screening is necessary to determine whether the sample must be shipped as a radioactive shipment, how it should be packaged, and to which laboratory it can be shipped for analysis. All sample screening will be performed with hand held instruments which have been properly calibrated before field use. All results will be recorded in a radiation screening logbook. Field radiation screening will be performed by RWMC qualified HP's using approved methods.

6.2.2.2 Packaging of Radioactive Materials

A radioactive sample for shipping purposes contains a specific activity greater than 2×10^3 pCi/g or 2×10^6 pCi/L. Radioactive samples will be



Place name and address of analytical laboratory and words: ENVIRONMENTAL SAMPLES on lid of ice chest. Seal with filament tape and 2 signed custody seals.

Place COC Record in a plactic bag and tape bag here.

Seal with tape or twist tie

If blue ice is needed place it outside of the trash bag and in the cooler

Place orientation labels on all four sides

Place sample container and attached tag inside plactic bag. Place bag inside trash bag with vermiculite.

Place name and return address of laboratory on outside of cooler

Tape the drain plug

Figure 6-6. Packaging of environmental samples for shipment to the analytical laboratory packaged to protect the health and safety of personnel and the public. Samples will be packaged in steelbelted coolers and checked by Health Physics personnel and shippers onsite to ensure proper packaging and labeling. Figure 6.7 depicts proper packaging and labeling.

6.2.2.3 Custody Seals

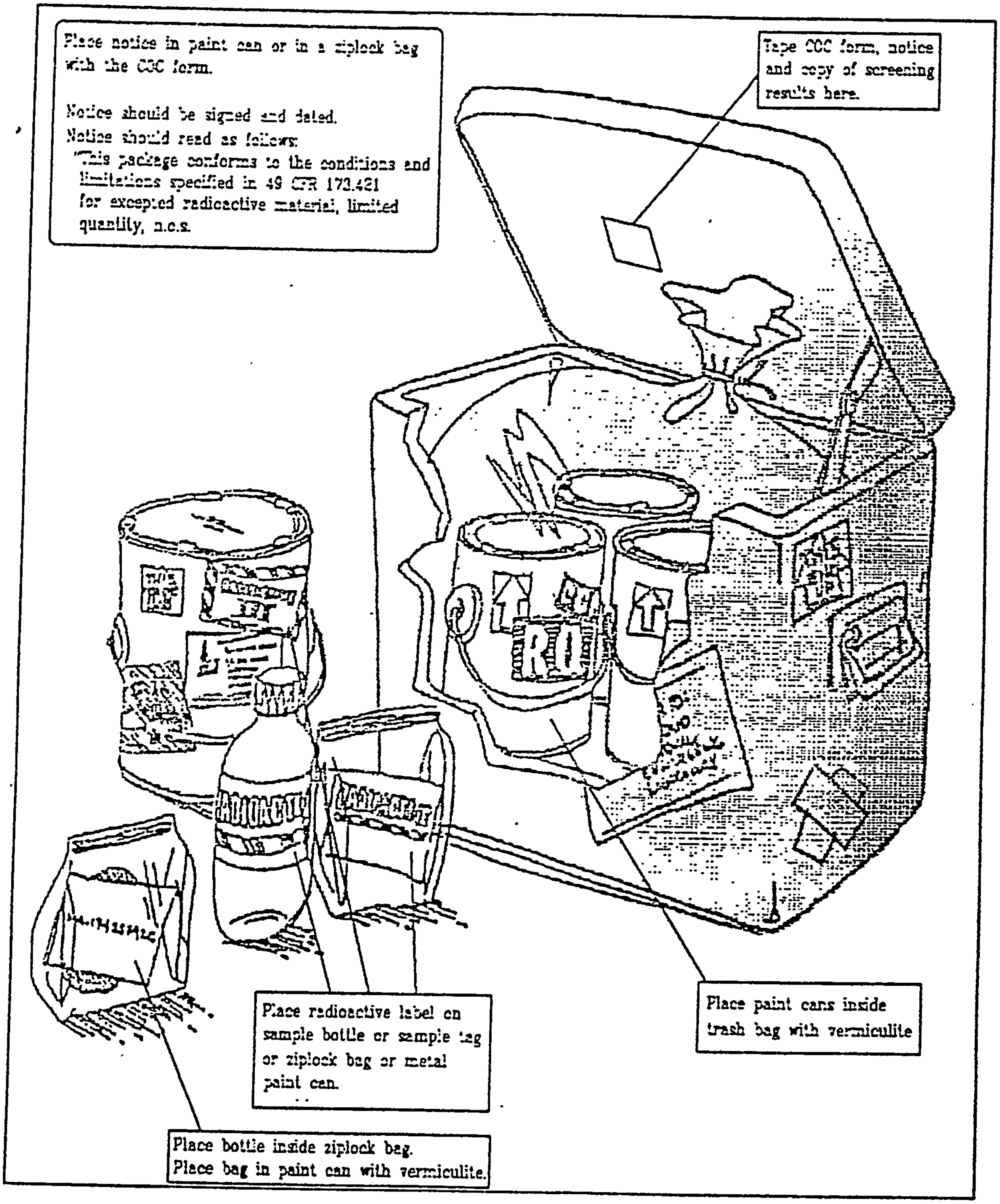
Custody seals will be placed on all shipping containers. Clear, plastic tape will be placed over the seals to ensure that they are not accidentally broken during shipment.

6.2.2.4 Onsite Shipping

An onsite shipment is any transfer of material within the perimeter of the INEL. Site-specific requirements for transportation of samples within site boundaries and those required by the shipping/receiving department will be followed. Shipments within INEL boundaries will conform to DOT requirements, as stated in 49 CFR.

6.2.2.5 Approvals Needed for Transportation of Samples

Transportation of radioactive and hazardous samples both onsite and offsite will be coordinated with EG&G Idaho shipping personnel. These arrangements will be made prior to the onset of field sampling activities.



Place notice in paint can or in a ziplock bag with the COC form.

Notice should be signed and dated.
Notice should read as follows:
"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for excepted radioactive material, limited quantity, n.o.s.

Tape COC form, notice and copy of screening results here.

Place radioactive label on sample bottle or sample bag or ziplock bag or metal paint can.

Place paint cans inside trash bag with vermiculite

Place bottle inside ziplock bag.
Place bag in paint can with vermiculite.

Figure 6-7. Packaging of limited quantity radioactive samples for shipment to the analytical laboratory.

7.0 EQUIPMENT

7.1 Maintenance and Operation

Prior to initiation of sampling, preventive maintenance will be completed as follows:

- Sampling equipment will be checked for proper operation.
- Spare sampling equipment will also be provided for minimizing any down time due to equipment malfunction
- Although laboratories will be responsible for their preventive maintenance, at a minimum, they will be required to have the following:
    - service contracts on all instruments
    - spare parts as recommended by the manufacturer
    - the above items delineated in the laboratories' QA/QC plans.

Equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with specified recommendations of the manufacturers and the written procedures developed by the operators. This includes daily maintenance and cleaning of the OVA/PID per the manufacturer's specifications.

7.2 Calibration

All instruments in both field and laboratories will be calibrated as per manufacturer's instructions and SOPs. Calibration frequency of each radiation detection instrument will be as specified in the *Health Physics Instrument Laboratory Operating Procedure Manual* (EG&G, unpublished data). Calibration frequencies for other instruments will be as specified by the manufacturers. A logbook of instrument and equipment calibration and maintenance will be kept by the sampling team and controlled by the Document Control Coordinator.

7.3 Field Equipment

Portable radiation detection instruments shall be calibrated prior to initial use, after modification or adjustment, and following any modification or alteration that may affect instrument response, or at intervals that do not exceed six months. Changing batteries and/or probe cords only, is not considered maintenance. Procedures for calibration and use of field detection instruments will be performed by RWMC HPs using approved methods.

Portable radiological instrumentation shall have satisfactorily passed a source check performed within the week preceding its use for surveys. The instrument shall be checked to respond to a known source rather than merely verifying that radiation causes the indicator to move. Instrument response shall be within 20% of the expected reference reading. Results of this weekly operational check shall be recorded and kept with the instruments.

Additional periodic instrument checks shall be made prior to each use:

1. Check battery
2. Check the calibration label on the instrument to verify that calibration has been performed within 6 months
3. Check the instrument's physical condition
4. Check instrument response.

7.4 Laboratory Equipment

Laboratory instrument calibration will follow procedures outlined in SW-846 (EPA, 1986) for organic and inorganic chemical analyses, and procedures outlined in RML SOPs for gamma spectroscopy analysis.

All calibration standards, including internal standards and surrogate standards, are obtained from chemical suppliers with certification of high purity and concentration. The standards are routinely checked by the laboratory for traceability to National Institute of Standards and Technology (NIST). Standard Reference Materials (SRMs) are used as stock standards.

Working standards are made to cover the linear range of the calibration curve. The working standards are used for initial calibration curves, continuing calibration checks, and preparation of analyte spiking solutions.

Radiation standards used by the RML are obtained from suppliers that certify their quality. Use and procurement of radiation standards is controlled by the RML QA/QC manual (EG&G, 1989d).

7.5 Decontamination

Procedures will be followed which will prevent or minimize contamination. These procedures will enhance the integrity and quality of the samples. Decontamination procedures are discussed in greater detail in Section 5.2. These decontamination procedures are designed to prevent cross contamination of trace concentrations of chemicals between samples.

8.0 ANALYTICAL PROCEDURES

EPA published methods will be used as the basis for all analyses for which such methods exist. The EPA methods to be followed are contained in *Test Methods for Evaluation of Solid Waste*, SW-846, 3rd edition (EPA, 1986). Procedures for the analysis of gamma-emitting radionuclides are detailed in the SOPs for the RML.

The analytical methods to be used for verification samples are listed below:

6010	Metals by inductively coupled plasma, atomic absorption spectroscopy, limited to the following: Al, Sb, As, Ba, Be, B, Cd, Ca, Cr, Co, Cu, Fe, Mg, Mn, Mo, Ni, K, Se, Si, Ag, Na, Tl, V, Zn
7421	Lead by furnace (AA)
7470-7471	Mercury by cold vapor (AA)
8080	Organochlorine pesticides and PCBs
8240	GC/ms for volatile organics

Concentrations of the gamma-emitting radionuclides will be measured in overburden and sideburden using standard gamma-ray spectrometry methods. These methods allow for the nondestructive determination of low-level concentrations of gamma-emitting radionuclides present in the samples. A detailed description of analysis methods and techniques, as well as QA/QC programs, can be found in documented and approved RML procedures (SOPs). SOPs for soils and sediments are numbered as follows: RML-3 (Rev. 11/22/89), DM-9 (Rev. 7/13/89), and DM-1 (Rev. 4/19/89); SOPs for aqueous samples are numbered: RML-6 (Rev. 11/22/89), DM-11 (Rev. 7/13/89), and DM-1 (Rev. 4/19/89). The RML procedures are reviewed and approved annually. The RML program is described in the *Quality Assurance/Quality Control Program of the Radiation Measurements Laboratory for Gamma Spectroscopy and Direct Gross Alpha/Beta Counting* (EG&G, 1989c). The RML will analyze for the gamma-emitting radionuclides on the ERP Target List (Table 4-4).

Analysis of gamma-emitting radionuclides by gamma spectroscopy provides adequate information for this investigation. In addition, detection of americium-241 by gamma spectroscopy is a good indication of other transuranics. Concentrations of beta-emitters may be estimated or inferred from detections of gamma-emitters which are found in similar proportions in mixed fission products (i.e., cesium-137 and strontium-90).

A field GC will be used to analyze overburden and sideburden for VOC's. Field GC's contain temperature controlled ovens and will support a variety of injectors and detectors. The flexibility of the portable GC's will allow analysis of all volatile organic compounds on the Target Organic Compound list (Section 2.1). The sensitivity of most field GC's is very good, detections can be made in the ppb and ppm range for most compounds. Benzene sensitivity is generally around 0.1 ppm with an Argon Ionization Detector (AID) and about 1.0 ppb with a Photoionization Detector (PID), chlorinated hydrocarbon sensitivities of 0.1 ppb can be realized with an Electron Capture Detector (ECD). Depending on the detector used, detections of volatile organic compounds on the Target Organic Compound list will be in the ppb range.

Analytical methods for field GC analysis will follow methods outlined in <u>Soil Gas Sensing for Detection and Mapping of Volatile Organics</u> (Devitt et al., 1987) and manufacturer procedures. Devitt outlines detailed analytical and Quality Assurance/Quality Control (QA/QC) procedures for field GC screening.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

9.1 Data Reduction and Reporting

Data Reduction refers to computations and calculations performed on the data, as defined by the *Buried Waste Program Data Collection Quality Assurance Plan* (EG&G 1988). These procedures are only necessary for samples analyzed by SW-846 Methods. This includes computing summary statistics, standard errors, confidence limits, tests of hypothesis relative to the parameters, and model validation. Standard equations and statistically acceptable procedures will be used. When appropriate, data will be reported with statistically supported limits of uncertainty to indicate limitations on the use of the data. All data, when reported, will be rounded to the number of significant figures consistent with the confidence limits. Confidence limits will be justified by the accuracy and precision of the sampling measurement and the analytical method.

Laboratory data reduction will be addressed in the TSA Soil Overburden Removal Project Analytical Statement of Work (SOW) issued to the analytical laboratory(s). All bench chemists will document sample preparation activities in a bound laboratory notebook, which will serve as the primary record for subsequent data reduction. Final data reduction of analyses performed will be the responsibility of the individual compiling the final report. Results from each data collection activity will be reported in consistent units throughout each task. Data from different tasks will be compared using statistical methods that will be described when the data is presented. When applicable, as when presenting data on contaminant concentrations, any applicable state or federal regulatory limits will be presented with the analytical data.

Field data reporting procedures and formats are specified in Section 6 in this SAP. Laboratory data reporting will follow the procedures and format specified in the TSA Overburden Sampling Analytical SOW. Results and QC data for each analysis will be transcribed onto analytical reporting forms specific to the particular analysis. These forms will be provided in the analytical SOW. All data will be checked for accuracy and precision at the bench and instrument operator/analyst level and the laboratory manager's level before submitting the data package to EG&G Idaho.

9.2 Data Validation

Data Validation is the process by which a sample measurement, method, or piece of data is deemed useful for a specified purpose (EG&G, 1988). The TSA Overburden Sampling Analytical SOW will specify information and guidance specific to the samples to be analyzed and data reporting forms to be used. Separate SOW's for chemical and radiological analyses are prepared and have separate reporting requirements. The data reporting forms will be reviewed as part of the data validation process to verify that the proper information is complete and correct.

The data flow process is illustrated in Figure 9-1; Figure 9-2 depicts a separate data flow process for radiological data. Sample labels and tags are developed by data management personnel using this database. Selected field data will be captured by data management for producing summary tables of field and analytical data.

When data management personnel receives a data package, the next steps in the process are preparation of the package for data entry via the computer programs, followed by data entry, with automated error checks of the data. The data management staff decides if the package has sufficient completeness and accuracy for entry into the data management system (DMS) and reports to the project manager. The process commonly results in a need to procure additional data or clarification from the lab that performed the analyses, prior to entering the data. For example, a data package cannot be entered with the proper linkage maintained for records if sample numbers are used inconsistently throughout the data package. Once the package is deemed adequate, it is then entered into the DMS.

Concurrent with data entry, an automated routine is invoked that performs a set of checks on the data as part of the data verification and validation (V/V) process. A listing of suspect data entries (errors) is

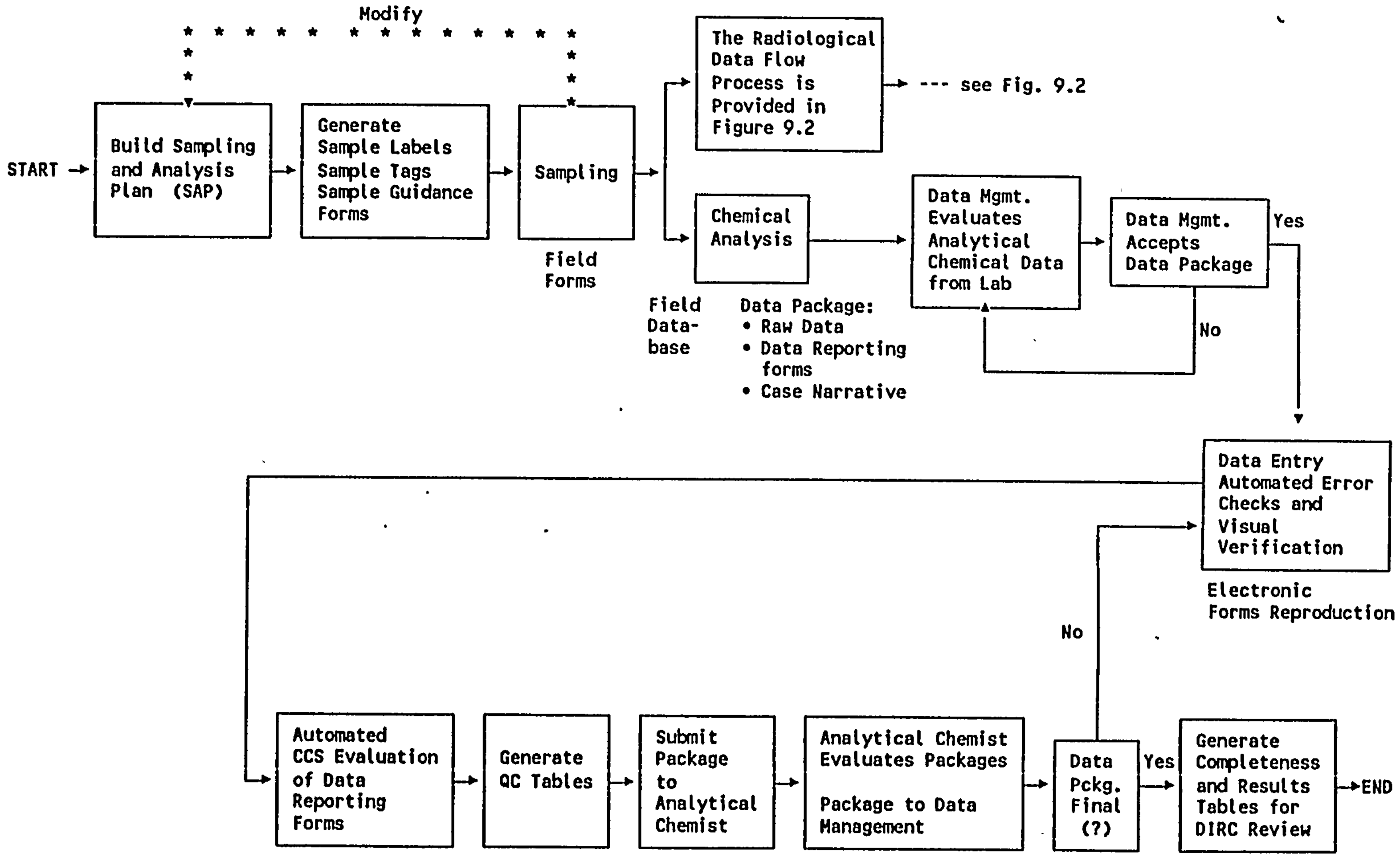


Figure 9.1 - Integrated Chemical Data Flow Process

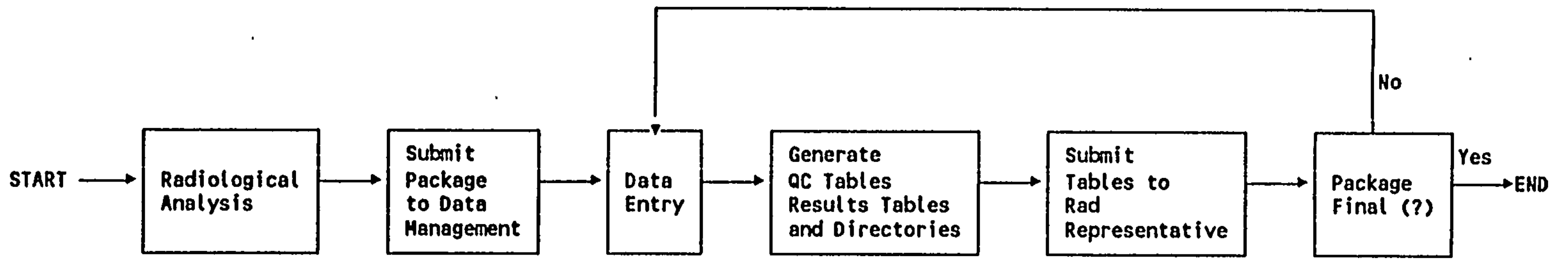


Figure 9.2 - Integrated Radiological Data Flow Process

printed to an output file. Then an attempt is made to resolve each error. First, a check is made to determine if the error resulted from data entry. Other attempts are made to resolve the errors and when the effort is successful, the data forms and databases are modified to reflect any changes. A listing of the residual set of errors is made and each error is highlighted on the applicable data form. The data entry clerk visually verifies the data through comparison of data on the original data forms and data on electronically produced forms, the latter originating from the database created in the data entry process. The next step in the V/V process is generating QC tables. The QC tables provide an efficient, easily readable tabular presentation of all data included on the complete set of data forms. The QC table is part of a package of information that is then forwarded to an analytical chemist to perform the next step of the data V/V. The package includes the following:

1. Raw analytical data
2. Original data forms
3. Electronically reproduced data forms
4. Error file output
5. Contract Compliance Screening (CCS) output
6. QC table.

The chemist continues the data quality assessment using the set of information identified above. The chemist attempts to resolve deficiencies identified in the error file listing. Concurrently, the chemist reviews the raw data to assess whether the analysis was performed per the specifications for the underlying analytical method and that data on the reporting forms is consistent with the raw data. All laboratory data will be cross-referenced to the appropriate trip blank, field blank, rinsate (equipment blank), method blank, field duplicate or replicate, matrix spike, and matrix spike duplicate. In addition, all pertinent data (data collected, received by the laboratory, and analyzed) for each laboratory analysis will be referenced against their respective hold times.

At completion of the chemist's evaluation, the modified data forms are resubmitted to the data management staff. These forms will detail any required changes to the database, with each change dated and initialed by the chemist to maintain the traceability for all modifications made to the database. A report of the quality assessment of the data package will be generated by the analytical chemist and submitted to the DIRC. The DIRC will make a final assessment of the data's quality as to whether it conforms to the program's data quality objectives.

9.3 List of Required Data

The following is a list of information that is required on all samples to complete a Data Qualification Package. The listed information is described in the ERP *Data Qualification Manual* (EG&G, 1989e).

9.3.1 Chemical Analysis Data

Level III Organic Analyses

Organic analyses will be performed for volatiles (EPA method 8240 and 8260) and PCBs for water and soil/sediment samples. General guidance requirements will be defined from EPA's *User's Guide to the Contract Laboratory Program.* Each organic data qualification package will include the following:

- Data Quality Objectives
- Sampling Information
    - SAP reference
    - DOP and/or SOP reference
    - Logbook reference or copies of applicable pages
    - Copies of calibration logs
    - Sample number(s)
    - Sample location
    - Sample date and time
    - Field duplicates
    - Field spikes

  - Field blanks
  - Copies of QC reports
  - Chain-of-custody
  - Storage and shipping requirements
- Contract Requirements and EG&G Statement of Work or Reference
- Analytical Information
  - Analytical summary
    - lab name
    - date and time samples were analyzed
    - analytical method or procedure reference
    - type of instrumentation used
    - description of analytical problems encountered and internal decisions applied
    - summary of sample preparation procedure (lab notebook reproduction or bench sheets) including addition of surrogate and/or matrix percent recovery information
  - Quality control summary
    - surrogate recoveries
    - reagent blank analyses
    - matrix spike and matrix spike duplicate recoveries
    - instrument tuning and performance information
  - Sample data
    - sample size (aqueous samples in ml, others in grams)
    - matrix (water, soil or others)
    - tabulated results of all required organic compounds
    - assigned data qualifiers
    - established method detection limits
    - reported concentration in µg/L (water) or µg/kg (soil, sludge, or other)
  - Raw sample analytical data
    - sample chromatographs
    - sample spectra
    - standard spectra for positive qualitative sample results
    - quantitation reports

    - calculations
- Standards data package
    - standards chromatograms
    - data system printouts
    - initial calibration summary forms
    - continuing calibration summary forms
- QC data package
    - GC/MS instrument tunes for both volatile and semivolatile compound analyses (spectra and tables of m/z vs. relative abundance)
    - addition of surrogate compounds to each sample and blank for determining percent recovery information
    - matrix spike and matrix spike duplicate analyses (including all information required for sample data and raw sample analytical data)
- Data review
    - analytical chemist review report
    - computerized QC checks
    - established uncertainties
    - DIRC report

Level III Inorganic Analyses

Level III analyses for inorganic compounds will be for metals in water and soil/sediment samples. General requirements are obtained from *EPA's User's Guide to the Contract Laboratory Program* for inorganic routine analytical services. The EPA summary forms for inorganics will not be required but may be used to summarize the lab analysis. The following information will be included in the data qualification package:

- Data Quality Objectives
- Sampling Information
    - SAP reference
    - DOP and/or SOP reference
    - Logbook reference or copies of applicable pages

    - Copies of calibration logs
    - Sample number(s)
    - Sample location
    - Sample date and time
    - Field duplicates
    - Field spikes
    - Field blanks
    - Copies of QC reports
    - Chain-of-custody
    - Storage and shipping requirements
- Contract requirements or reference
- Analytical information
    - Analytical summary
        - lab name
        - date and time samples were analyzed
        - analytical method or procedure reference
        - type of instrumentation used
    - Cover letter
        - listing of samples
        - comments describing problems encountered in analysis
    - Tabulated results
        - inorganic compounds identified and quantified
        - reported in µg/L or mg/kg
    - QC samples
        - initial calibration verification
        - continuing calibration verification
        - ICP interference check sample analysis
        - preparation blank analysis
        - matrix spike analysis
        - duplicate sample analysis
        - laboratory control sample analysis

- Raw data system printouts
    - calibration standards
    - calibration blanks
    - preparation blanks
    - samples and any atypical dilution
    - duplicates
    - spikes
    - interference checks
    - instrument adjustments

9.3.2 Radiological Data

- Chain-of-Custody
    - Field CoC form
    - Lab CoC form
- Request for Analysis Form
- Lab Data Package
    - Case narrative or cover sheet
        - lab name
        - contract, work request or SAP number
        - analytical method and equipment used
        - summary of any quality control, sample, shipment and/or analytical problems encountered in a specific case
        - background spectra IDs and duration of count
        - the samples that make up the analytical batch or sample delivery group (SDG); a listing of sample external or field ID numbers with internal or lab ID numbers that were analyzed.
    - Summary report
        - sample ID
        - date of analysis
        - instrument ID and model number
        - analytical method or procedure number
        - sample matrix

    - reported radionuclides (ERP Target List)
    - activity reported in Pci/g
    - uncertainties in one sigma reported in Pci/g
- QA/QC summary
    - documentation indicating the lab was in control.
        - QA/QC program summary sheet
        - energy calibration verification
        - control charts
            - detection efficiency check - monthly
            - instrument background - monthly
    - any applicable external QA/QC documentation

9.4 Uncertainty Analysis

Uncertainty measurements will be assigned to all chemical/radiological contaminant concentration data. For chemical analysis under SW-846, historical precision and accuracy measures for the water matrix will be used as uncertainties.

The uncertainty measure assigned to each concentration will be given by +/-U where

$$U = (B^2 + 4S^2)^{1/2}$$

and

$$B = \% \text{ Bias} = \% \text{ Recovery} - 100$$

$$S = \% \text{ RSD}$$

The calculation of % Recovery and % RSD is discussed in Section 12. For the standard analysis techniques (i.e., those done under SW-846), historical values will be used if the laboratory is in control. For radiological analysis, uncertainties will be calculated as described in Section 11.2.

10.0 QUALITY ASSURANCE

10.1 Field QA/QC

Internal quality control (QC) checks are established by submitting QC samples to the analytical laboratory. The number of field quality control samples is approximately 5% of the total number of field samples collected, deviations to this rule-of-thumb are stated below. The types and frequency of collection for field quality control samples are provided below:

- Trip Blank - defined as samples that originated from HPLC-grade organic free water sent to the laboratory with the VOA samples. One trip blank shall accompany each cooler containing VOA samples. Trip blanks are stored at the laboratory with samples and analyzed only for VOCs. The results of the trip blank analyses will help determine the level of contamination introduced to the sample during shipping, handling, and storage. Trip blanks are only necessary for verification samples.

- Field Blanks - (SW-846) for verification samples are defined as samples of ASTM Type II (or other high purity) water from the same source as water used for decontamination. Field blanks are collected at a frequency of 1 in 20 field samples or 5%. Field blanks are prepared and preserved using sample containers from the same lot as the other samples collected that day. Results of the field blank analysis will help determine the level of contamination introduced into the sample due to sampling technique and as a check of the water used for decontamination. Field blanks for field GC analysis will consist of 40 ml glass VOA vials half filled with HPLC grade water submitted for head space analysis by the field GC.

- Rinsates (equipment blanks) - (SW-846) defined as the final analyte-free water rinse from equipment cleaning, collected during a sampling event. The sample is analyzed for the same analytes as the samples which are collected that day. The results of the rinsate analyses will be used to flag or assess the level of analytes in the samples which enables evaluation of the decontamination process, the final rinse water, and the sample containers for contamination.

- Field Replicates - defined as independent samples collected in such a manner that they are equally representative of the variables of interest at a given point in space and time. Replicate samples provide an estimate of sampling precision. Replicates are also used to determine the variability of the sampling and analytical technique and provide a means to statistically determine total variance of the method which results from both the analytical and the sampling variances.

10.2 Laboratory QA/QC

The daily quality of analytical data generated in the contracted analytical laboratories is controlled by the implementation of an Analytical Laboratory Quality Assurance Plan. Only laboratories approved by the Environmental Restoration Programs' QA program will be used to conduct sample analysis as defined in this plan. The types of internal quality control checks are described below:

- Method Blanks: Method blanks usually consist of laboratory reagent grade water treated in the same manner as the sample (i.e., digested, extracted, distilled, etc.) which is then analyzed and reported as a standard sample would be.

- Method Blank Spike: A method blank spike is a sample of laboratory reagent grade water fortified (spiked) with the analytes of interest which is prepared and analyzed with the associated sample batch. Method blank spikes are not included with volatiles analyses since the same function is served by the calibration blank.

- Laboratory Control Sample for Inorganics: This is a standard solution with a certified concentration which is analyzed as a sample and is used to monitor analytical accuracy. (Equivalent to a method blank spike).

- Matrix Spikes: A matrix spike is an aliquot of an investigative sample which is fortified (spiked) with the analytes of interest and analyzed with an associated sample batch to monitor the effects of the investigative sample matrix (matrix effects) on the analytical method. Matrix spikes are performed only in association with selected protocols. Matrix spikes will be performed on 5 percent of the samples (1 in 20) or one per batch of samples, whichever is greater.

- Laboratory Duplicate Samples: Duplicate samples are obtained by splitting a field sample into two separate aliquots and performing two separate analyses on the aliquots. The analysis of laboratory duplicates monitors sample precision; however, it may be affected by heterogeneity of the sample, particularly in the case of nonaqueous samples. Duplicates are performed only in association with selected protocols. Laboratory duplicates are performed on 5 percent of the samples (1 in 20) or one per batch of samples, whichever is greater.

- Known QC Check Sample: This is a QC sample of known concentration obtained from the U.S. EPA, the NIST or a commercial source. This QC sample is to check the accuracy of an analytical procedure. It is particularly applicable when a minor revision or adjustment has been made to an analytical procedure or instrument.

Laboratory QA/QC for gamma spectroscopy analysis is described in the QA plan for the RML (EG&G, 1989d). Field GC QA/QC procedures are described in Soil Gas Sensing for Detection and Mapping of Volatile Organics (Devitt et al., 1987).

10.3 Audits

Evaluating the performance of activities in accordance with the QA plan will be the responsibility of the project manager, field team leaders and analytical managers, in conjunction with the appropriate QA Coordinators. Quality-related activities will be routinely inspected to ensure compliance with the QA plan. Internal inspections will be performed routinely and for specific activities. Significant deviations from the QA plan will be discussed with the project manager, QA coordinators, and affected personnel, as appropriate.

The first phase of an auditing program should be the preparation of checklists that identify the methods and techniques necessary to perform all aspects of the required audit. The checklists must be adequate to perform sampling (collection, field, and data management) audits. The second phase will then be the actual conduct of the required field audit. Audits are conducted at a frequency determined by the project manager. The final phase will be the preparation of the QA Audit Report by the field and laboratory QA officers, which will be submitted to EPA.

10.3.1 System Audit

The system audit is an overall evaluation of the sampling project and it is performed to:

1. Verify that the sampling methodology is being performed in accordance with program requirements.

2. Check on the use of appropriate QA/QC measures.

3. Check methods of sample handling (i.e., packaging, labeling, preserving, transporting, and archiving), in accordance with program requirements.

4. Identify any existing quality problems.

5. Check program documentation (i.e., records, site description, chain-of-custody collection and analytical tags, field and sample bank logbooks and field work sheets).

6. Initiate corrective action if a problem is identified.

7. Assess personnel experience and qualifications, if required.

8. Follow-up on any corrective action previously implemented.

9. Provide debriefings for sampling team and sample bank personnel.

10. Provide a written evaluation of the sampling and sample bank program.

The purpose of the system audit is to ensure that the QA/QC system planned for the project is in place and functioning properly.

The auditor first must review work plans, protocols, test plans, the QA/QC project plan, and all program reports. A discussion with the project manager of the current status of the project and the identity of any problems encountered is suggested before conducting the onsite sampling audit. Sample chain-of-custody procedures and raw data are checked, as appropriate. Spot checks of sampling methods and techniques, sampling and analysis calculations, and data transcription are performed.

10.3.2 Sample Collection Audits

An audit of the overall QA/QC plan for sample documentation, collection, preparation, storage, and transfer procedures will be performed just before sampling starts. The intent of this audit is to critically review the entire sampling operation to determine the need for any corrective action early in the program. Additional total program or partial audits can be conducted at various times throughout the sampling program.

It is recommended that a QA officer (QAO) perform unannounced site inspections to monitor the sampling team's activities, provide technical and corrective action suggestions to the sampling teams, and supplement sampling performance audits.

10.3.3 Field Audits

The primary objective of field audits is to determine the status of sampling operations. Emphasis is placed on the following activities:

1. Verify that operational aspects and procedures are in accordance with the protocols and the SAP.
2. Verify the collection of all samples, including duplicates and field blanks.
3. Verify that documentation is in order and sufficient to establish the collection location of any sample collected.
4. Determine discrepancies that exist and initiate corrective action, as appropriate.
5. Allow the QAO to direct the collection of independent samples.

The purpose of the onsite field audit is to inspect sample records and equipment. Records inspected include the following:

1. Chain-of-custody forms
2. Sample tags
3. Unit description forms
4. Logbooks

The operational procedures inspected should include the following:

1. Sampling procedures
2. Equipment
3. Techniques
4. Decontamination
5. Collection of duplicate and field blank samples
6. Security
7. Sample storage and transportation
8. Containers
9. Contaminated waste storage and disposal
10. Unit description form entries

10.3.4 Data Management Audits

An audit should be performed on the data management system by tracing the flow of specific samples through the system. In particular, the system should be checked for its ability to allow correct identification of a sample from any stage of sampling and analysis. Plan Sampling and Analysis information, field logbook information and chemical data package deliverables will provide the basis for these performance checks. From time to time, input information may be used to audit the system.

10.4 Corrective Actions

10.4.1 Laboratory Corrective Action

Laboratory corrective action will be initiated, when required, to ensure data quality meets the criteria outlined in the laboratory QA plans.

10.4.2 Project Corrective Action

Corrective action will be initiated when the project objectives are not met, or when assessment of the data reveals questionable or unknown data quality.

Corrective action may be initiated by any individual on the project subject to approval by the project manager. These corrective actions will include, but are not limited to: modifications of the sampling procedure, modifications of sampling design, modifications of analytical techniques within EPA-approved guidelines, and modifications of data reporting procedures.

10.5 Quality Assurance Reports to Management

Quality Assurance reports to project management will be prepared for each sampling site. A report on the performance of the quality assurance program will be prepared by the QAO and presented to the Program Manager. These reports will cover data quality assessment and results of internal performance inspections, with corrective action recommendations and status, as necessary.

11.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURAC COMPLETENESS, REPRESENTATIVENESS AND COMPARABILITY

The quality assurance objective for measurement data is to ensure that site characterization data are of known and acceptable quality. Data from laboratory analysis of site samples will be used for site assessments and hazard determination at the TSA.

The quality assurance objectives for analytical data from the environmental samples collected will include the following and shall be described in more detail by the project Data Quality Assurance Objectives and by the sampling and analysis plan for TSA Overburden sampling.

Descriptions for precision, accuracy, representativeness, comparability and completeness are given below.

11.1 Precision

Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is assessed by means of laboratory duplicate/field replicate sample analysis. The laboratory objective for precision is to equal or exceed the precision demonstrated for similar samples, and shall be within the established control limits for the methods, as published by the EPA (SW-846).

11.1.1 Field Precision

The field precision will be calculated using results of replicate samples as both the standard deviation and the percent relative standard deviation (%RSD). The standard deviation, s, is calculated from the variance, s^2, as

$$s^2 = \frac{\sum(x_i-\bar{x})^2}{n-1}$$

and

$$s = \sqrt{s^2}$$

The %RSD is then

$$\%RSD = s/\bar{x}$$

The standard deviation and %RSD are calculated for every contaminant measured.

11.1.2 Laboratory Precision

Precision of the chemical laboratory data will be measured through the use of the matrix spike/matrix spike duplicate (MS/MSD) samples and will be calculated as the %RSD.

11.2 Accuracy

Accuracy means the nearness of a result, or the mean of a set of results, to the true value. Accuracy is assessed by means of reference samples and percent recoveries. The laboratory objective for accuracy is to equal or exceed the accuracy demonstrated for these analytical methods on similar samples, and shall be within the established control limits for the methods as published by EPA (SW-846). Historical ranges for percent recoveries, for each analytical method, are stated in SW-846.

11.2.1 Field Accuracy

Determining whether a sample will yield results which accurately reflect the true concentration of a contaminant in the soil, sediment, or groundwater cannot be quantitatively assessed. However, the sampling locations and methods described in the SAP have been chosen such that the resultant samples are believed to be representative of the media being sampled.

Contamination of the samples would yield inaccurate results. Hence, rinsates, field blanks, and trip blanks will be sent to the chemical and radiological laboratories for analysis. Sections 4 and 10 discuss QA/QC samples in greater detail.

11.2.2 Laboratory Accuracy

The QAPP and SOPs of radiological and analytical laboratories will describe procedures to evaluate accuracy. However, the actual techniques used will depend upon the type of laboratory, radiological or chemical. Accuracy will be used to help determine if the laboratory is in control and used to assign the uncertainties to the radiological data, as discussed in Section 9.4.

Accuracy of the chemical laboratory data will be assessed through the calculation of percent recovery from MS/MSD analysis and any certified standards that the laboratory analyzes as part of its ongoing QA/QC program. The %Recovery is calculated as

$$\%\ \text{Recovery} = \frac{\text{SSR} - \text{SR}}{\text{SA}} \times 100\% ,$$

where SSR is the spiked sample result, SR is the sample result, and SA is the spike added. The laboratory is also required to run a sufficient number and type of blanks to detect laboratory contamination.

11.3 Radiological Laboratory Precision and Accuracy

For radiological analyses, uncertainties traditionally have not been broken down into precision and accuracy components. Instead, either a statistical uncertainty, based on Poisson statistics or radioactive emissions, and/or a total uncertainty, in which other error components are combined with the statistical uncertainty by adding in quadrature, is reported. The statistical component is a function of the number of counts in the peak; since the decay of radioactive elements is subject to Poisson statistics, the statistical uncertainty is equal to the square root of the number of counts in the peak. For gamma spectrometry, where peak-fitting programs are used to quantify the peak area, the statistical uncertainty is dependent on the peak-fitting routine. Other components added may be uncertainties due to the chemical procedure, if any, or uncertainties in the efficiency of the detector or geometry of the sample. A variety of other uncertainties may be included in efficiency or geometry uncertainties, or may be added separately. Because of cascade summing effects of some gamma decays, uncertainties may be higher for samples containing more than one radionuclide or for samples not in the exact geometry for which the detector has been calibrated.

Tables 11-1 and 11-2 list radionuclides selected for their probability of occurring in buried waste at the INEL; Table 11-1 lists radionuclides that may be found in soil samples and Table 11-2 lists those that may be found in water samples. These radionuclides are sufficiently long-lived that they may still be present in environmental samples after many years and have occasionally been found in samples taken from the RWMC and other sites at the INEL. A number of these are radionuclides that naturally occur in the soil

TABLE 11-1. RADIONUCLIDES LIKELY TO BE FOUND IN SOIL SAMPLES AS A RESULT OF PAST WASTE DISPOSAL ACTIVITIES AT THE INEL.

RADIO-NUCLIDE	HALF-LIFE	NOTE	ESTIMATED DETECTION LIMIT (Pci/g)	ESTIMATED ANALYTICAL UNCERTAINTY (%)
^{54}Mn	312.5 d	b	0.3	7-13
^{60}Co	5.27 y	b	0.3	7-13
^{65}Zn	244.1 d	b	0.6	7-13
^{90}Sr	28.8 y	a	0.3	5-100
^{110m}Ag	252 d	b	0.3	7-25
^{125}Sb	2.7 y	b	0.6	7-20
^{134}Cs	2.06 y	b	0.3	7-20
^{137}Cs	30.2 y	b	0.3	7-16
^{144}Cs	284 d	b	1.5	7-15
^{152}Eu	13 y	b	1.5	7-20
^{154}Eu	8.5 y	b	0.6	7-18
^{155}Eu	4.9 y	b	2.0	7-21
^{212}Bi	60.6 m	b	c	c
^{214}Bi	19.7 m	b	c	c
^{212}Pb	10.64 h	b	c	c
^{214}Pb	26.8 m	b	c	c
^{226}Ra	1600 y	b	c	c
^{228}Ac	6.13 h	b	c	c
^{234}Pa	6.7 h	b	c	c
^{234}Th	24.1 d	b	c	c
^{234}U	2.45E5 y	b	c	c
^{238}U	4.5E9 y	a	c	c
^{238}Pu	87.7 y	a	.003	3-100
^{239}Pu	24100 y	a	.003	3-100
^{241}Am	433 y	a	.003	3-100
Tritium	12.33 y		na	na
gross α		e	5.0E-5	5-100
gross β		e	2.5E-4	5-100

a. determined by radiochemistry.

b. In 500-ml squat jars counted by gamma spectroscopy for 2 hr. Different geometries or different count times will change detection limits and uncertainties. Each radionuclide is assumed to be the only significant gamma-emitter in the sample. More complex mixtures will have different detection limits.

c. Since these may occur in significant quantities in soils and rocks naturally, a detection limit is difficult to define.

e. 60 mg solid from 1000 ml, counted 2 hr.

TABLE 11-2. RADIONUCLIDES LIKELY TO BE FOUND IN WATER SAMPLES AS A RESULT OF PAST WASTE DISPOSAL ACTIVITIES AT THE INEL.

RADIO-NUCLIDE	HALF-LIFE	NOTE	ESTIMATED DETECTION LIMIT (pCi/g)	ESTIMATED ANALYTICAL UNCERTAINTY (%)
^{54}Mn	312.5 d	b	0.3	7-13
^{60}Co	5.27 y	b	0.3	7-13
^{65}Zn	244.1 d	b	0.6	7-13
^{90}Sr	28.8 y	a	0.3	5-100
^{110m}Ag	252 d	b	0.3	7-25
^{125}Sb	2.7 y	b	0.6	7-20
^{134}Cs	2.06 y	b	0.3	7-20
^{137}Cs	30.2 y	b	0.3	7-16
^{144}Cs	284 d	b	1.5	7-15
^{152}Eu	13 y	b	1.5	7-20
^{154}Eu	8.5 y	b	0.6	7-18
^{155}Eu	4.9 y	b	2.0	7-21
^{238}U	4.5E9 y	a	c	c
^{238}Pu	87.7 y	a	.003	3-100
^{239}Pu	24100 y	a	.003	3-100
^{241}Am	433 y	a	.003	3-100
Tritium	12.33 y		na	na
gross α		e	5.0E-5	5-100
gross β		e	2.5E-4	5-100

a. determined by radiochemistry.

b. In 4-L Marinelli beakers counted by gamma spectroscopy for 16 hr. Different geometries or different count times will change detection limits and uncertainties. Each radionuclide is assumed to be the only significant gamma-emitter in the sample. More complex mixtures will have different detection limits.

c. Since ^{238}U may occur in significant quantities in ground water naturally, a detection limit is difficult to define.

d. 10 mL counted for 2 hr.

e. 60 mg solid from 1000 ml, counted 2 hr.

TABLE 11-3. NATURALLY OCCURRING RADIONUCLIDES IN SOILS AT THE INEL.

RML CODE	ISOTOPE	SERIES (CHAIN)
RAB 214	^{214}Bi	Uranium (^{226}Ra)
RAP 214	^{214}Pb	Uranium (^{226}Ra)
THT 208	^{208}Tl	Thorium (^{232}Th)
THB 212	^{212}Bi	Thorium (^{232}Th)
THP 212	^{212}Pb	Thorium (^{232}Th)
RA 226	^{226}Ra	Uranium (^{238}U)
THA 228	^{228}Ac	Thorium (^{232}Th)
THM 234	^{234}Th	Uranium (^{238}U)
PAM 234	^{234}Pa	Uranium (^{238}U)

and are decay products of uranium and thorium (Table 11-3). Potassium-40 is also found as a natural component in soil and rock samples.

Column 2 of Tables 11-1 and 11-2 lists the half-life of each radionuclide. However, the natural radionuclides listed are analyzed not by using half-life of the individual decay product given in the table, but by using the half-life of the parent of the natural decay chain in which they occur. Column 4 lists the detection limit of each radionuclide in the geometry specified in the table. Detection limits are calculated according to the definition of L.A. Curie:

$$D = (2.71 = 4.66B^{½})/[(t)(E)(Y)(P)(3.7 \times 10^{-2})]$$

where D is the detection limit in picoCuries (pCi), B is the number of counts in the background, t is the counting time in seconds, E is the counting efficiency expressed as a decimal, P is the gamma emission probability of applicable, Y is the chemical yield if a chemical procedure is included in the counting process, and 3.7×10^{-2} is the number of disintegrations per second in a pCi. These detection limits were calculated in 1985, and will be updated in the near future.

Column 5 of each table gives an estimation of the range of total uncertainty, expressed as one standard deviation, which may be expected for each radionuclide if the sample is in the geometry as defined in each table. For gamma emitters, the range of uncertainties is that seen in samples of water and soil taken at the RWMC over several years. The high end of the range may be seen when quantities are 1.5 to 3 times the detection limit; as the activities approach the detection limit, uncertainties will be higher, up to 100% or more. The low end of the uncertainty range is the lowest possible uncertainty, and may be seen when the activity is well above the detection limit, when no interferences exist, and when the geometry is exactly the same as that for which the detector is calibrated.

Results of radiological analyses are very dependent on the geometry and matrix of the sample. If these are not as specified, both the detection limits and range of uncertainties may change in ways that can only be determined by an experienced analyst. An experienced analyst should always be consulted for each individual analysis to resolve these and other questions.

11.4 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter which is most concerned with the proper design of the sampling program. The representativeness criterion is best satisfied by making certain that sampling locations are selected properly and a sufficient number of samples are collected.

The amount of data available from previous sampling efforts is not adequate for purposes of determining optimum sample locations or numbers of samples. However, the limited information available has been used to develop a sample design to thoroughly sample all areas that are likely to have been contaminated by waste storage activities and will be affected by enclosure building foundation construction. Biased samples will be collected in areas most likely to be contaminated, such as the subsidence area in TSA-1 and TSA-2 Pads. Random and systematic samples will be collected in the remaining areas of the TSA which are going to be affected by enclosure building foundation construction. Using this design, it is believed that the sampling locations and methods proposed in this plan will result in samples representative of overburden and sideburden at the TSA.

11.5 Comparability

All data will be reported in units consistent with the conventions used for the given analyte and methods employed. The results of analyses can be compared with analyses by other laboratories because of the following project comparability objectives:

- Use standard methodology;
- Report results from similar matrices in consistent units;
- Apply appropriate levels of quality control within the context of the Laboratory Quality Assurance Program.

11.6 Overall Precision and Completeness

11.6.1 Precision

The best estimate of the overall precision is the standard deviation or %RSD calculated from the field duplicates or replicates, as discussed in Section 11.1.1. The field precision calculated from the replicates actually does contain a component of variation due to the laboratory. However, the laboratory variability is expected to be small compared to the field variation.

11.6.2 Completeness

The completeness of the data is the amount of valid data obtained from the measurement system or laboratory analysis versus the amount of data planned to be collected from the field. The specific objective for completeness of this project is 90 percent.

12.0 DATA MANAGEMENT

Data management is being addressed by the ERP data management staff. Portions of the DMS are in different stages of development. The DMS is being developed using guidance of standard data management practices to ensure the overall integrity of the data it captures.

The DMS is designed cognizant of the need to capture large volumes of data from several ERP programs. The DMS is also designed around the requirements that it ensure reliable, consistent, and effective flow, treatment, storage, and retrieval of all data. The DMS captures Sampling and Analysis Plan (SAP) data, field sampling data, and analytical data. Additional data types will be incorporated into the DMS as the needs arise.

As cited, earlier parts of the DMS are currently under development. However, the portion that captures SAP, field, and analytical data for chemical analysis samples is in place and functional. The flow process for these data is depicted in Figures 9-1 and 9-2. The data are all channeled through the ARDC to ensure that a consistent flow path is maintained for all data. Discussions on the reduction, reporting, and validation of these data are presented in Sections 9.1 and 9.2. A flow process similar to that shown in Figures 9-1 and 9-2 will be developed for other data types.

The DMS will include software for database management, data analysis, and report generation with a well-defined set of files with standardized record structures for maintaining the data and for archival purposes. This uniformity of data storage makes possible the integration of data from different ERP programs and maintenance of a global DMS for all ERP data.

Data entry, retrieval, manipulation, and report production capabilities either exist or will be developed for all data sets. The DMS will include several levels of automated verification and validation to ensure the highest level of reliability, accuracy, and quality in the data captured by the system.

13.0 SAFETY AND TRAINING

The Health and Safety Plan establishes the procedures and provides general guidelines for worker and public safety to be used by EG&G Idaho, Inc., and subcontractors during characterization of the project area. A site specific Health and Safety Plan is presented in Appendix A.

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- FINAL REPORT -
SOIL OVERBURDEN SAMPLING
AT THE RWMC
TRANSURANIC STORAGE AREA

September 1991

Prepared by the
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NOTE: The master copy of this report is located at the EG&G Idaho Environmental Restoration Program (ERP) Administrative Records and Document Control (ARDC) Office.

ABSTRACT

The purpose of the Transuranic Storage Area (TSA) overburden sampling task was to characterize the TSA waste stack overburden and sideburden soil for selected contaminants. Methods used to characterize the soil were based on Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) guidance. A field screening procedure with the portable gas chromatograph was used to determine areas most likely to be contaminated. The gas chromatograph detected transient vapors of volatile organic compounds near the oldest cells of the waste stack. This was followed by the collection of samples for laboratory analysis. Results of the laboratory analysis showed that all of the soils tested were below detection limits for contaminants sought. The conclusion of this report states that the soil is uncontaminated (below action levels) with respect to contaminants of concern and may be excavated with continuous real-time monitoring to ensure worker health and safety.

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FIGURES

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ACRONYMS AND ABBREVIATIONS

A-E	architecture-engineering
ARDC	Administrative Records and Document Control
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
EPA	Environmental Protection Agency
ERP	Environmental Restoration Program
GC	gas chromatograph
ID	identification
IEDMS	Integrated Environmental Data Management System
IH	industrial hygienist
INEL	Idaho National Engineering Laboratory
PCB	polychlorinated biphenyl
RCRA	Resource Conservation and Recovery Act
RML	Radiation Measurements Laboratory
RWMC	Radioactive Waste Management Complex
SMO	ERP Sample Management Office
TRU	transuranic
TSA	Transuranic Storage Area
USCS	Unified Soil Classification System
VOCs	volatile organic compounds
WIPP	Waste Isolation Pilot Plant

1. INTRODUCTION

This report summarizes results from the Radioactive Waste Management Complex (RWMC) Transuranic Storage Area (TSA) stored waste stack soil overburden sampling task, compares the results to the action levels, and provides recommendations in response to these findings. Section 1 of this document provides background information and describes the scope and objectives of the soil sampling investigation.

1.1 PURPOSE AND SCOPE OF REPORT

This report addresses results from the TSA soil sampling task performed during the months of February through May of 1991. The intent of the field characterization is to determine whether the overburden soil has become contaminated, identify the type (radiological and/or chemical) and extent of the contamination. The data obtained by this investigation will: 1) ascertain if the contaminants from the waste stack have migrated into the overburden soil, 2) promote more accurate planning of cost and schedule, and 3) facilitate preparations to safeguard the workers and environment while removing soil for the foundation construction of the TSA Retrieval Enclosure. Also, these results established a baseline database by which future soil analysis will be compared. The following topics are addressed in the order shown below:

- Scope of the TSA field investigation.
- TSA waste stack background information.
- Details of the physical characteristics of the study area.
- Description of the study area investigation, including field activities.

- Nature and extent of any contamination. This includes the comparison of the validated data to the established action levels.

- Data limitations and recommendations for future data collection.

- Recommendations for excavation and disposition of the overburden soil.

1.2 SITE BACKGROUND

This section provides background information for the RWMC TSA stored waste stack as it relates to this field characterization.

1.2.1 Site Description and History

Since 1970, the RWMC at the Idaho National Engineering Laboratory (INEL) (see Figure 1) has accepted over 65,000 m^3 of defense-generated and other transuranic (TRU) waste for interim 20-year retrievable storage. Waste in boxes and drums is stored in "cell" configurations on adjoining, aboveground asphalt pads at the TSA (see Figure 2). There are eight cells in TSA-1, three cells in TSA-2, and three cells in TSA-R. Figure 3 shows the location of these cells.

When a storage cell reached its waste volume limit, the waste containers were topped with plywood and polyvinyl sheeting, followed by a minimum of 2 ft of soil cover above the highest container of the cell. Soil depth over the remainder of the containers may exceed 4 ft. Sideburden soil was added to reduce grade angle. The depths of the sideburden soil average approximately 16 ft at the edge of the stored waste containers. There is a potential that some breaching of waste containers has occurred, with the possibility of contaminant migration into the overburden/sideburden soil. The underlying soil is assumed to be protected from contaminant migration by asphalt pads, although the current condition of the asphalt has not been assessed. Prior to the TSA soil sampling task, visual inspections and routine instrument surveys

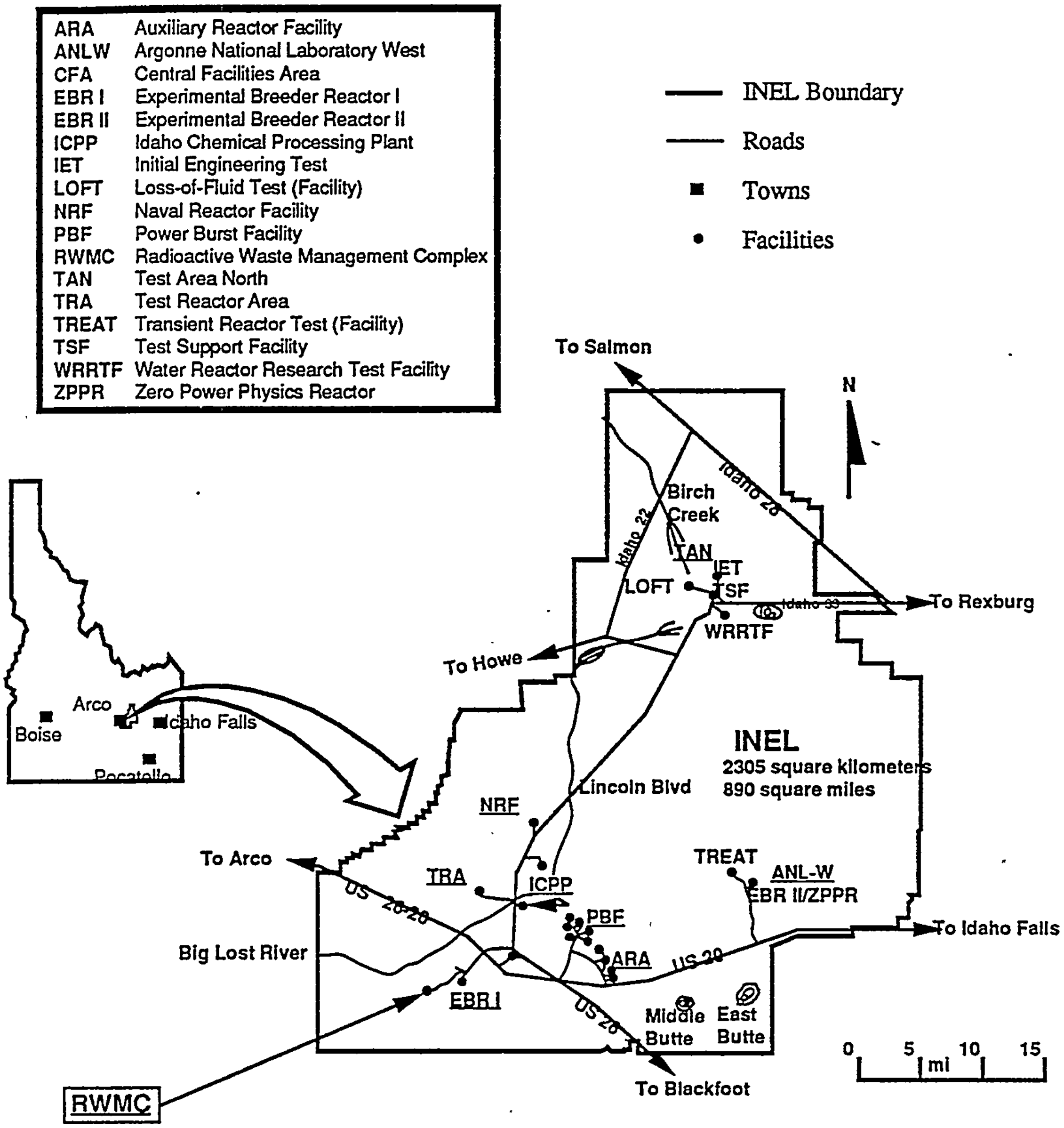

Figure 1. Map of the INEL showing the location of the RWMC.

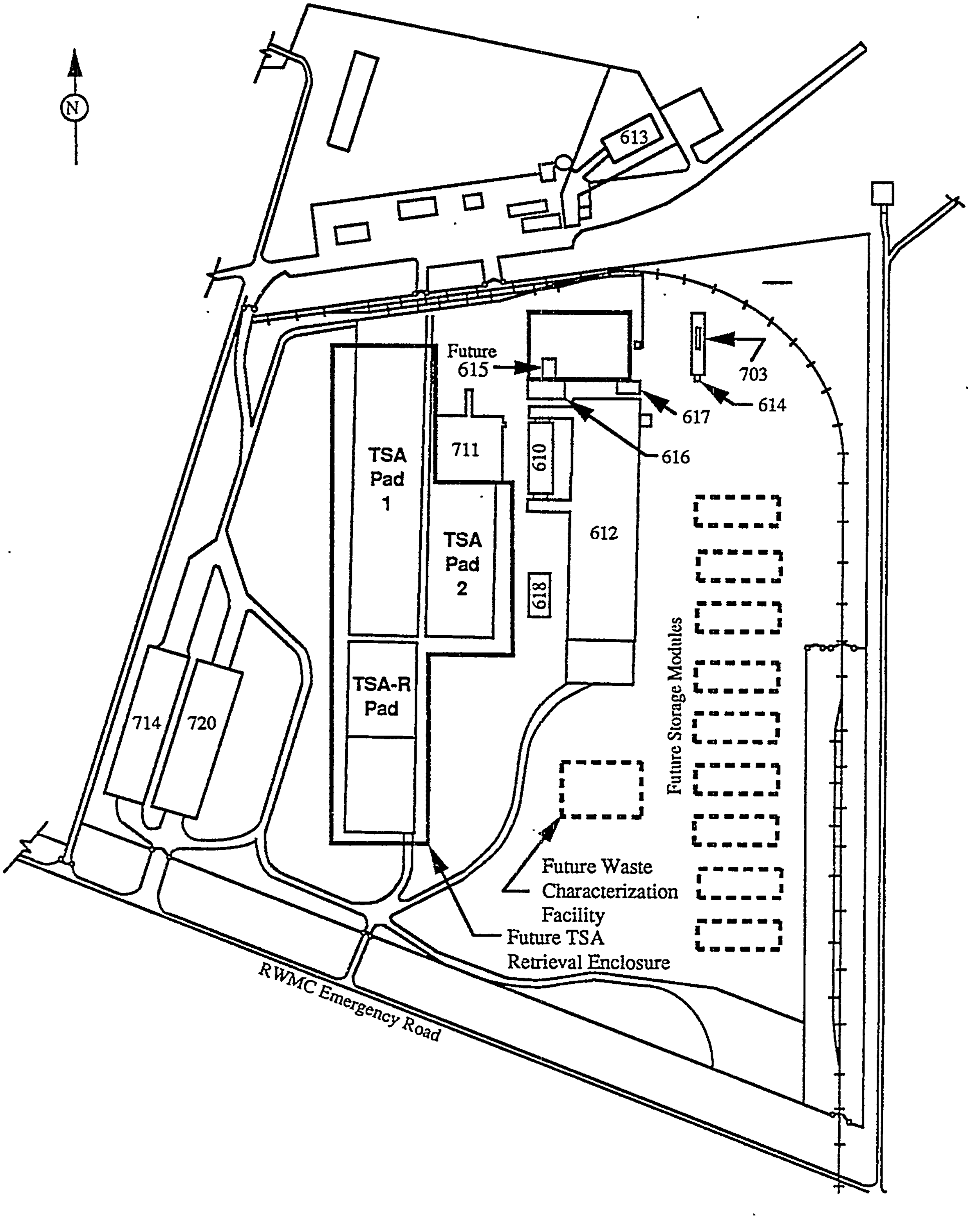

Figure 2. Map of RWMC showing the location of the TSA Pads.

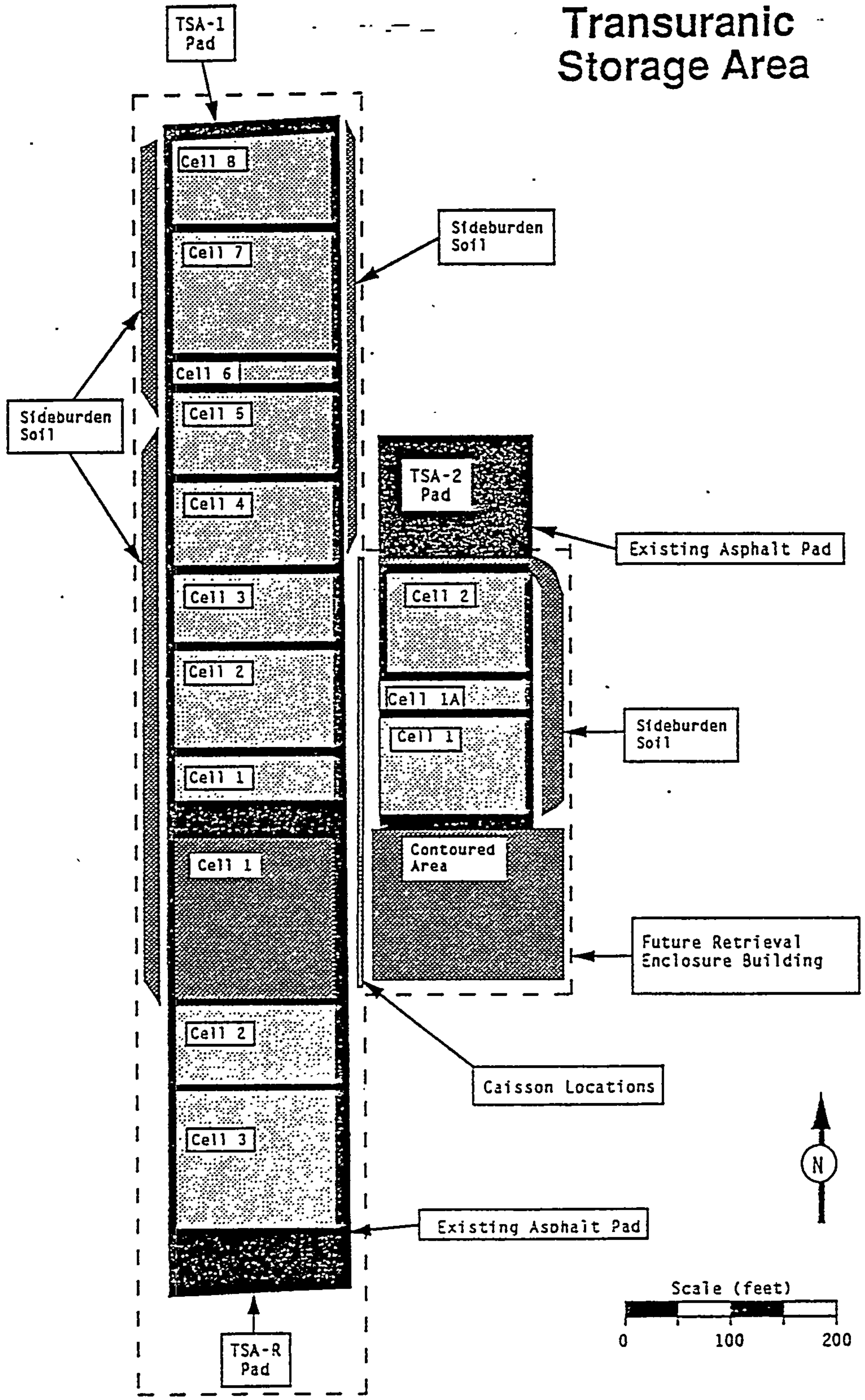

Figure 3. Location of cells within the TSA Pads.

have not detected any contamination in the cell areas overlain by soil. However, a spill of TRU contaminated material from containers stored on TSA-R pad is known to have occurred. The suspect containers, located in cell 3, are not covered with soil, and therefore the spill was readily contained and stabilized.

1.2.2 Future Site Objectives

The Department of Energy (DOE) Nuclear Waste Management Program's objective is to remove all retrievable stored waste from the INEL and send it to the Waste Isolation Pilot Plant (WIPP) in New Mexico. The TSA Retrieval Enclosure Project has been implemented to provide a structure and equipment to safely retrieve the waste containers presently stacked in the TSA. This project is described in the EG&G Idaho Architecture-Engineering (A-E) document, *A-E Conceptual Report, TSA Retrieval Process*[a]; the specifications for the building are found in *A-E Advanced Conceptual Report, TSA Retrieval Containment Building.*[b]

Prior to beginning construction of the waste retrieval building, the TSA soil overburden was characterized to determine if the soil is contaminated and to what extent. The soil sampling and analysis plan that guided the field sample collection and laboratory analysis was the *Soil Sampling Plan for the Transuranic Storage Area Soil Overburden.*[c]

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[a] *A-E Conceptual Report, TSA Retrieval Process*, Project File #020147R, EG&G Idaho, Inc., January 1990.

[b] *A-E Advanced Conceptual Report, TSA Retrieval Containment Building*, Project File #020147, EG&G Idaho, Inc., October 1989.

[c] Hardy, C. K., Pickett, S. L., and Stanisich, S. N., *Soil Sampling Plan for the Transuranic Storage Area Soil Overburden*, EG&G-WM-8986, Idaho National Engineering Laboratory, Idaho Falls, Idaho, March, 1990.

1.2.3 Previous Investigations

Surface radiation surveys and air monitoring for radioactive particulates at the TSA are routinely performed by RWMC Health Physics personnel. The site investigation performed this spring was the first field study of the TSA soil overburden that sampled and analyzed the soil for contaminants.

2. STUDY AREA INVESTIGATION

This section describes the TSA waste stack and the soil sampling investigation.

2.1 PHYSICAL CHARACTERISTICS OF THE TSA STUDY AREA

To adequately describe the soil types and conditions on the TSA waste stack, the process by which the soil surrounding the waste was originally placed must be described. Information on this process was gained by verbal communication with RWMC personnel as follows:

> "Soil used to cover the waste was excavated from a borrow area about 400 yd south of the TSA and outside of the RWMC fence. The soil was excavated using large earthmoving equipment (scrapers) and then transported to the TSA waste stack. The scrapers dumped the soil evenly on the top of the waste stack, and it was further spread and compacted with a tracked loader."

Soil in the borrow area typically consists of eolian silts with increasing clay content to the basalt bedrock. The basalt bedrock varies from surface exposures on higher ground to about 25 ft below the ground surface in the lower areas.

Areas of the TSA cover soil reflect the variation of the soils in the borrow area. By inspection, at least 90% of the soil would classify under the Unified Soil Classification System (USCS) as ML-CL (clayey-silt of low plasticity) and the remaining 10% or less would be CL (lean clay). A few areas have relatively high compaction, but the typical unit weight of the soil is estimated to be 95 lb/ft^3. Soil moisture content of the soil during the field sampling was estimated to be less than 5%.

The top surface of the waste stack is relatively flat and with very little slope. The sideburden soils have slopes of typically 1.5(horizontal):1(vertical), although some small areas have held nearly vertical slopes for several years.

Vegetation on the TSA waste stack was sparse and typical of the INEL. Vegetation communities at the INEL are typical of the sage brush steppe/cold desert ecosystem. Big sagebrush and rabbitbrush are common in most native communities of the INEL. Other locally important shrubs include winterfat, shadscale saltbush, Nuttall's saltbush, and gray horsebrush. Bottlebrush squirreltail, needle-and-thread grass, giant wildrye, bluebunch wheatgrass, thickspike wheatgrass, and bluegrass are the most abundant grass species.[a]

2.2 SOIL SAMPLING INVESTIGATION

The general areas of interest for the field sampling were as follows:

- Sideburden soils on the west side of TSA-R, the west and east sides of TSA-1, and the east and north sides of TSA-2
- Soil in the caisson area between TSA-1 and TSA-2
- Soil comprising the "contoured area" south of TSA-2
- Overburden soil on TSA-R, TSA-1, and TSA-2.

The reasons these areas are of interest are as follows. Sideburden soils must be removed in most areas to provide room for construction of the TSA Retrieval Enclosure foundation. The soil in the caisson area between TSA-1 and TSA-2 will be drilled with a 5-ft auger during installation of the support caissons. Soils located in the "contoured area" and a large portion

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[a] McBride, R., French, N. R., Dahl, A. H., and Detmer, J. E., *Vegetation Types and Surface Soils of the Idaho National Engineering Laboratory Site*, IDO-12084, 1978.

of the soil on top of TSA-R will also be removed prior to construction of the retrieval enclosure. The remaining overburden soil was characterized to provide current site information and a data base for future retrieval operations.

The investigation was conducted in two phases. Phase I consisted of collecting samples for analysis of soil vapor headspace using the field gas chromatograph (GC). Phase II consisted of collecting and shipping soil samples to offsite laboratories for radiological and chemical analyses. The contaminants sought are believed to be the most reasonable indicators of any contamination at the site based on the site history and waste inventory.

2.2.1 Phase I - Gas Chromatograph (GC) Sampling and Analysis

Soil samples were collected for field GC headspace analysis at 174 initial locations. These locations are identified as SS#1, SS#2, SS#3,. . . etc. Figure 4 shows the sample locations on the TSA waste stack. The original full-size drawing is located at the EG&G Idaho Environmental Restoration Program (ERP) Administrative Records and Document Control (ARDC) office. Results from the GC analysis were used to determine appropriate locations for collecting samples for offsite laboratory analysis.

Approximately 500-mL samples collected for field GC analysis were placed in 1-gal sealed plastic bags. Following collection, the samples were either taken to the GC for immediate analysis or further sealed with tape and refrigerated at 4°C for later analysis. All GC samples were analyzed within a week of collection. The samples were allowed to come to room temperature before the headspace air in the bag was analyzed.

2.2.2 Phase II - Collection of Samples for Laboratory Testing

The soil samples for offsite laboratory analysis were collected at points within 2 ft (horizontally and vertically) of selected initial GC sample locations. Additional soil samples for field GC headspace analysis were collected simultaneously with the laboratory samples for later comparison.

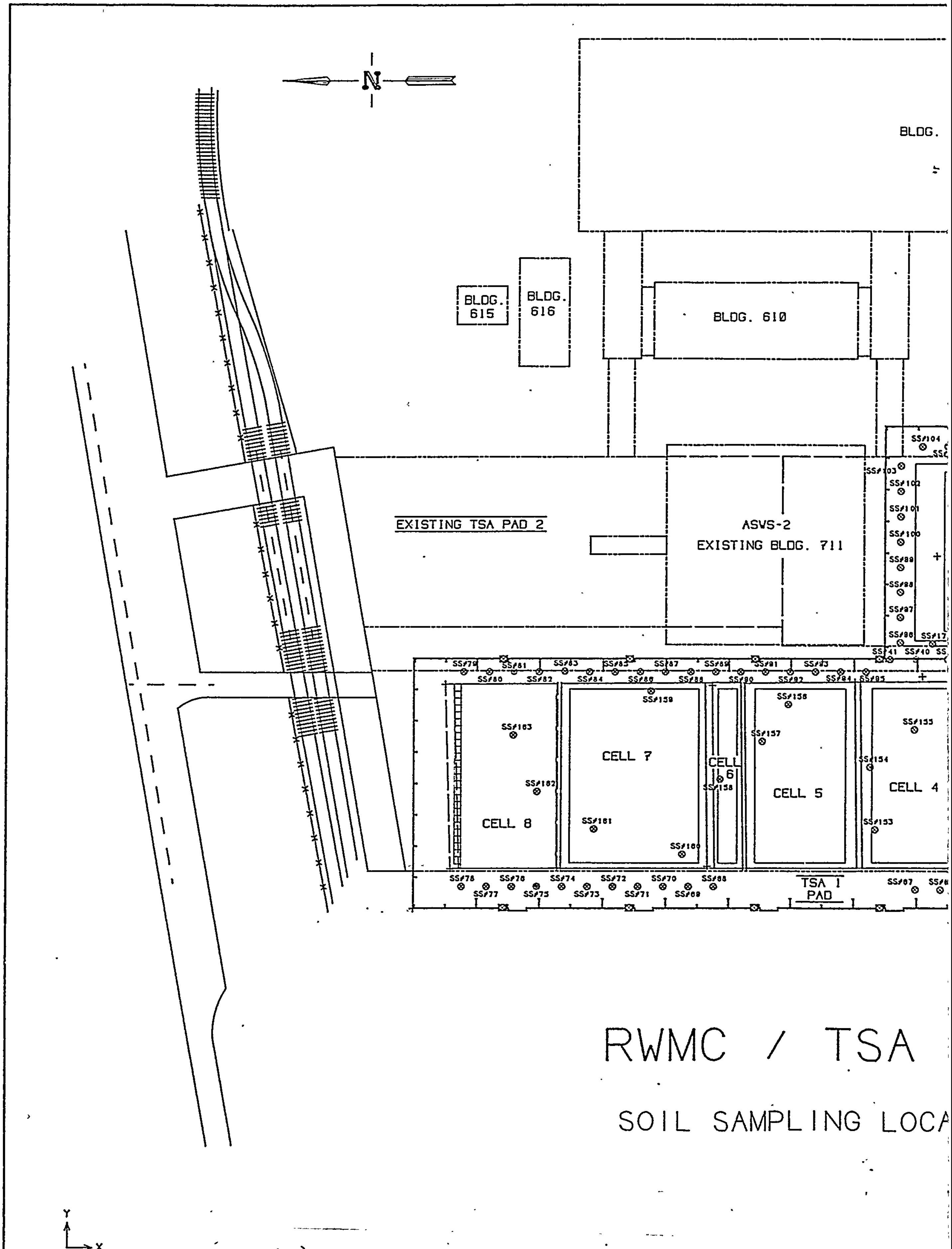
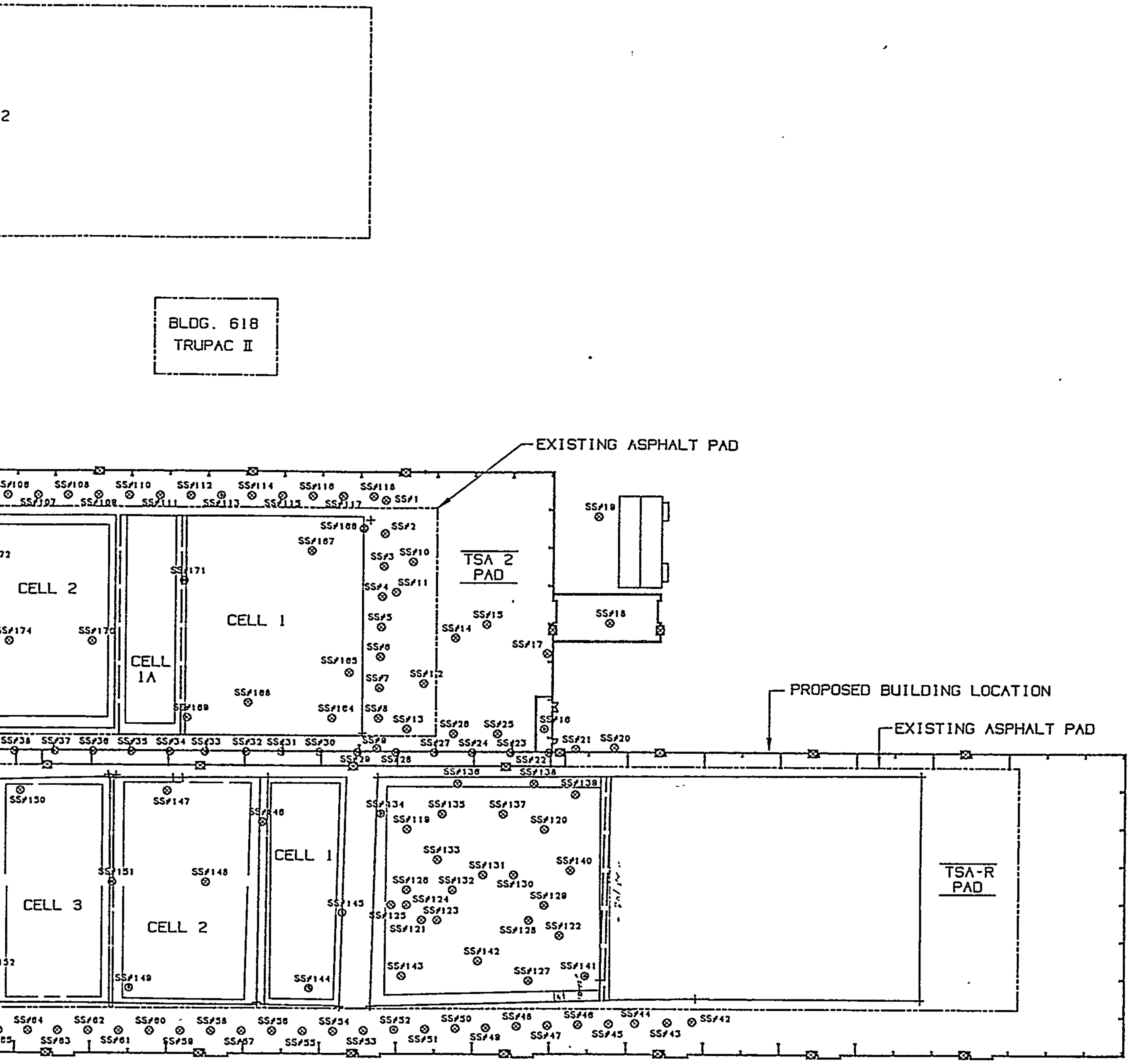


Figure 4. Soil sampling locations at the TSA waste stack.



WASTE STACK

TIONS - SPRING 1991

SCALE: 1" = 50'-0" (ON D-SIZE DRAWING)

0 ft 100 ft 200 ft

⊗ - LOCATION OF TEST BOREHOLE
⊛ - LABORATORY SAMPLE LOCATIONS

REFERENCE DRAWING: RCSSK3.DWG (ON AUTOCAD)
DRAWING NAME: STACPLT.DWG (ON GENERIC CADD LEVEL 3)
SAMPLE LOCATIONS PLOTTED BY R.G. SCHWALLER. AUGUST, 1991
ENVIRONMENTAL TECHNOLOGY UNIT. EG&G IDAHO, INC.

A total of thirteen locations were selected for laboratory sample collection. The locations were selected either because they yielded positive results with the field GC screening or they represented a typical section of the TSA waste stack due to their location. The laboratory sample locations are designated with an "L" at the end of the location number, i.e. SS#16L, SS#30L, etc.

Samples sent offsite were analyzed for volatile organic compounds (VOCs), metals, polychlorinated biphenyls (PCBs), and radionuclides by gamma spectroscopy. Argonne National Laboratory-East performed the offsite analyses for chemical constituents and the INEL Radiation Measurements Laboratory (RML) performed the radiological analysis. Sampling procedures were dictated in the soil sampling plan[a] and conform to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sampling guidance recommendations.

2.2.3 Onsite Monitoring for Radionuclides and VOCs

Continuous air monitoring for radionuclides was performed by the RWMC Health Physics technician (HP) immediately downwind of all drilling and sampling activities. All soil samples were screened with a Ludlum 2A for gamma activity and a Ludlum 61 for alpha particles. Smears were taken on all equipment that contacted the soil during drilling and sampling and were counted with a scaler instrument (NMC DS33 proportional counter converter) for total activity. These field screening/monitoring activities did not detect the presence of any radioactivity greater than normal INEL background levels (typically less than 100 counts/minute with a Ludlum 2A). RWMC Health Physics provided a report of the monitoring activities and results for the TSA soil sampling task. That report (found in Appendix A) supports the conclusion that no radiological contamination was detected in the overburden soil.

Boreholes in the support caisson area between TSA-1 and TSA-2 were checked for volatile organic vapors with an HNu photoionization meter. The

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[a] Hardy, C. K., Pickett, S. L., and Stanisich, S. N., *Soil Sampling Plan for the Transuranic Storage Area Soil Overburden*, EG&G-WM-8986, Idaho National Engineering Laboratory, Idaho Falls, Idaho, 1990.

boreholes in the caisson area were selected for HNu screening since the RWMC Industrial Hygienist (IH) reasoned that the sampling personnel had the greatest risk of exposure from drilling in this area. This was because samples were collected at the asphalt pad level and were very close to the waste stack on TSA-2. The HNu probe was positioned about 2 ft from the top of each borehole checked. HNu readings for the support caisson area are shown in Table 1 and indicate the presence of low levels of VOCs in the soil gas.

Table 1. HNu readings at caisson locations recorded in the TSA Logbook #1[a]

Location	HNu Reading (ppm)
SS#31	4
SS#32	14
SS#33	1
SS#35	4
SS#36	5

An organic vapor badge was placed in SS#32 overnight and sent to the laboratory for analysis the following day. The badge was placed just inside the covered sampling borehole. Carbon tetrachloride was detected at a concentration of 5.3 ppm. Lesser concentrations of benzene, trichloroethene, chloroform, and perchloroethene were also detected. The results and calculations provided by the RWMC IH are found in Appendix B. The results confirmed the presence of organic vapors in borehole SS#32, as detected by the HNu.

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[a] *INEL RCRA/CERCLA Investigations Sample Logbook (#ERP-294-90)*, TSA Site Logbook #1, February 26 - April 22, 1991.

3. NATURE AND EXTENT OF CONTAMINATION

This section addresses data validation and the results of the field screening and laboratory analysis for both chemical and/or radiological contamination at the TSA waste stack. The GC field screening results are shown in Appendix C. Detailed laboratory results are presented in Appendix D and Table 2. A summary of the results are reported below.

3.1 DATA VALIDATION

This section discusses validation of the field GC and the offsite laboratory data.

3.1.1 Field GC Data Validation

The data for the field GC were reviewed by EG&G Idaho Environmental Technology Unit personnel. The validation performed ensured that the values used for interpretation of the field GC data were representative of the samples and not ambient conditions, calibration gases, or spiked samples. The field GC was calibrated frequently and stayed within calibration. The field GC data quality was sufficient for screening purposes.

3.1.2 Offsite Laboratory Data Validation

Data from the offsite laboratory were validated by the EG&G Idaho Environmental Restoration Program (ERP) Sample Management Office (SMO). A level B validation was performed. Checks were made for chain of custody, requested versus reported analyses, analysis holding times, method blank analysis, matrix spike/matrix spike duplicate analysis, duplicate analysis, internal standard areas, and surrogate recoveries. The data was useable and valid with the exception of some where VOC samples exceeded holding times.[ab] Data validation reports are located at the ERP ARDC.

3.2 CHEMICAL CONTAMINATION

The portable GC detected trace levels ranging from 0.01 to 19.48 ppm of VOCs in the air headspace of the soil samples collected at several locations on the TSA waste stack. Laboratory tests of the soils found VOC concentrations to be above the detection limits in some cases but below the action levels established in the soil sampling plan.[c] The laboratory results for metals were similarly below action levels. The laboratory did not detect the presence of PCBs. The analyses and results are further discussed in the following sections.

3.2.1 Inorganic Compounds

Soils samples were collected for analysis of metals by EPA method 6010 (inductively coupled plasma) and EPA method 7471 (mercury by cold vapor, atomic absorption spectroscopy). The sampling locations were biased to locations where relatively elevated concentrations of volatile organic compounds were detected by the field GC. Biased samples were collected in an effort to detect the highest concentrations of metals in the soils. The greatest concentrations of VOCs were thought to have the potential for the

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a. Letters from R. D. Grant to W. R. Paskey, EG&G Idaho Interoffice Correspondence, Letters RG-132-91 through RG-136-91, RG-138-91, Subject: "Validation of...Data from the 1990 Sampling Effort of Transuranic Storage Area Soil Overburden Sample Delivery Group Number...," September 11-12, 1991.

b. Letters from R. J. Sheehan to R. G. Schwaller, EG&G Idaho Interoffice Correspondence, Letters RJS-25-91, RJS-26-91, and RJS-28-91, Subject: "Level "B" Validation for the Transuranic Storage Area Pads Project, Inorganic Analysis, Delivery Group Number...," September 11-12, 1991.

c. Hardy, C. K., Pickett, S. L., and Stanisich, S. N., *Soil Sampling Plan for the Transuranic Storage Area Soil Overburden*, EG&G-WM-8986, Idaho National Engineering Laboratory, Idaho Falls, Idaho, 1990.

highest concentrations of metals in the soils. Any leaks from the waste containers could contain the whole range of contaminants sought.

The results of this analysis were compared to concentrations of metals in undisturbed soils near the RWMC. Ten soil samples were collected to establish a range of background concentrations of metals that occur naturally in soils. The upper range of background was established using the data collected from the background samples and standard statistical techniques. The range of background was estimated using the upper 99 % percentile with 99% confidence.[a] This upper range of background (the highest estimated concentration of a specific metal) was then compared directly to concentrations detected at the biased sampling locations. All concentrations of samples collected from the TSA were less than the estimated upper range of background.

Some concentrations of metals naturally occurring in soils were less than the detection limit of the analytical methods used. When this was the case, tolerance limits could not be calculated because a range of concentrations was not established. Instead, the concentration was noted as being less than or equal to the detection limit. In these cases, the results of the TSA samples were compared to the maximum detection limit for the background samples. Detection limits of soil samples vary slightly between samples. All of the samples collected from the TSA were less than or equal to the maximum detection limit of the background soils.

The soil samples collected at biased locations indicated that the concentration of metals in soils from the TSA were similar to concentrations that are found naturally. It can be concluded that the TSA overburden soils are free of metals contamination.

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[a] Crow, E. L., Davis, B. D., and Maxfield, M. W., *Statistics Manual*, Dover Publications, Inc., New York, 1960.

3.2.2 Volatile Organic Compounds (VOCs)

Samples were collected for analysis of volatile organic compounds by EPA method 8240. These samples were collected to verify the results of the portable GC analysis. Although the two methods and media are quite different, the target compounds (VOCs) were the same. The GC method determined the concentration of VOCs in air in the container headspace above the sample. The 8240 method uses Gas Chromatography/Mass Spectroscopy to determine the concentration of VOCs absorbed or adsorbed to the soil. Seven different VOCs were detected at low concentrations in some soil samples. Methylene chloride (one detection), acetone (one detection), 1,2-dichloropropane (one detection), trichloroethene (two detections), tetrachloroethene (one detection) , toluene (four detections) and xylene (three detections) were the compounds detected. The highest concentration detected was 51 ug/kg of methylene chloride. This common laboratory contaminant was found in only one sample. The other detections were less than 8 ug/kg. All detections were qualified with a "J" by the SMO indicating that the concentrations were estimates, but the identification of the compound is confirmed. The detections of xylene may be false positive because of xylene detections in the rinsate sample. The methylene chloride detection may be biased high because of methylene chloride detections in one trip blank. Holding times were exceeded on all but three samples and raises the concern that VOCs were originally present but not detected (false negatives).

The analysis by method 8240 indicates that low concentrations (0-10 ppb range) of various VOCs are present and appear to be only in isolated areas. Generally this correlates well with the results of the GC method.

3.3 RADIOLOGICAL CONTAMINATION

Based on the laboratory data from the INEL Radiation Measurements Laboratory (RML), the sideburden and overburden soils do not contain any contamination from radionuclides in levels above background. The presence of Cs-137 was noted at trace levels (the highest was 0.12 pCi/gm) and is attributed to worldwide nuclear fallout, which is present in the INEL soils. Typical concentrations of Cs-137 in INEL soils, due to fallout, are 0.8 pCi/gm, but can vary by a factor of two.[a] A copy of the RML report is shown in Appendix E.

Table 2. Results of the laboratory analysis for radiological contamination

Sample ID	RML ID	Manmade Radionuclides	Activity (T) (pCi/gm)
TSA1401G	D2040391025	None Detected	N/A
TSA1402G	D1041291030	None Detected	N/A
TSA1403G	D3042591024	None Detected	N/A
TSA1501G	D1040391024	Cs-137	(1.1±.3)E-01
TSA1502G	D2040391022	Cs-137	(1.2±.2)E-01
TSA1503G	D1040391022	None Detected	N/A
TSA1504G	D1041591025	None Detected	N/A
TSA1505G	D2041291031	None Detected	N/A
TSA1506G	D2042591023	None Detected	N/A
TSA1507G	D1042591022	None Detected	N/A
TSA1508G	D3042691028	None Detected	N/A
TSA1509G	D3042591034	Cs-137	(4.0±.8)E-02
TSA1510G	D1042591028	None Detected	N/A
TSA1901G	D1042691027	None Detected	N/A

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a. Letter from T. J. Haney to R. G. Schwaller, EG&G Idaho Interoffice Correspondence, Letter TJH-47-91, Subject: "Gamma Analysis of Sixteen TSA Soil Overburden Samples," May 10, 1991.

4. SUMMARY AND CONCLUSIONS

This section discusses the limitations of field and laboratory measurements, compares results to the action levels, and provides recommendations for use of the data.

4.1 DATA LIMITATIONS

The data from both the field GC and the laboratory may be subject to some limitations in its use. These limitations are described below.

4.1.1 Field GC Data Limitations

Results from the field GC were used for screening purposes as per the sampling plan. The GC data provide screening information for subsequent sampling and as an alert for potentially contaminated areas during the TSA waste retrieval operations. Also, the information gathered from GC screening may provide some additional insight for the future determination of breached waste containers within the TSA waste stack.

Data obtained from the field GC may be subject to several sources of error. Each sample collected was roughly measured to 500 mL. The sample weight, temperature, and air headspace volume were not precisely measured, but were held as constant as possible by inspection. Barometric pressure and exact air temperature were not recorded as each sample was taken. All of these factors can affect the results of GC screening to some degree and in combination, may diminish the data quality. The GC results show general trends and are sufficient for screening and identification of critical areas. This was the intent as per the sampling plan.

4.1.2 Laboratory Data Limitations

This section discusses any limitations of the radiological and chemical data which affect the data objectives.

4.2.1.1 Radiological Laboratory Data. Monitoring of radiological conditions combined with laboratory analysis for radionuclides thoroughly characterized the soils for radiological contamination. It is believed that the continuous monitoring of the air, drill cuttings, samples, and personnel, in addition to the soil laboratory analysis, provided comprehensive information for radionuclide contamination.

4.2.1.1 Chemical Laboratory Data. Nearly three-quarters (10 soil samples) of the samples collected for VOC analysis exceeded allowable holding times while at the offsite laboratory. Analytical data from samples exceeding the allowable holding times were declared invalid by the SMO.

4.2 DATA INTERPRETATION

This section describes the data interpretation methods which support conclusions for both the GC and laboratory analyses.

4.2.1 GC Data Interpretation

The GC data collected represents the concentrations of VOCs in the air headspace in each sample. This data does not measure concentrations of contaminants in the soil but rather shows the presence of VOCs in the soil gas in situ at the TSA site. Methods of interpretation and analysis of the GC data are as follows.

4.2.1.1 General Interpretation of GC Data. An interpretation of the field GC screening data is shown in Figures 5 and 6. The total VOCs detected with the GC were summed and assigned to each sampling point. Additionally, the points in space halfway between each adjacent sampling point were assumed to have a concentration of VOCs that is the average of the adjacent sampling points. Section 4.2.1.2 describes in detail how Figures 5 and 6 were developed. These figures show that the greatest <u>potential</u> for encountering VOCs in the soil gas is in the oldest part of the waste stack (TSA-1, Cell 1) and that this diminishes in the newer parts of the stack. The soil properties

TSA WASTE STACK - TOTAL VOCs DETECTED AT DEPTHS FROM 2 - 19 FT

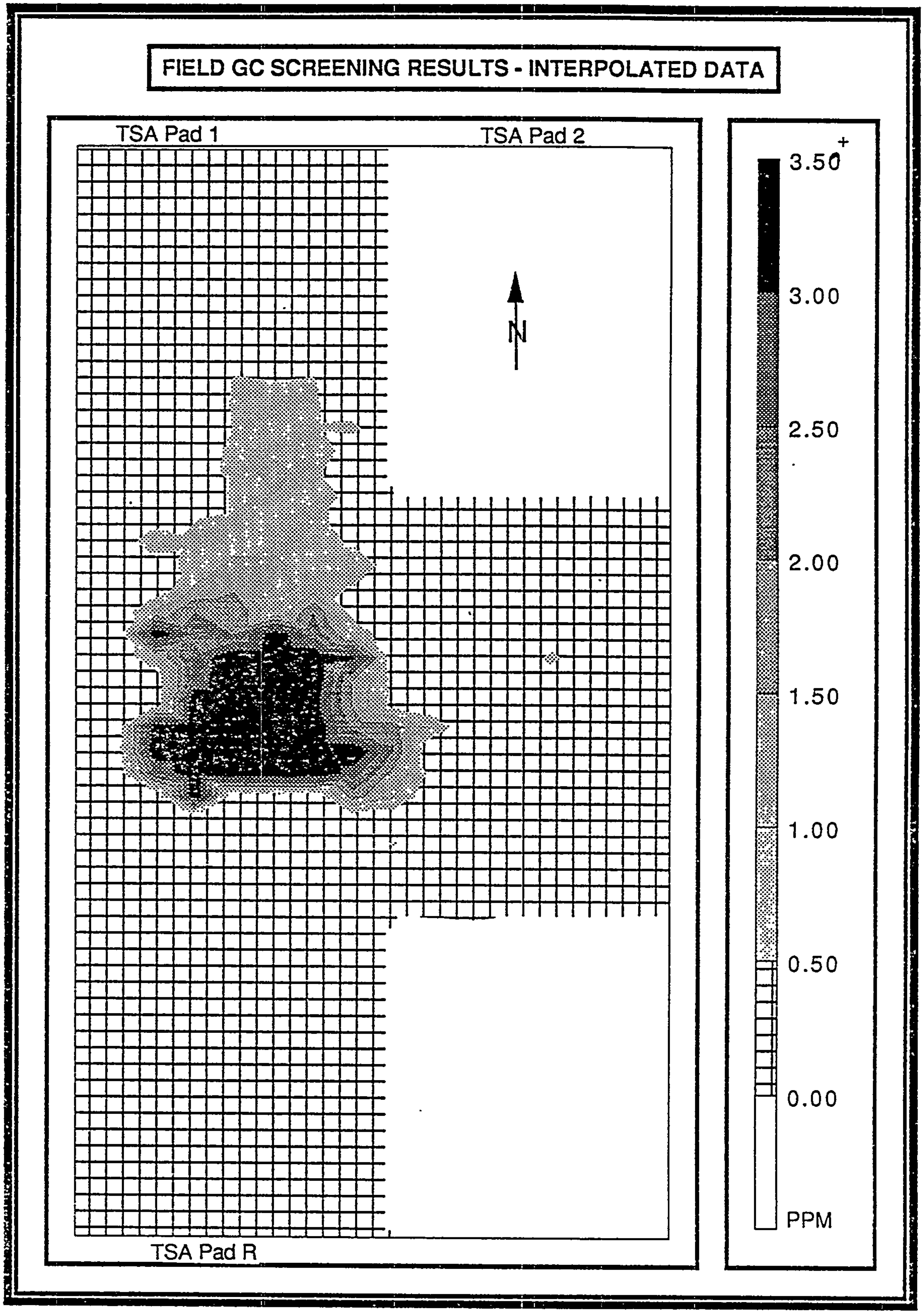


Figure 5. Interpreted results of the GC field screening method for the entire TSA waste stack.

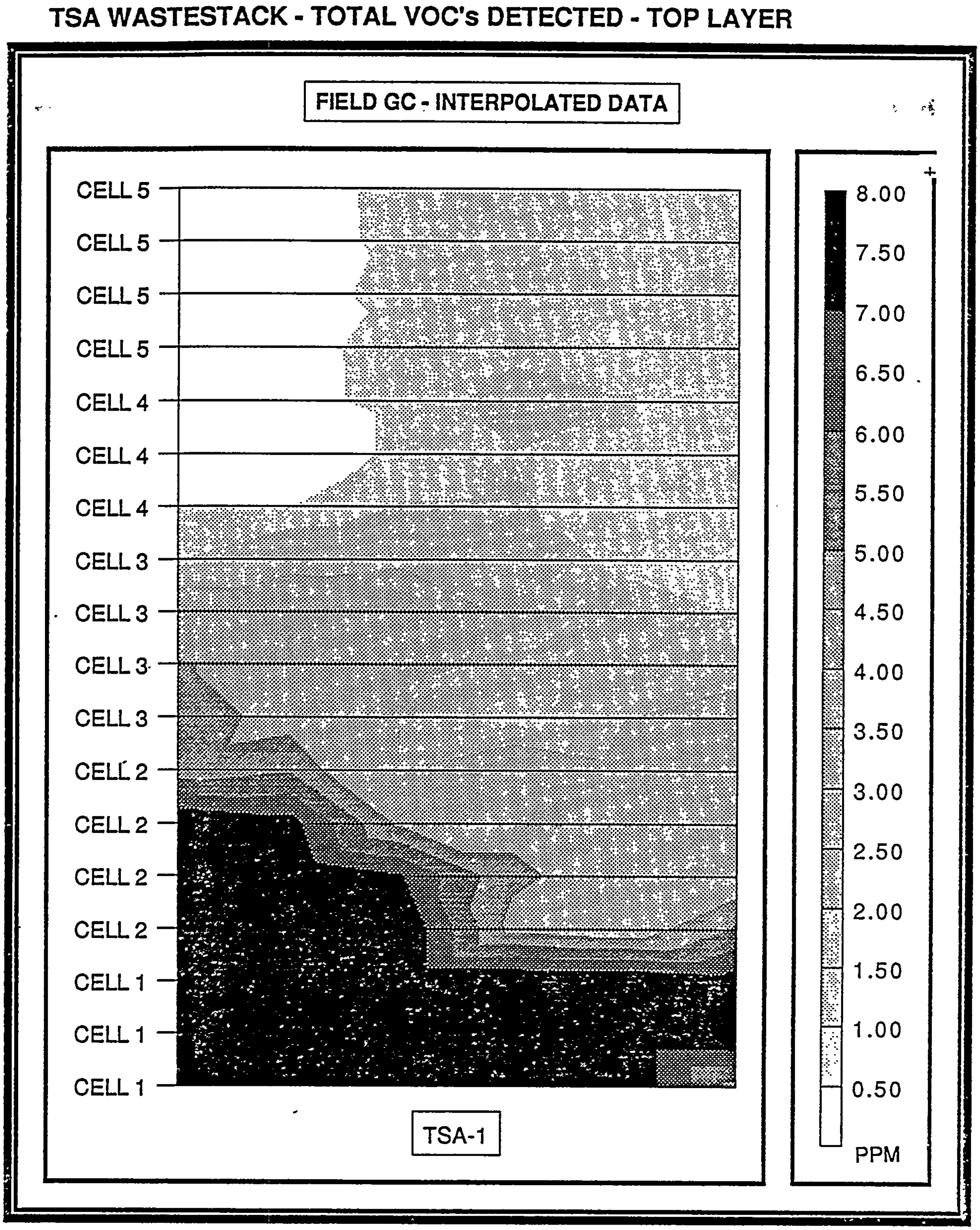


Figure 6. Interpreted results of the TSA-1 overburden soil headspace analysis for VOCs.

were relatively uniform so container degradation was most likely responsible for these differences.

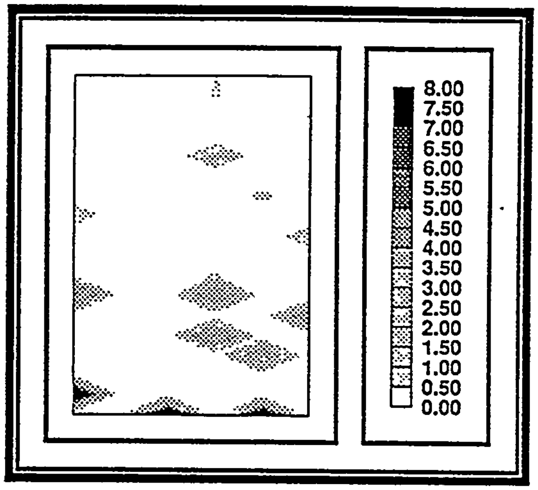
4.2.1.2 Graphical Representation of GC Data. Figure 7 was developed to support the following description of how the GC data were interpreted. Figure 7 shows the TSA-1 (Cells 1 through 5) area and the steps taken to arrive at the final interpretation of the GC data.

The VOCs detected in each GC sample were totaled, with a total of 0.50 ppm or greater considered as above background level for analysis. Totaled GC data were plotted on a 25 x 25-ft grid, sized to the physical dimensions of the TSA waste stack. Data from points not actually on grid coordinates were plotted at the nearest grid coordinate point. If more than one data point was plotted on a single grid coordinate point, then the highest data point value was used. Grid data were transferred to a spreadsheet program for processing. To enhance clarity in presentation of the data, the highest totals found were consolidated so that in each chart, higher values exist than are listed on the accompanying scale. In other words, values greater than 7.00 ppm are presented in black in Figures 5, 6, and 8.

Points that do not have actual test data assigned are assumed to have a potential for VOC contamination, which can be depicted by averaging the surrounding point values. Each data coordinate point (except for edge and corner points) is surrounded by eight other coordinate points. All open points were first examined to see if one or more of the contiguous points contained test data. The average value of all contiguous points was then assigned to the coordinate point under consideration. The total grid was then reexamined, starting with the coordinate point in the lower left-hand corner of the grid, evaluating each point in the lowest row of points before moving to the left end of the next higher row. Each open point considered was assigned the average value of all original and derived values contiguous to the point under consideration. Open points above and to the right of the considered points were ignored in the averaging process. The lower right-hand data point was arbitrarily given one-half the value of the point to the

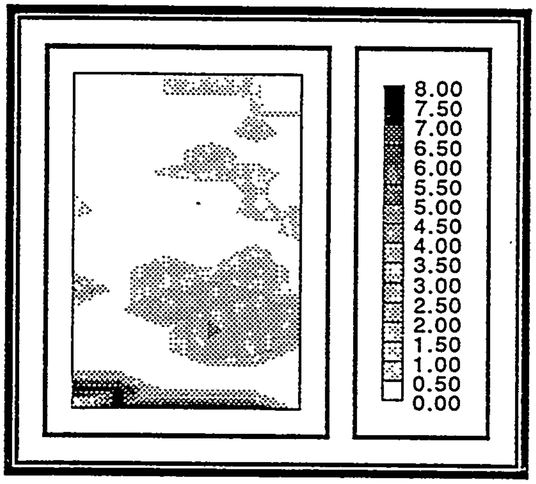
ORIGINAL DATA

	E50	E75	E100	E125	E150	E175
CELL 5				0.50		
CELL 5				0.56		
CELL 5						0.61
CELL 5						
CELL 4				1.29		
CELL 4		0.00				
CELL 4					0.67	
CELL 3	0.96					
CELL 3						0.97
CELL 3						
CELL 3				0.58		
CELL 2	4.37			3.35		
CELL 2						3.15
CELL 2				4.18		
CELL 2					3.25	
CELL 1						
CELL 1	12.58					
CELL 1			19.48		9.30	



FIRST INTERPOLATION

	E50	E75	E100	E125	E150	E175
CELL 5			0.53	0.50	0.53	
CELL 5			0.53	0.56	0.56	
CELL 5					0.59	0.61
CELL 5					0.95	
CELL 4				1.29		
CELL 4		0.00	0.65	0.98	0.98	
CELL 4	0.48	0.48			0.67	
CELL 3	0.96				0.82	0.82
CELL 3						0.97
CELL 3					0.78	
CELL 3			1.97	0.58	1.97	
CELL 2	4.37		1.97	3.35	2.36	
CELL 2			3.77	3.77	3.56	3.15
CELL 2				4.18	3.53	3.20
CELL 2				3.72	3.25	
CELL 1						
CELL 1	12.58	16.03				
CELL 1		16.03	19.48	14.39	9.30	



SECOND INTERPOLATION

	E50	E75	E100	E125	E150	E175
CELL 5	0.39	0.44	0.53	0.50	0.53	0.55
CELL 5	0.34	0.44	0.53	0.56	0.56	0.57
CELL 5	0.27	0.40	0.55	0.65	0.59	0.61
CELL 5	0.22	0.33	0.63	0.85	0.95	0.82
CELL 4	0.16	0.28	0.64	1.29	1.00	0.94
CELL 4	0.32	0.00	0.65	0.98	0.98	0.82
CELL 4	0.48	0.48	1.01	1.05	0.67	0.82
CELL 3	0.96	1.70	1.84	1.45	0.82	0.82
CELL 3	2.89	2.80	2.59	1.63	1.14	0.97
CELL 3	4.13	3.59	2.43	1.54	0.78	1.42
CELL 3	4.66	3.59	1.97	0.58	1.97	1.96
CELL 2	4.37	4.96	1.97	3.35	2.36	2.76
CELL 2	10.06	7.61	3.77	3.77	3.56	3.15
CELL 2	14.40	11.41	7.31	4.18	3.53	3.20
CELL 2	14.58	14.23	10.10	3.72	3.25	5.25
CELL 1	14.31	14.85	13.20	10.40	8.56	7.72
CELL 1	12.58	16.03	16.48	14.91	10.81	8.25
CELL 1	14.88	16.03	19.48	14.39	9.30	4.65

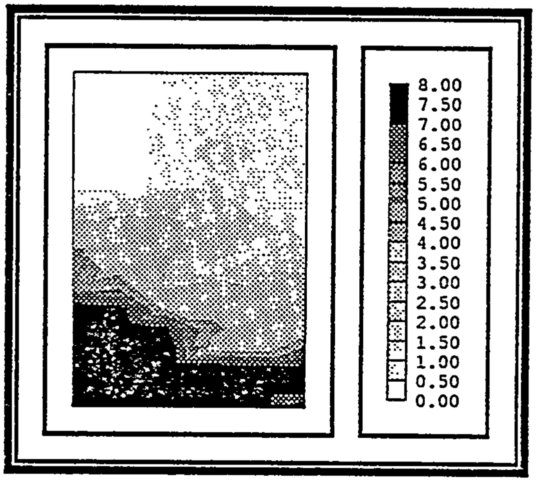


Figure 7. Step-by-step method for interpretation of the field GC screening data for VOCs in the TSA-1 Cells 1-5 overburden soil headspace.

immediate left if no other contiguous points contained an original or a derived value.

Two topographical maps (Figures 5 and 6) representing gradient potentials of the point data were generated using the contour mapping capabilities of the spreadsheet and the above procedure. Figure 5 contains data from all data sampling depths and all data points, while Figure 6 contains data only from the upper overburden above Cells 1 through 5 of the TSA-1 Pad.

4.2.1.3 Graphical Representation of GC Data for the Caisson Area. Figure 8 shows the depths of the test holes and concentrations detected by GC headspace analysis for each of the boreholes in the support caisson area. This figure shows the area(s) where monitoring conditions during construction will be most critical.

4.2.2 Laboratory Data and Action Levels

The laboratory data for PCBs, metals, and radionuclides did not show any contamination exceeding action levels in the soils. Only one data point exceeded action levels for VOCs and this value was estimated. Action levels are established in the *Soil Sampling Plan for the Transuranic Storage Area Soil Overburden* and are shown in Table 3.[a]

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[a] Hardy, C. K., Pickett, S. L., and Stanisich, S. N., *Soil Sampling Plan for the Transuranic Storage Area Soil Overburden*, EG&G-WM-8986, Idaho National Engineering Laboratory, Idaho Falls, Idaho, 1990.

Table 3. Action levels for contaminants detected in the soils

Metals:	95% upper one-tailed tolerance limit.
VOCs:	3 x method detection limit
PCBs:	3 x method detection limit
Radionuclides:	greater than D&D release criteria[a]

4.3 COMPARISON OF GC TO LABORATORY DATA FOR VOCs

The laboratory tests of the TSA overburden soil measured the concentrations of VOCs that were adhered to the soil particles by sorption or dissolved in the pore water. The laboratory detection limits for VOCs in soils were greater than the concentrations of any VOCs present in the TSA overburden soil. The field GC detected soil vapor concentrations in samples that were warmed to room temperature in a sealed bag. The field GC data cannot be directly compared to the laboratory data since the variables discussed in Section 4.1 were not carefully controlled.

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[a] "Radiological Release Criteria for Soils", Development of Criteria for Release of Idaho National Engineering Laboratory Sites Following Decontamination and Decommissioning, EG&G Idaho, 1986.

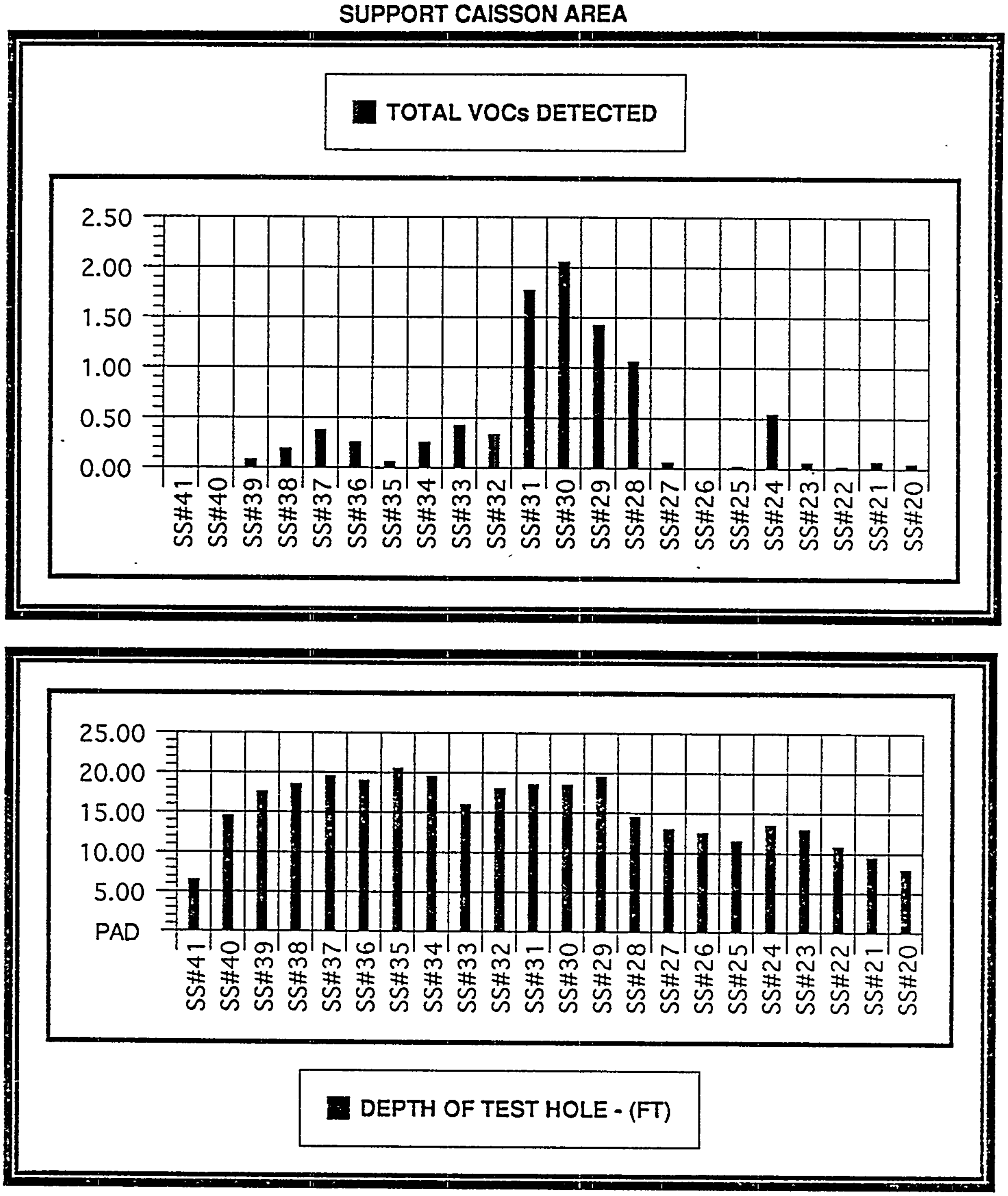

Figure 8. Results of soil headspace analysis for VOCs in the support caisson area.

4.4 CONCLUSIONS AND RECOMMENDATIONS

The overburden and sideburden soils characterized by this investigation are uncontaminated (below action limits) for the contaminants sought. This is based on the results of the GC field screening, measurements made by instruments in the field, and laboratory analysis for both radionuclides and chemical constituents.

The intent of the field characterization is to determine whether the overburden soil has become contaminated, identify the type (radiological and/or chemical) and extent of the contamination. Although the results of the field characterization conclude that contaminant concentrations are below action levels, continuous monitoring of the conditions during construction activities is recommended. Conditions are subject to change due to weather influences or degradation of materials within the waste stack. Particular care should be taken in the TSA-1 Cell 1 area, based on the potential presence of VOCs in the soil gas (see Figure 5).

Transient organic vapors may be present during periods of low atmospheric pressure, as they may be drawn through the soil from the source to the atmosphere. Monitoring for these vapors (particularly carbon tetrachloride) is recommended during all construction activities. It is believed that vapors detected in the soil sample headspace with the field GC originated from the TSA waste stack.

Radiological contamination is not expected during excavation, but soils should be surveyed during critical operations. Soils removed from the lower part of the stack will have the greatest potential for the presence of radionuclides.

In conclusion, construction activities should proceed with caution and arrangements should be made to provide continuous monitoring of conditions during the excavation.

APPENDIX A

RWMC HEALTH PHYSICS REPORT FOR THE TSA SOIL SAMPLING TASK

EG&G Idaho

"Providing research and development services to the government"

INTEROFFICE CORRESPONDENCE

Date: August 28, 1991

To: [redacted]

From: M. K. Branter, MS 4202

Subject: RADIOLOGICAL SURVEY RESULTS OF TSA OVERBURDEN DRILLING AND SAMPLING - MKB-74-91

The following is a brief description of radiological surveys performed during the sampling and drilling of the TSA overburden.

Radiation surveys were performed in drilling areas, prior to work and intermittently during work operations. Radiation levels were <0.1 mr/hr on the majority of the TSA pads with the exception of areas adjacent to TSAR and ASB-II. The highest whole body radiation field next to TSAR was 3 mr/hr. The highest whole body field next to ASB-II was 0.5 mr/hr. Radiation surveys were also taken in sample holes where it was suspected a box had been hit. Results of these surveys were all <0.1 mr/hr.

During drilling operations of the TSA overburden, power auger bits, hand auger heads, and soil spin-off's were direct monitored using a Ludlum 2A for β-γ contamination and a Ludlum 61 or Eberline ASP-1 for α contamination. Throughout drilling and sampling, direct monitoring results remained <100 cpm β-γ and no detectable α. In areas where background levels were too high to direct monitor, extra smears were taken to compensate.

Smear surveys were taken on auger bits and hand auger heads after drilling each bore hole. Also, at the completion of work each day, smears were taken on drilling equipment and on all tools used. The smears were counted on an α, β-γ smear counter with results of all smears <20 dpm/smear α and <200 dpm/smear β-γ.

Several times during drilling operations, foreign objects were detected in the soil spin-off. The objects consisted of wood chips, yellow herculite, white styrofoam, and construction rope. When these items were encountered, work was stopped. The material was scanned for alpha and beta-gamma contamination and then placed in an α, β-γ smear counter. No radioactivity was detected on any of this material.

High volume air samples were taken continuously during drilling operations. Air samples were taken in the breathing zone downstream of workers and drilling operations. Upon completion of work, air filters were pulled and counted to determine the β-γ to α ratios. All ratios were consistent with the natural activity usually found at the INEL. After at least one week decay, air filters were counted on a Tennelec LB5100 smear counter. The results of all air filters were <10% dac for α and β-γ radioactivity. See Attachment for individual air sample results.

Water samples were taken of decontamination rinse for auger heads. Decontamination was not performed for radiological purposes. Results of all water samples taken were less than the EG&G water release limits of 3 x 10^{-7} μC/mi β-γ and 3 x 10^{-8} μCi/mi for α contamination.

ERS:bmr

Attachment:
As Stated

cc: w/Attachment
E. R. Spruill, Jr., MS 8107
M. K. Branter File
Central File, MS 1651

Air Sample Data Sheet

General Formula
(dpm/ft^3) x (1.59 x 10^{-11}) = µCi/cc

C Bγ = 2 x 10^{-9} [unidentified, no alpha]
α = 2 x 10^{-11} [unknown alpha, but no TRU]
α = 2 x 10^{-12} [unknown alpha]

Counter/Scaler type: Tennelec LB 5100 Serial No. 262227
CAM Manufacturer: HI Q Model No. MRU 12C Serial No. 2093

Date & Time	CAM Location	CAM Flow Rate (cfm)	Filter Run Time (min)	Total Volume (ft^3)	Absorption Factor	Count Time (min)	Gross Counts (CPM)	Background (cpm)	Net cpm	Counter/Scaler Efficiency	dpm	µCi/cc	Type of Activity	Decay Time (min)	% DAC	HP Name	Remarks
2-27-91 0800	T3A DRILL	6	252	1512	1.0	10.0	3.7	3.3	0.4	20%	2.0	$2.10e^{-14}$	Bγ	10,080	1.0^{-3}	3-6-91 ER Spruill	
2-27-91 1400	"	"	"	"	0.7	10.0	0.2	0.1	0.1	31%	0.46	$4.84e^{-15}$	α	" [illegible]	2.4^{-1}		6.0:1 βγ Tc
2-28-91 0800	T3A DRILL	6	210	1260	1.0	10.0	4.3	3.3	1.0	20%	5.0	$6.31e^{-14}$	Bγ	8640	3.2^{-3}	3-6-91 ER Spruill	
2-28-91 1400	"	"	"	"	0.7	"	0.1	0.1	0	31%	0	<HDA	α	"	<10% DAC		4.1:1 βγ Tc
3-7-91 0800	T3A DRILL	6	180	1080	1.0	10.0	3.8	3.6	0.2	21%	0.95	$1.40e^{-14}$	Bγ	15840	7.0^{-4}	3-18-91 ER Spruill	
3-7-91 1600 " ~~0800~~	"	"	"	"	0.7	"	0	0.2	-0.2	31%	-0.95	$-1.40e^{-14}$	α	"	7.0^{-1}		4.0:1 βγ i
3-12-91 0900	T3A DRILL	6	120	720	1.0	10.0	4.6	3.6	1.0	21%	4.76	$1.05e^{-13}$	Bγ	8640	5.3^{-3}	3-18-91 ER Spruill	
3-12-91 1200	"	"	"	"	0.7	10.0	0.1	0.2	-0.1	31%	-0.46	$-1.01e^{-14}$	α	"	-5.1^{-1}		3.6:1 βγ T
3-12-91 1300	T3A DRILL	6	135	792	1.0	10.0	3.8	3.6	0.2	21%	0.95	$1.91e^{-14}$	Bγ	8640	9.5^{-4}	3-18-91 ER Spruill	
3-12-91 1600	"	"	"	"	0.7	"	0.1	0.2	-0.1	31%	-0.46	$-1.01e^{-14}$	α	"	-5.1^{-1}		3.8:1 βγ T
3-13-91 0800	T3A DRILL	6	168	1008	1.0	10.0	2.9	3.6	-0.7	21%	-3.33	$-5.25e^{-14}$	Bγ	7200	2.6^{-3}	3-18-91 ER Spruill	
3-13-91 1200	"	"	"	"	0.7	"	0.1	0.2	-0.1	31%	-0.46	$-1.01e^{-14}$	α	"	-5.1^{-1}		3.5:1 βγ T

Supervisor Review
5-21-91

General Formula
(dpm/ft^3) x (1.59 x 10^{-11}) = µCi/cc

AC Bγ = 2 x 10^{-9} [unidentified, no alpha]
α = 2 x 10^{-11} [unknown alpha, but no TRU]
α = 2 x 10^{-12} [unknown alpha]

Counter/Scaler type: Tennelec LB 5100 Serial No. ______
CAM Manufacturer: HI Q Model No. MRU 12C Serial No. 2093

Date & Time	CAM Location	CAM Flow Rate	Filter Run Time (min)	Total Volume (ft^3)	Absorption Factor	Count Time (min)	Gross Counts (CPM)	Background (cpm)	Net cpm	Counter/Scaler Efficiency	dpm	µCi/cc	Type of Activity	Decay Time (min)	% DAC	HP Name	Remarks
3-13-91 1300	TSA DRILL	6	138	828	1.0	10.0	3.8	3.6	0.2	21%	0.95	$1.83e^{-14}$	Bγ	7200	9.1^{-4}	3 18 91 LR Spruill	
3-13-91 1620	"	"	"	"	0.7	"	0.6	0.2	0.4	31%	1.29	$2.48e^{-14}$	α	"	1.2%		3.7:1 βγ TO
3-14-91 0900	TSA DRILL	6	120	720	1.0	10.0	4.9	3.6	1.3	21%	6.19	$1.37e^{-13}$	Bγ	5760	6.8^{-3}	3-18 91 LR Spruill	
3-14-91 1530	"	"	"	"	0.7	"	0.6	0.2	0.4	31%	1.29	$2.84e^{-14}$	α	5760	1.47%		3.0:1 βγ TO
3-18-91 0900	TSA DRILL	6	378	2268	1.0	10.0	4.3	3.4	0.9	21%	4.29	$3.00e^{-14}$	Bγ	22 DAYS	1.5^{-3}	4-11 91 LR Spruill	
3-18-91 1600	"	"	"	"	0.7	"	0.3	0.1	0.2	30%	0.95	$6.68e^{-15}$	α	"	2-4-11 3.3^{-1}		4.2:1 βγ TO
3-19-91 0800	TSA DRILL	6	180	1080	1.0	10.0	4.6	3.4	1 2	21%	5.71	$8.41e^{-14}$	Bγ	21 DAYS	4.2^{-3}	4-11-91 LR Spruill	
3-19-91 1630	"	"	"	"	0.7	"	0.1	0.1	0	30%	0	<MDA	α	"	<10% DAC		4.6:1 βγ TO
3-20-91 09000	TSA DRILL	6	330	1980	1.0	10.0	5.8	3.4	2.4	21%	11.43	$9.18e^{-14}$	Bγ	20 DAYS	4.6^{-3}	4-11-91 LR Spruill	
3-20-91 1630	"	"	"	"	0.7	"	0.2	0.1	0.1	30%	0.48	$3.82e^{-15}$	α	"	1.9^{-1}		3.8:1 βγ TO
3-21-91 0820	TSA DRILL	6	438	2628	1.0	10.0	5.3	3.4	1.9	21%	9.05	$5.47e^{-14}$	Bγ	20 DAYS	2.7^{-3}	4 11 91 LR Spruill	
3-21-91 1540	"	"	"	"	0.7	"	0.5	0.1	0.4	30%	1.90	$1.15e^{-14}$	α	"	5.7^{-1}		4.1:1 βγ TO

S.E. 5-21-91

Air Sample Data Sheet

General Formula
$(dpm/ft^3) \times (1.59 \times 10^{-11}) = \mu Ci/cc$

\C Bγ = 2×10^{-9} [unidentified, no alpha]
α = 2×10^{-11} [unknown alpha, but no TRU)
α = 2×10^{-12} [unknown alpha]

Counter/Scaler type: Tennelec LB 5100 Serial No. 262227
CAM Manufacturer: HIQ Model No. HRV 12C Serial No. 2093

Date & Time	CAM Location	CAM Flow Rate	Filter Run Time (min)	Total Volume (ft³)	Absorption Factor	Count Time (min)	Gross Counts (CPM)	Background (cpm)	Net cpm	Counter/Scaler Efficiency	dpm	µCi/cc	Type of Activity	Decay Time (min)	% DAC	HP Name	Remarks
3-28-91 0900	T3A DRILL	6	145	864	1.0	10.0	4.5	3.4	1.1	21%	5.24	$9.64e^{-14}$	Bγ	13 DAYS	4.8^{-3}	4-11-91	
3-28-91 1300	"	"	"	"	0.7	"	0.2	0.1	0.1	30%	0.48	$8.76e^{-15}$	α	"	4.4^{-1}		3.0:1 Bγ
4-1-91 0800	T3A DRILL	6	180	1080	1.0	10.0	5.1	4.6	0.5	21%	2.38	$3.51e^{-14}$	Bγ	14 DAYS	1.8^{-3}	4-16-91	
4-1-91 1600	"	"	"	"	0.7	"	0.4	0.1	0.3	30%	1.43	$2.10e^{-14}$	α	"	1.6%		3.5:1 Bγ T
4-2-91 0800	T3A DRILL	6	216	1296	1.0	10.0	5.8	4.6	1.2	21%	5.71	$7.01e^{-14}$	Bγ	13 DAYS	3.5^{-3}	4-16-91	
4-2-91 1500	"	"	"	"	0.7	"	0.5	0.1	0.4	30%	1.90	$2.34e^{-14}$	α	"	1.27%		4.1:1 Bγ T
4-3-91 0800	T3A DRILL	6	144	864	1.0	10.0	4.1	4.6	-0.5	21%	-2.38	$-4.38e^{-14}$	Bγ	12 DAYS	2.2^{-3}	4-16-91	
4-3-91 1300	"	"	"	"	0.7	"	0	0.1	-0.1	30%	-0.47	$-8.76e^{-15}$	α	"	-4.4^{-1}		4.1:1 Bγ T
4-4-91 0800	T3A DRILL	6	156	936	1.0	10.0	4.6	4.6	0	21%	0	<MDA	Bγ	11 DAYS	<10% DAC	4-16-91	
4-4-91 1200	"	"	"	"	0.7	"	0	0.1	-0.1	30%	-0.47	$-8.09e^{-15}$	α	"	4.0^{-1}		4.6:1 Bγ
4-8-91 0830	T3A DRILL	6	180	1080	1.0	10.0	4.0	4.6	-0.6	21%	-2.86	$4.21e^{-14}$	Bγ	8 DAYS	-2.1%	4-16-91	
4-8-91 1630	"	"	"	"	0.7	"	0.1	0.1	0	30%	0	<MDA	α	"	<10% DAC		4.2:1 Bγ T

S.R. Butler 5-21-91

General Formula
$(\text{dpm}/\text{ft}^3) \times (1.59 \times 10^{-11}) = \mu\text{Ci/cc}$

\C Bγ = 2×10^{-9} [unidentified, no alpha]
α = 2×10^{-11} [unknown alpha, but no TRU)
α = 2×10^{-12} [unknown alpha]

Counter/Scaler type: Tennelec LB 5100 Serial No. 262227
CAM Manufacturer: HI Q Model No. MRV 12C. Serial No. 2093

Date & Time	CAM Location	CAM Flow Rate	Filter Run Time (min)	Total Volume (ft3)	Absorption Factor	Count Time (min)	Gross Counts (CPM)	Background (cpm)	Net cpm	Counter/Scaler Efficiency	dpm	µCi/cc	Type of Activity	Decay Time (min)	% DAC	HP Name	Remarks
4-9-91 0800	TSA DRILL	6	72	432	1.0	10.0	3.9	4.3	-0.4	21%	-1.9	$7.01e^{-14}$	Bγ	14 DAYS	3.5^{-3}	4-23-91 ER Spruell	
4-9-91 1100	"	"	"	"	0.7	"	0.7	0.2	0.5	30%	2.38	$8.76e^{-14}$	α	"	4.3%		4.2:1 βγ Tc
4-10-91 0830	TSA DRILL	6	114	684	1.0	10.0	4.9	4.3	0.6	21%	2.86	$6.64e^{-14}$	Bγ	13 DAYS	3.3^{-3}	4-23-91 ER Spruell	
4-10-91 1200	"	"	"	"	0.7	"	0.2	0.2	0	30%	0	<MDA	α	"	<10% DAC		4.0:1 βγ T.
4-10-91 1300	TSA DRILL	6	60	360	1.0	10.0	4.2	4.3	-0.1	21%	-0.48	$2.10e^{-14}$	Bγ	13 DAYS	1.1^{-3}	4-23-91 ER Spruell	
4-10-91 1630	"	"	"	"	0.7	"	0.4	0.2	0.2	30%	0.95	$4.21e^{-14}$	α	"	2.1%		5.0:1 βγ Tc
4-11-91 1400	TSA DRILL	6	84	504	1.0	10.0	6.0	4.3	1.7	21%	8.10	$2.55e^{-13}$	Bγ	12 DAYS	1.3^{-2}	4-23-91 ER Spruell	
4-11-91 1600	"	"	"	"	0.7	"	0.4	0.2	0.2	30%	0.95	$3.00e^{-14}$	α	"	1.5%		3.6:1 βγ T.
4-17-91 1000	TSA DRILL	6	120	720	1.0	10.0	4.7	4.3	0.4	21%	1.90	$4.21e^{-14}$	Bγ	6 DAYS	2.1^{-3}	4-23-91 ~~4-23-91~~ ER Spruell	
4-17-91 1600	"	"	"	"	0.7	"	0.1	0.2	-0.1	30%	-0.48	$1.05e^{-14}$	α	"	5.3^{-1}		3.6:1 βγ Tc
4-22-91 0800	TSA DRILL	6	216	1296	1.0	10.0	4.0	3.8	0.2	21%	0.95	$1.17e^{-14}$	Bγ		5.8^{-4}	~~4-23-91~~ "	
4-22-91 1500	"	"	"	"	0.7	"	0.3	0.1	0.2	30%	0.95	$1.17e^{-14}$	α		$.5.8^{-1}$		5.0:1 βγ Tox

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Air Sample Data Sheet

General Formula
(dpm/ft³) x (1.59 x 10^{-11}) = µCi/cc

\C Bγ = 2 x 10^{-9} [unidentified, no alpha]
α = 2 x 10^{-11} [unknown alpha, but no TRU]
α = 2 x 10^{-12} [unknown alpha]

Counter/Scaler type: Tennelec LB 5100 Serial No. 7. 262227
CAM Manufacturer: HI Q Model No. MRV 12C Serial No. 2093

Date & Time	CAM Location	CAM Flow Rate	Filter Run Time (min)	Total Volume (ft3)	Absorption Factor	Count Time (min)	Gross Counts (CPM)	Background (cpm)	Net cpm	Counter/Scaler Efficiency	dpm	µCi/cc	Type of Activity	Decay Time (min)	% DAC	HP Name	Remarks
4-23-91 0900	T3A DRILL	6	108	648	1.0	10.0	4.3	3.8	0.5	21%	2.38	$5.84e^{-14}$	Bγ		2.9^{-3}	ER Spindl	
4-23-91 1500	"	"	"	"	0.7	"	0.1	0.1	0	30%	0	<MDA	α		<10% DAC		3.7:1 βγ:
													Bγ				
													α				
													Bγ				
													α				
													Bγ				
													α				
													Bγ				
													α				
													Bγ				
													α				

5-21-91

APPENDIX B

RWMC INDUSTRIAL HYGIENE DATA AND CALCULATIONS

EG&G ENVIRONMENTAL HYGIENE LABORATORY ANALYTICAL REPORT

Date: May 21, 1991

Report No. 91-0362

Requestor: D. S. Shoop

Address: ROB-I/MS 4202

The samples received by the laboratory on March 19, 1991 were collected on Sorbent Capsules Badges manufactured by SKC. These samples were analyzed on May 14, 1991 for the presence of methylene chloride and carbon tetrachloride. Analysis was performed by gas chromatography/flame ionization detector (GC/FID) equipped with a 20 foot by 1/8 inch inside diameter packed column. The packing was GP-10% SP-1000 on 80/100 Supelcoport.

The samples were extracted with 1.5 mL OMNISOLVE Carbon Disulfide. The results for sample 225103 are reported in micrograms only. Insufficient information provided by SKC prevented futher calculations. The desorption efficiency for carbon tetrachloride was determined to be 93.5%. Also, on sample 225103 other organic compounds were detected. These compounds were benzene, trichloroethene, chloroform, and perchloroethene, all were at lower levels than carbon tetrachloride. Concentrations were determined using SOP-EM-EH-4.01.

ANALYTICAL RESULTS

SAMPLE ID	LAB ID	DCM ppm	CTC ppm
225101	91-1641	N.D.	N.D.
225102	91-1642	N.D.	N.D.
225104	91-1643	N.D.	N.D.
225103	91-1647	N.D.	457.8*

* Micrograms

N.D.: Not Detected- less than minimum quantifiable amount

Minimum quantifiable amount: Methylene Chloride (DCM) 7.3 microgams/sample

Carbon Tetrachloride (CTC) 16.8 micrograms/sample

Analyst:

Laboratory Director:

AIHA Accredited

From: OOP --INELVM1 Date and time 08/21/91 12:01:43
To: RGS --INELVM1

FROM: DOUG S SHOOP - Industrial Hygienist
Waste Management - RWMC
MS 4202 Phone 526-6653 Profs ID: OOP
Subject: TSA VOC CONCENTRATIONS
Calculated concentration of carbon tetrachloride is 5.93 ppm. The associated calculations are in the mail. Hope the info. is helpful. Talk to you later.
Doug

Ray, please find below the calculated concentration of carbon tetrachloride reported in parts per million as per your request.

Carbon Tetrachloride reported concentration = 457.8 ug or 0.4578 mg
Carbon Tetrachloride molecular weight = 153.81 or 154
Gas volume at standard temperature & pressure = 24.45
Diffussion rate for Carbon Tetrachloride = 9.39 ml/min.
Sampling time = 1305 min.
Volume sampled = 9.39 ml/min. x 1305 min. = 12253.95 ml
12253.95 cm^3 x 1 m^3 /10^6 cm^3 = 1.225395 x 10^{-2} m^3

$$\text{ppm} = \frac{(0.4578)}{(1.225395 \times 10^{-2})} \times \frac{(24.45)}{(154)} = 5.93 \text{ ppm } CCl_4$$

It is important to note that the expressed concentration is <u>only an approximation.</u> The diffussion rate for carbon tetrachloride is based on sampling in ambient air not inside a moist hole in the ground and is therefore likely to be some what inaccurate. The conversion for standard temperature and pressure would also be some what inaccurate since the sample was taken in the hole. Without additional product and environmental (i.e. down hole temperature and barometeric pressure) data, it is unclear wether these variables would significantly bias the data to the high side or low side. If I can help you any further please let me know. Doug.

APPENDIX C

RESULTS OF THE FIELD GC SCREENING METHOD

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*** ANALYSIS          *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE       TIME     C/A  PEAK       CONCNT        RT           AREA      NAME
-----------------------------------------------------------------------------------------
  1  Feb 26,91  11:41    C  BENZENE      9.80  PPM      59        1864417     BTEX
  1                      C  TOLUENE      9.80  PPM      87        2957165
  1                      C  E-BENZ       9.30  PPM     166        1235858
  2  Feb 26,91  11:55    A  BENZENE     14.38  PPM      59        2736651     TSA1752GC
  2                      A  UNKNOWN    203.21  PPM      91       38660031
  2                      A  UNKNOWN    184.05  PPM     131       35014784
  2                      A  E-BENZ      12.53  PPM     166        2338669
  2                      A  UNKNOWN      1.21  PPM     198         325014
  2                      A  UNKNOWN      0.57  PPM     263         111512
  3  Feb 27,91  08:32    C  BENZENE      9.80  PPM      54        1227423     BTEX
  3                      C  TOLUENE      9.80  PPM      83        1021920
  3                      C  E-BENZ       9.30  PPM      94        1391322
  4  Feb 27,91  08:39    C  BENZENE      9.80  PPM      60        1435571     BTEX
  4                      C  TOLUENE      9.80  PPM      89        1860294
  4                      C  E-BENZ       9.30  PPM     172        1008843
  5  Feb 27,91  08:48    C  BENZENE      9.80  PPM      60        1631280     BTEX
  5                      C  TOLUENE      9.80  PPM      88        2175982
  5                      C  E-BENZ       9.30  PPM     169        1283212
  6  Feb 27,91  09:05    A  BENZENE      0.04  PPM      59           5849     ROOM BLANK
  6                      A  TOLUENE      0.06  PPM      87          14245
  7  Feb 27,91  10:21    A               0.00  PPB      30              0     TSA0101GC
```

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*** ANALYSIS          *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE       TIME     C/A  PEAK       CONCNT        RT           AREA      NAME
-----------------------------------------------------------------------------------------
  8  Feb 27,91  10:40    A  •            0.00  PPB      30              0     TSA0101GC
  9  Feb 27,91  13:57    A               0.00  PPB      30              0     TSA1753GC
 10  Feb 28,91  08:39    C  BENZENE      9.80  PPM      51        2728553     BTEX
 10                      C  TOLUENE      9.80  PPM      84        2451512
 10                      C  E-BENZ       9.30  PPM     165        3294293
 11  Feb 28,91  09:18    C  BENZENE      9.80  PPM      56        4323699     BTEX
 11                      C  TOLUENE      9.80  PPM      88        6278092
 11                      C  E-BENZ       9.30  PPM     168        9244891
 12  Feb 28,91  09:35    C  BENZENE      9.80  PPM      60        4709543     BTEX
 12                      C  TOLUENE      9.80  PPM      88        6994869
 12                      C  E-BENZ       9.30  PPM     169        4651510
 13  Feb 28,91  09:51    C  BENZENE      9.80  PPM      60        4900528     BTEX
 13                      C  TOLUENE      9.80  PPM      88        7811482
 13                      C  E-BENZ       9.30  PPM     169        5089542
 14  Feb 28,91  10:06    A  BENZENE      0.13  PPM      60          66966     ROOM BLANK
 14                      A  TOLUENE      0.09  PPM      88          71630
 15  Feb 28,91  10:43    A  BENZENE      0.01  PPM      60           5629     TSA0102GC
 15                      A  TOLUENE      0.02  PPM      88          18959
 16  Feb 28,91  11:01    A  TOLUENE      0.01  PPM      88           9804     TSA0102GC
 17  Feb 28,91  13:20    C  BENZENE      9.80  PPM      63        5172226     BTEX
 17                      C  TOLUENE      9.80  PPM      92        9251247
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*** ANALYSIS          *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE       TIME     C/A  PEAK       CONCNT        RT           AREA      NAME
-----------------------------------------------------------------------------------------
 17                      C· E-BENZ       9.30  PPM     171        5420652
 18  Feb 28,91  13:26    C  BENZENE      9.80  PPM      59        5357581     BTEX
 18                      C  TOLUENE      9.80  PPM      87       10799798
 18                      C  E-BENZ       9.30  PPM     166        5976020
 19  Feb 28,91  13:31    C  BENZENE      9.80  PPM      59        6648611     BTEX
 19                      C  TOLUENE      9.80  PPM      87       14764633
 19                      C  E-BENZ       9.30  PPM     165        9250103
 20  Feb 28,91  13:48    C  BENZENE      9.80  PPM      59        7586927     BTEX
 20                      C  TOLUENE      9.80  PPM      87       15384954
 20                      C  E-BENZ       9.30  PPM     169        6422757
 21  Feb 28,91  14:05    A  BENZENE      0.10  PPM      59          75240     TSA0103GC
 21                      A  TOLUENE      0.07  PPM      87         117499
 21                      A  E-BENZ       0.02  PPM     164          11973
 22  Feb 28,91  14:19    A  TOLUENE      0.05  PPM      87          77580     TSA0103GC
 23  Feb 28,91  14:33    A  TOLUENE      0.01  PPM      88          10811     ROOM BLANK
 24  Mar 07,91  08:46    C  BENZENE      9.80  PPM      59        1270793     BTEX
 24                      C  TOLUENE      9.80  PPM      88        1374835
 24                      C  E-BENZ       9.30  PPM     160        1588284
 25  Mar 07,91  08:52    C  BENZENE      9.80  PPM      60        1616364     BTEX
 25                      C  TOLUENE      9.80  PPM      88        2228798
 25                      C  E-BENZ       9.30  PPM     159        1460046
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*** ANALYSIS              *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE      TIME      C/A  PEAK        CONCNT         RT         AREA      NAME
-------------------------------------------------------------------------------------
 26   Mar 07,91 09:19      C  BENZENE       9.80  PPM      59      1960140     BTEX
 26                        C  TOLUENE       9.80  PPM      87      2715572
 26                        C  E-BENZ        9.30  PPM     167      1768203
 27   Mar 07,91 09:35      C  BENZENE       9.80  PPM      59      1985345     BTEX
 27                        C  TOLUENE       9.80  PPM      87      2597183
 27                        C  E-BENZ        9.30  PPM     166      1697552
 28   Mar 07,91 09:50      A  BENZENE       0.08  PPM      59        15227     ROOM BLANK
 28                        A  TOLUENE       0.03  PPM      86         9061
 29   Mar 07,91 10:02      A  UNKNOWN       1.30  PPM      43       242921     C-TET
 29                        A  UNKNOWN       7.49  PPM      68      1516456
 29                        A  UNKNOWN      20.89  PPM      80      4231303
 30   Mar 07,91 10:15      A  UNKNOWN       0.97  PPM      68        13718     ROOM BLANK
 30                        A  UNKNOWN       0.26  PPM      81        53081
 31   Mar 07.91 10:21      A  UNKNOWN       0.01  PPM      68         2821     TSA0104GC
 31                        A  UNKNOWN       0.17  PPM      80        34431
 32   Mar 07,91 10:39      A  UNKNOWN       0.03  PPM      76         6238     TSA0104GC
 32                        A  UNKNOWN       0.21  PPM      82        43179
 33   Mar 07,91 10:43      A  UNKNOWN       0.02  PPM      69         3611     TSA0105GC
 33                        A  UNKNOWN       0.10  PPM      78        19870
 34   Mar 07,91 10:58      A                0.00  PPB      30            0     ROOM BLANK
 35   Mar 07,91 11:04      A                0.00  PPB      30            0     TSA0105GC

*** ANALYSIS              *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE      TIME      C/A  PEAK        CONCNT         RT         AREA      NAME
-------------------------------------------------------------------------------------
 36   Mar 07,91 11:07      A                0.00  PPB      30            0     TSA0104GC
 37   Mar 07,91 11:23      C  BENZENE       9.80  PPM      36      2405445     BTEX
 37                        C  TOLUENE       9.80  PPM      88      3419148
 37                        C  E-BENZ        9.30  PPM     168      2160126
 38   Mar 07,91 11:42      A  BENZENE       0.03  PPM      60         6134     TSA0106GC
 38                        A  UNKNOWN       0.02  PPM      73         3708
 39   Mar 07,91 13:46      A  UNKNOWN       0.11  PPM      70        25969     TSA0107GC
 39                        A  UNKNOWN       0.12  PPM      78        29811
 39                        A  UNKNOWN       0.04  PPM     155         8752
 40   Mar 07,91 14:02      A  UNKNOWN       0.17  PPM      69        42452     TSA0108GC
 40                        A  UNKNOWN       0.17  PPM      79        41409
 41   Mar 07,91 14:18      A                0.00  PPB      30            0     ROOM BLANK
 42   Mar 07,91 14:57      A  UNKNOWN       0.67  PPM      68       165069     TSA0109GC
 42                        A  UNKNOWN       0.45  PPM      80       110800
 43   Mar 07,91 15:14      A  UNKNOWN       0.49  PPM      68       129385     TSA0109GC
 43                        A  UNKNOWN       0.47  PPM      80       115480
 44   Mar 07,91 15:29      A                0.00  PPB      30            0     ROOM BLANK
 45   Mar 07,91 15:34      A                0.00  PPB      30            0     TSA0110GC
 46   Mar 07,91 16:18      A  UNKNOWN       0.02  PPM      70         3800     TSA0111GC
 46                        A  UNKNOWN       0.03  PPM      79         8553
 47   Mar 12,91 09:33      C  BENZENE       9.80  PPM      36         6690     BTEX

*** ANALYSIS              *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE      TIME      C/A  PEAK        CONCNT         RT         AREA      NAME
-------------------------------------------------------------------------------------
 47                        C  TOLUENE       9.80  PPM      49      1090526
 47                        C  E-BENZ        9.30  PPM      60      2159074
 48   Mar 12,91 09:49      C  BENZENE       9.80  PPM      59      3528693     BTEX
 48                        C  TOLUENE       9.80  PPM      88      3626293
 48                        C  E-BENZ        9.30  PPM     167      2450320
 49   Mar 12,91 10:06      C  BENZENE       9.80  PPM      59      2734784     BTEX
 49                        C  TOLUENE       9.80  PPM      86      3898490
 49                        C  E-BENZ        9.30  PPM     166      2469111
 50   Mar 12,91 10:23      A  BENZENE       0.10  PPM      59        27265     ROOM BLANK
 50                        A  TOLUENE       0.34  PPM      86        14575
 51   Mar 12,91 10:41      A  TOLUENE       0.02  PPM      86         6608     TSA0112GC
 52   Mar 12,91 11:27      A                0.00  PPB      30            0     TSA0113GC
 53   Mar 12,91 11:43      A  UNKNOWN       0.01  PPM      69         1613     TSA1701GC
 54   Mar 12,91 11:59      A  UNKNOWN       0.03  PPM      70         8814     TSA0114GC
 54                        A  UNKNOWN       0.04  PPM      77        10423
 55   Mar 12,91 12:36      A  UNKNOWN       0.01  PPM      70         2375     TSA0115GC
 56   Mar 12,91 13:32      C  BENZENE       9.80  PPM      59      3660335     BTEX
 56                        C  TOLUENE       9.80  PPM      86      2719414
 56                        C  E-BENZ        9.30  PPM     166      2628629
 57   Mar 12,91 13:48      A  BENZENE       0.10  PPM      59        23248     TSA0116GC
 57                        A  UNKNOWN       0.11  PPM      69        42521
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*** ANALYSIS         *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE     TIME   C/A  PEAK       CONCNT      RT        AREA       NAME
--------------------------------------------------------------------------------
 57                      A UNKNOWN     0.13 PPM    77        50030
 58  Mar 12,91 14:03     A BENZENE     0.00 PPM    59          423      TSA0117GC
 58                      A UNKNOWN     0.04 PPM    70        13635
 58                      A UNKNOWN     0.04 PPM    77        15588
 59  Mar 12,91 14:20     A BENZENE  '11499.13 PPM     60     -1395        TSA0118GC
 59                      A UNKNOWN     0.04 PPM    70        13883
 59                      A UNKNOWN     0.06 PPM    77        24243
 60  Mar 12,91 14:24     A UNKNOWN     0.02 PPM    70         8579      TSA0118GC
 60                      A UNKNOWN     0.04 PPM    77        16701
 61  Mar 12,91 14:40     A UNKNOWN     0.02 PPM    70         6894      TSA0119GC
 61                      A UNKNOWN     0.03 PPM    77        11400
 62  Mar 12,91 14:56     A             0.00 PPB    30            0      ROOM BLANK
 63  Mar 12,91 15:42     A UNKNOWN     0.02 PPM    70         5625      TSA0120GC
 63                      A UNKNOWN     0.03 PPM    77        10828
 64  Mar 12,91 16:28     A UNKNOWN     0.03 PPM    69        11131      TSA0121GC
 64                      A UNKNOWN     0.04 PPM    77        15405
 65  Mar 13,91 08:45     C BENZENE     9.80 PPM    50       168085      BTEX
 65                      C TOLUENE     9.80 PPM    62      2051210
 65                      C E-BENZ      9.30 PPM    92      3415162
 66  Mar 13,91 09:16     C BENZENE     9.80 PPM    59      2754998      BTEX
 66                      C TOLUENE     9.80 PPM    88      3954664

*** ANALYSIS         *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE     TIME   C/A  PEAK       CONCNT      RT        AREA       NAME
--------------------------------------------------------------------------------
 66                      C E-BENZ      9.30 PPM   168      2679101
 67  Mar 13,91 09:32     A BENZENE     0.07 PPM    59        18555      ROOM BLANK
 67                      A TOLUENE     0.02 PPM    87         7259
 68  Mar 13,91 10:13     A UNKNOWN     0.02 PPM    68         6913      TSA0901GC
 69  Mar 13,91 10:32     A.UNKNOWN     0.05 PPM    68        15163      TSA0902GC
 69                      A UNKNOWN     0.01 PPM    81         4153
 70  Mar 13,91 11:14     A UNKNOWN     0.35 PPM    68        97561      TSA0903GC
 70                      A UNKNOWN     0.19 PPM    81        52858
 71  Mar 13,91 12:03     A UNKNOWN     0.02 PPM    67         5554      TSA0122GC
 72  Mar 13,91 12:36     C BENZENE     9.80 PPM    56.     3808024      BTEX
 72                      C TOLUENE     9.80 PPM    87      3269049
 72                      C E-BENZ      9.30 PPM   167      3797872
 73  Mar 13,91 13:36     A             0.00 PPB    30            0      TSA0123GC
 74  Mar 13,91 14:05     A UNKNOWN     0.04 PPM    97        15186      TSA0904GC
 74                      A UNKNOWN .   0.02 PPM    79         7057
 75  Mar 13,91 15:09     A             0.00 PPB    30            0      ROOM BLANK
 76  Mar 13,91 16:01     A UNKNOWN     0.69 PPM    67       266692      TSA0905GC
 76                      A UNKNOWN     0.37 PPM    79       141908
 77  Mar 13,91 16:24     A UNKNOWN     0.18 PPM    67        69963      TSa1754GC
 77                      A UNKNOWN     0.19 PPM    79        73919
 78  Mar 14,91 13:50     C BENZENE     9.80 PPM    48       194269      BTEX

*** ANALYSIS         *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE     TIME   C/A  PEAK       CONCNT      RT        AREA       NAME
--------------------------------------------------------------------------------
 78                      C TOLUENE     9.80 PPM    60      1544428
 78                      C E-BENZ      9.30 PPM    81      2587284
 79  Mar 14,91 14:06     C BENZENE     9.80 PPM    60      3489387      BTEX
 79                      C TOLUENE     9.80 PPM    88      3658093
 79                      C E-BENZ      9.30 PPM   170      2493090
 80  Mar 14,91 14:24     A BENZENE     0.18 PPM    60        45567      TSA0906GC
 80                      A UNKNOWN     0.82 PPM    68       208269
 80                      A UNKNOWN     0.42 PPM    81       105813
 80                      A TOLUENE     0.22 PPM    60        81751
 81  Mar 18,91 08:37     C BENZENE     9.80 PPM    61       706131      BTEX
 81                      C TOLUENE     9.80 PPM    92      1245874
 81                      C E-BENZ      9.30 PPM    60      2275451
 82  Mar 18,91 08:51     C BENZENE     9.80 PPM    60      2678731      BTEX
 82                      C TOLUENE     9.80 PPM    88      3860672
 82                      C E-BENZ      9.30 PPM   167      3202005
 83  Mar 18,91 11:49     A UNKNOWN     0.86 PPM    67      2338813      TSA0907GC
 83                      A UNKNOWN     0.14 PPM    83       313096
 83                      A UNKNOWN     0.05 PPM   152        13929
 84  Mar 18,91 15:41     A UNKNOWN     0.21 PPM    66        57122      TSA0909GC
 84                      A UNKNOWN     0.13 PPM    81        32404
 85  Mar 19,91 09:14     C BENZENE     9.30 PPM    49       226974      BTEX
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*** ANALYSIS         *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE     TIME    C/A  PEAK        CONCNT         RT          AREA      NAME
-------------------------------------------------------------------------------------
 85                      C  TOLUENE     9.80  PPM       59       3776324
 85                      C  E-BENZ      9.30  PPM       87       6105366
 86  Mar 19,91  09:31    C  BENZENE     9.80  PPM       59       3764211       BTEX
 86                      C  TOLUENE     9.80  PPM       87       5508878
 86                      C  E-BENZ      9.30  PPM      167       3752115
 87  Mar 19,91  10:03    A  UNKNOWN     1.34  PPM       46        523909.      C-IET STD
 87                      A  BENZENE     0.12  PPM       59        451125
 87                      A  UNKNOWN     1.03  PPM       68        396927
 87                      A  UNKNOWN     0.90  PPM       80       2650900
 88  Mar 19,91  10:11    A  UNKNOWN     0.04  PPM      .46        145533       BLANK
 88                      A  UNKNOWN     0.17  PPM       80         56003
 89  Mar 19,91  10:15    A  BENZENE     8.22  PPM       59       3350907       BTEX
 89                      A  TOLUENE     8.73  PPM       87       4995148
 89                      A  E-BENZ      7.88  PPM      167       3113347
 90  Mar 19,91  10:31    A  BENZENE     0.34  PPM       60        129912       ROOM BLANK
 90                      A  TOLUENE     0.32  PPM       88        124205
 90                      A  E-BENZ      0.06  PPM      167         24929
 91  Mar 19,91  12:11    A  BENZENE     0.07  PPM       60         27421       TSA0908GC
 91                      A  UNKNOWN     1.01  PPM       68        389910
 91                      A  TOLUENE     0.69  PPM       85        394385
 92  Mar 19,91  12:27    A  UNKNOWN     0.26  PPM       68         99948       TSA0910GC
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*** ANALYSIS         *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE     TIME    C/A  PEAK        CONCNT         RT          AREA      NAME
-------------------------------------------------------------------------------------
 92                      A  TOLUENE     0.16  PPM       86         91057
 93  Mar 19,91  14:55    A  UNKNOWN     0.16  PPM       67         90276       TSA0911GC
 93                      A  UNKNOWN     0.08  PPM       83         36319
 94  Mar 19,91  15:58    A  UNKNOWN     0.06  PPM       66         22871       TSA0912GC
 95  Mar 20,91  08:28    C  BENZENE     9.80  PPM       49        201494       BTEX
 95                      C  TOLUENE     9.80  PPM       60       2911256
 95                      C  E-BENZ      9.30  PPM       89       4504243
 96  Mar 20,91  08:44    C  BENZENE     9.80  PPM       60       3477640       BTEX
 96                      C  TOLUENE     9.80  PPM       88       5007064
 96                      C  E-BENZ      9.30  PPM      168       3319542
 97  Mar 20,91  14:44    A  UNKNOWN     0.29  PPM       67        103543       TSA0914GC
 97                      A  UNKNOWN     0.08  PPM      155         38514
 98  Mar 20,91  15:31    A  UNKNOWN     0.25  PPM       67         88624       TSA0913GC
 99  Mar 21,91  08:13    C  BENZENE     9.80  PPM       49       2728877       BTEX
 99                      C  TOLUENE     9.80  PPM       60       3532820
 99                      C  E-BENZ      9.30  PPM       88       5322732
100  Mar 21,91  08:29    C  BENZENE     9.80  PPM       59       3367733       BTEX
100                      C  TOLUENE     9.80  PPM       87       5348932
100                      C  E-BENZ      9.30  PPM      166       3495732
101  Mar 21,91  09:21    A  BENZENE     0.02  PPM       59          9685       TSA0915GC
101                      A  UNKNOWN     0.17  PPM       67         66618
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*** ANALYSIS         *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE     TIME    C/A  PEAK        CONCNT         RT          AREA      NAME
-------------------------------------------------------------------------------------
102  Mar 21,91  10:08    A  UNKNOWN     0.08  PPM       68         31329       TSA0916GC
103  Mar 21,91  10:30    A              0.00  PPB       30             0       ROOM BLANK
104  Mar 21,91  11:09    A              0.00  PPB       30             0       TSA0917GC
105  Mar 21,91  12:04    A              0.00  PPB       30             0       TSA0918GC
106  Mar 27,91  13:00    C  BENZENE     9.80  PPM       39         16188       BTEX
106                      C  TOLUENE     9.80  PPM       49        698849
106                      C  E-BENZ      9.30  PPM       59       3483814
107  Mar 27,91  13:04    C  BENZENE     9.80  PPM       59       3614816       BTEX
107                      C  TOLUENE     9.80  PPM       82       5403303
107                      C  E-BENZ      9.30  PPM      197       3297415
108  Mar 27,91  13:22    A  UNKNOWN     0.04  PPM      182         16192       TSF0503GC
108                      A  UNKNOWN   182.78  PPM       43       6742073
109  Apr 03,91  07:57    C  BENZENE     9.80  PPM       60          -144       BTEX
109                      C  TOLUENE     9.80  PPM       76        477694
109                      C  E-BENZ      9.30  PPM      119        994085
110  Apr 03,91  08:31    C  BENZENE     9.80  PPM       64       2311857       BTEX
110                      C  TOLUENE     9.80  PPM       94       4424130
110                      C  E-BENZ      9.30  PPM      192       3021780
111  Apr 03,91  08:36    C  BENZENE     9.80  PPM       73       1321607       BTEX
111                      C  TOLUENE     9.80  PPM      103       2742333
111                      C  E-BENZ      9.30  PPM      200       1848390
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*** ANALYSIS               *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE   DATE      TIME      C/A  PEAK       CONCNT         RT          AREA      NAME
--------------------------------------------------------------------------------------
112   Apr 03,91  08:42      A               0.00  PPB      30             0     ambient
113   Apr 03,91  08:49      C  BENZENE      9.80  PPM      70       1694109     BTEX
113                         C  TOLUENE      9.80  PPM     103       2817532
113                         C  E-BENZ       9.30  PPM     128       1555003
114   Apr 03,91  09:09      A               0.00  PPB      30             0     ambient
115   Apr 03,91  09:16      C  BENZENE      9.80  PPM      70       1925105     BTEX
115                         C  TOLUENE      9.80  PPM     103       2782358
115                         C  E-BENZ       9.30  PPM     128       1691585
116   Apr 03,91  09:40      A               0.00  PPB      30             0     ambient
117   Apr 08,91  09:34      C  BENZENE      9.80  PPM      52        499604     BTEX
117                         C  TOLUENE      9.80  PPM      64        681774
117                         C  E-BENZ       9.30  PPM      87        884191
118   Apr 08,91  09:41      C  BENZENE      9.80  PPM      61       1242681     BTEX
118                         C  TOLUENE      9.80  PPM      91       1709991
118                         C  E-BENZ       9.30  PPM     176       1050345
119   Apr 08,91  09:48      C  BENZENE      9.80  PPM      60       1657525     BTEX
119                         C  TOLUENE      9.80  PPM      89       2320764
119                         C  E-BENZ       9.30  PPM     171       1452251
120   Apr 08,91  10:38      A               0.00  PPB      30             0     TSA0116GCL
121   Apr 08,91  10:55      A               0.00  PPB      30             0     TSA0917GCL
122   Apr 08,91  11:15      A               0.00  PPB      30             0     TSA0907GCL
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*** ANALYSIS               *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE   DATE      TIME      C/A  PEAK       CONCNT         RT          AREA      NAME
--------------------------------------------------------------------------------------
123   Apr 08,91  11:31      A               0.00  PPB      30             0     TSA0908GCL
124   Apr 08,91  11:42      A               0.00  PPB      30             0     TSA0515GC
125   Apr 08,91  12:03      A               0.00  PPB      30             0     TSA0516GC
126   Apr 08,91  13:10      C  BENZENE      9.80  PPM      58       2025666     BTEX
126                         C  TOLUENE      9.80  PPM      85       3282020
126                         C  E-BENZ       9.30  PPM     163       2401670
126                         C  O-XYLENE     9.60  PPM     706        132343
127   Apr 08,91  13:26      A               0.00  PPB      30             0     TSA0518GC
128   Apr 08,91  13:43      A               0.00  PPB      30             0     TSA0519GC
129   Apr 08,91  13:59      A               0.00  PPB      30             0     TSA0521GC
130   Apr 08,91  14:16      A               0.00  PPB      30             0     TSA0522GC
131   Apr 08,91  14:31      A               0.00  PPB      30             0     TSA0523GC
132   Apr 08,91  14:42      A               0.00  PPB      30             0     TSA0525GC
133   Apr 08,91  15:03      A               0.00  PPB      30             0     TSA0526GC
134   Apr 08,91  15:21      A               0.00  PPB      30             0     TSA0527GC
135   Apr 08,91  15:38      A               0.00  PPB      30             0     TSA0502GC
136   Apr 08,91  15:54      A               0.00  PPB      30             0     TSA0509GC
137   Apr 09,91  08:08      C  BENZENE      9.80  PPM      58         68279     BTEX
137                         C  TOLUENE      9.80  PPM      72        958788
137                         C  E-BENZ       9.30  PPM     111       1413844
137                         C  O-XYLENE     9.60  PPM     223       1010100
```

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*** ANALYSIS               *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE   DATE      TIME      C/A  PEAK       CONCNT         RT          AREA      NAME
--------------------------------------------------------------------------------------
138   Apr 09,91  08:13      C  BENZENE      9.80  PPM      65       1314793     BTEX
138                         C  TOLUENE      9.80  PPM      95       1897225
138                         C  E-BENZ       9.30  PPM     195       1204468
139   Apr 09,91  08:17      C  BENZENE      9.80  PPM      62       1812499     BTEX
139                         C  TOLUENE      9.80  PPM      82       2275792
139                         C  E-BENZ       9.30  PPM     180       1393452
140   Apr 09,91  08:36      A  UNKNOWN      0.08  PPM      57          9186     TSA0511GC
140                         A  UNKNOWN      0.02  PPM      86          3580
141   Apr 09,91  08:40      C  BENZENE      9.80  PPM      59       1817602     BTEX
141                         C  TOLUENE      9.80  PPM      87       2576492
141                         C  E-BENZ       9.30  PPM     167       1550252
142   Apr 09,91  08:56      A  TOLUENE      0.05  PPM      86         13494     TSA0512GC
143   Apr 09,91  09:12      A               0.00  PPB      30             0     TSA0503GC
144   Apr 09,91  09:30      A               0.00  PPB      30             0     TSA0501GC
145   Apr 09,91  09:49      A               0.00  PPB      30             0     TSA0504GC
146   Apr 09,91  10:06      A               0.00  PPB      30             0     TSA0505GC
147   Apr 09,91  10:24      A               0.00  PPB      30             0     TSA0506GC
148   Apr 09,91  10:40      A               0.00  PPB      30             0     TSA0507GC
149   Apr 09,91  11:01      A               0.00  PPB      30             0     TSA0508GC
150   Apr 09,91  11:15      A               0.00  PPB      30             0     TSA0510GC
151   Apr 09,91  11:29      A               0.00  PPB      30             0     TSA0513GC
```

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*** ANALYSIS          *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE     TIME    C/A  PEAK        CONCNT        RT          AREA       NAME
--------------------------------------------------------------------------------------
152   Apr 09,91 11:44   A                0.00 PPB      30             0      TSA0514GC
153   Apr 09,91 11:58   A                0.00 PPB      30             0      TSA0517GC
154   Apr 09,91 13:06   C  BENZENE       9.80 PPM      58       2292874      BTEX
154                     C  TOLUENE       9.80 PPM      88       3605570
154                     C  E-BENZ        9.30 PPM     175       2313867
155   Apr 09,91 13:24   A                0.00 PPB      30             0      TSA0520GC
156   Apr 09,91 13:41   A                0.00 PPB      30             0      TSA0524GC
157   Apr 09,91 13:58   A                0.00 PPB      30             0      TSA0534GC
158   Apr 09,91 14:14   A                0.00 PPB      30             0      TSA0530GC
159   Apr 09,91 14:27   A                0.00 PPB      30             0      TSA0532GC
160   Apr 09,91 14:44   A                0.00 PPB      30             0      TSA0535GC
161   Apr 09,91 14:58   A                0.00 PPB      30             0      TSA0536GC
162   Apr 09,91 15:13   A                0.00 PPB      30             0      TSA0537GC
163   Apr 09,91 15:27   A                0.00 PPB      30             0      TSA1702GC
164   Apr 09,91 15:40   A                0.00 PPB      30             0      TSA0601GC
165   Apr 10,91 08:57   C  BENZENE       9.80 PPM      56         57301      BTEX
165                     C  TOLUENE       9.80 PPM      71        920905
165                     C  E-BENZ        9.30 PPM     110       1415835
165                     C  O-XYLENE      9.60 PPM     220        957358
166   Apr 10,91 09:03   C  BENZENE       9.80 PPM      63       1633898      BTEX
166                     C  TOLUENE       9.80 PPM      95       2339513

*** ANALYSIS          *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE     TIME    C/A  PEAK        CONCNT        RT          AREA       NAME
--------------------------------------------------------------------------------------
166                     C  E-BENZ        9.30 PPM     187       1453574
167   Apr 10,91 09:09   C  BENZENE       9.80 PPM      61       2048623      BTEX
167                     C  TOLUENE       9.80 PPM      90       2895107
167                     C  E-BENZ        9.30 PPM     175       1944290
168   Apr 10,91 09:13   C  BENZENE       9.80 PPM      59       2415442      BTEX
168                     C  TOLUENE       9.80 PPM      88       3532998
168                     C  E-BENZ        9.30 PPM     170       2178110
169   Apr 10,91 09:30   A  BENZENE       0.09 PPM      59         22465      TSA0603GC
169                     A  TOLUENE       0.05 PPM      87         18134
170   Apr 10,91 09:46   A                0.00 PPB      30             0      TSA0604GC
171   Apr 10,91 10:03   A                0.00 PPB      30             0      TSA0605GC
172   Apr 10,91 10:18   A                0.00 PPB      30             0      TSA0606GC
173   Apr 10,91 10:36   A                0.00 PPB      30             0      TSA0607GC
174   Apr 10,91 10:50   A                0.00 PPB      30             0      TSA0608GC
175   Apr 10,91 11:04   A                0.00 PPB      30             0      TSA0801GC
176   Apr 10,91 11:17   A                0.00 PPB      30             0      TSA0803GC
177   Apr 10,91 11:32   A                0.00 PPB      30             0      TSA0804GC
178   Apr 10,91 11:45   A                0.00 PPB      30             0      TSA0805GC
179   Apr 10,91 11:59   A                0.00 PPB      30             0      TSA0806GC
180   Apr 10,91 12:25   C  BENZENE       9.80 PPM      59       3414194      BTEX
180                     C  TOLUENE       9.80 PPM      87       5370971

*** ANALYSIS          *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE     TIME    C/A  PEAK        CONCNT        RT          AREA       NAME
--------------------------------------------------------------------------------------
180                     C  E-BENZ        9.30 PPm     167       3353598
181   Apr 10,91 12:42   A  BENZENE       0.01 PPM      59          3214      TSA0807GC
181                     A  TOLUENE       0.02 PPM      87         11351
182   Apr 10,91 12:58   A                0.00 PPB      30             0      TSA0808GC
183   Apr 10,91 13:13   A                0.00 PPB      30             0      TSA0526GC
184   Apr 10,91 13:29   A                0.00 PPB      30             0      TSA0528GC
185   Apr 10,91 13:45   A                0.00 PPB      30             0      TSA0529GC
186   Apr 10,91 14:03   A                0.00 PPB      30             0      TSA0531GC
187   Apr 10,91 14:23   A                0.00 PPB      30             0      TSA0533GC
188   Apr 10,91 14:37   A                0.00 PPB      30             0      TSA0602GC
189   Apr 10,91 14:51   A                0.00 PPB      30             0      TSA0614GC
190   Apr 10,91 15:06   A                0.00 PPB      30             0      TSA0610GC
191   Apr 10,91 15:22   A  TOLUENE       0.00 PPM      92          1887      TSA0511DCL
192   Apr 10,91 15:41   A                0.00 PPB      30             0      TSA0534GCL
193   Apr 10,91 16:08   A                0.00 PPB      30             0      TSA0603GCL
194   Apr 15,91 07:16   C  BENZENE       9.80 PPM      59         60780      BTEX
194                     C  TOLUENE       9.80 PPM      87       2825029
194                     C  E-BENZ        9.30 PPM     157       5437957
194                     C  O-XYLENE      9.60 PPM     138       4100121
195   Apr 15,91 09:20   C  BENZENE       9.80 PPM      58       3376352      BTEX
195                     C  TOLUENE       9.80 PPM      87       3460968
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*** ANALYSIS         *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE      TIME   C/A  PEAK       CONCNT        RT         AREA        NAME
---------------------------------------------------------------------------------
195                      C  E-BENZ     9.30  PPM     168       2504086
195                      C  O-XYLENE   9.60  PPM     489         88711
196  Apr 15,91  09:37    A  TOLUENE    0.07  PPM      87         24215    TSA0609GC
197  Apr 15,91  09:57    A             0.00  PPB      30             0    TSA0610GC
198  Apr 15,91  10:15    A             0.00  PPB      30             0    TSA0611GC
199  Apr 15,91  10:29    A             0.00  PPB      30             0    TSA0612GC
200  Apr 15,91  10:44    A             0.00  PPB      30             0    TSA0613GC
201  Apr 15,91  10:59    A             0.00  PPB      30             0    TSA0615GC
202  Apr 15,91  11:13    A             0.00  PPB      30             0    TSA0702GC
203  Apr 15,91  11:28    A             0.00  PPB      30             0    TSA0703GC
204  Apr 15,91  11:40    A             0.00  PPB      30             0    TSA0704GC
205  Apr 15,91  11:54    A             0.00  PPB      30             0    TSA0802GC
206  Apr 17,91  08:55    C  BENZENE    9.80  PPM      59        190784    BTEX
206                      C  TOLUENE    9.80  PPM      88        683425
206                      C  E-BENZ     9.30  PPM     100       1185238
207  Apr 17,91  08:58    C  BENZENE    9.80  PPM      59        426928    BTEX
207                      C  TOLUENE    9.80  PPM      63        767919
207                      C  E-BENZ     9.30  PPM      85       1047053
207                      C  O-XYLENE   9.60  PPM     186        610349
208  Apr 17,91  09:10    C  BENZENE    9.80  PPM      59       1844583    BTEX
208                      C  TOLUENE    9.80  PPM      87       2317424

*** ANALYSIS         *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE      TIME   C/A  PEAK       CONCNT        RT         AREA        NAME
---------------------------------------------------------------------------------
208                      C  E-BENZ     9.30  PPM     166       1462416
209  Apr 17,91  09:26    A  BENZENE    0.03  PPM      58          6272    TSA0701GC
210  Apr 17,91  09:39    A             0.00  PPB      30             0    TSA0705GC
211  Apr 17,91  09:53    A             0.00  PPB      30             0    TSA0706GC
212  Apr 17,91  10:08    A             0.00  PPB      30             0    TSA0707GC
213  Apr 17,91  10:22    A             0.00  PPB      30             0    TSA0708GC
214  Apr 17,91  10:36    A             0.00  PPB      30             0    TSA1203GC
215  Apr 17,91  10:51    A             0.00  PPB      30             0    TSA0709GC
216  Apr 17,91  11:04    A             0.00  PPB      30             0    TSA0710GC
217  Apr 17,91  11:18    A             0.00  PPB      30             0    TSA0711GC
218  Apr 17,91  11:32    A             0.00  PPB      30             0    TSA0712GC
219  Apr 17,91  11:45    A             0.00  PPB      30             0    TSA0713GC
220  Apr 17,91  12:00    A             0.00  PPB      30             0    TSA0714GC
221  Apr 17,91  12:55    A             0.00  PPB      30             0    TSA0715GC
222  Apr 17,91  13:10    C  BENZENE    9.80  PPM      58       2698571    BTEX
222                      C  TOLUENE    9.80  PPM      85       4390172
222                      C  E-BENZ     9.30  PPM     164       3119714
222                      C  O-XYLENE   9.60  PPM     711       1226122
223  Apr 17,91  13:26    A             0.00  PPB      30             0    TSA0301GC
224  Apr 17,91  13:40    A             0.00  PPB      30             0    TSA0302GC
225  Apr 17,91  13:55    A             0.00  PPB      30             0    TSA0303GC

*** ANALYSIS         *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE      TIME   C/A  PEAK       CONCNT        RT         AREA        NAME
---------------------------------------------------------------------------------
226  Apr 17,91  14:09    A             0.00  PPB      30             0    TSA0304GC
227  Apr 17,91  14:22    A             0.00  PPB      30             0    TSA0305GC
228  Apr 17,91  14:38    A             0.00  PPB      30             0    TSA0306GC
229  Apr 17,91  14:52    A             0.00  PPB      30             0    TSA0307GC
230  Apr 17,91  15:06    A             0.00  PPB      30             0    TSA0308GC
231  Apr 17,91  15:20    A             0.00  PPB      30             0    TSA0309GC
232  Apr 17,91  15:34    A             0.00  PPB      30             0    TSA0311GC
233  Apr 18,91  08:44    C  BENZENE    9.80  PPM      57         65285    BTEX
233                      C  TOLUENE    9.80  PPM      84        898743
233                      C  E-BENZ     9.30  PPM     103       1392676
233                      C  O-XYLENE   9.60  PPM     204       1098248
234  Apr 18,91  08:51    C  BENZENE    9.80  PPM      58       1370705    BTEX
234                      C  TOLUENE    9.80  PPM      83       2349962
234                      C  E-BENZ     9.30  PPM     181       1440459
235  Apr 18,91  08:55    C  BENZENE    9.80  PPM      59       1838845
235                      C  TOLUENE    9.80  PPM      87       2625313    BTEX
235                      C  E-BENZ     9.30  PPM     168       1517493
236  Apr 18,91  09:13    A  BENZENE    0.06  PPM      58         10841    TSA0312GC
236                      A  TOLUENE    0.03  PPM      83          7655
237  Apr 18,91  09:30    A             0.00  PPB      30             0    TSA0310GC
238  Apr 18,91  09:45    A             0.00  PPB      30             0    TSA0313GC
```

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*** ANALYSIS        *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE      TIME    C/A  PEAK       CONCNT        RT          AREA      NAME
-----------------------------------------------------------------------------------
239  Apr 18,91  10:01    A                0.00  PPB    30             0     TSA0314GC
240  Apr 18,91  10:16    A                0.00  PPB    30             0     TSA0315GC
241  Apr 18,91  10:31    A                0.00  PPB    30             0     TSA0316GC
242  Apr 18,91  10:45    A  UNKNOWN       0.03  PPM    29          5943     TSA0317GC
243  Apr 18,91  11:00    A                0.00  PPB    30             0     TSA0318GC
244  Apr 18,91  11:18    A                0.00  PPB    30             0     TSA0319GC
245  Apr 18,91  11:32    A                0.00  PPB    30             0     TSA0320GC
246  Apr 18,91  11:47    A                0.00  PPB    30             0     TSA0401GC
247  Apr 18,91  12:46    C  BENZENE       9.80  PPM    58       3136210     BTEX
247                      C  TOLUENE       9.80  PPM    85       4367402
247                      C  E-BENZ        9.30  PPM   194       3176328
247                      C  O-XYLENE      9.60  PPM   712         89378
248  Apr 18,91  13:03    A  TOLUENE       0.02  PPM    85         11017     TSA0402GC
249  Apr 18,91  13:19    A  UNKNOWN       0.01  PPM    67          3091     TSA0403GC
250  Apr 18,91  13:35    A                0.00  PPB    30             0     TSA0404GC
251  Apr 18,91  13:51    A                0.00  PPB    30             0     TSA0405GC
252  Apr 18,91  14:07    A                0.00  PPB    30             0     TSA1204GC
253  Apr 18,91  14:25    A                0.00  PPB    30             0     TSA1205GC
254  Apr 22,91  07:58    C  BENZENE       9.80  PPM    52        325305     BTEX
254                      C  TOLUENE       9.80  PPM    85        727548
254                      C  E-BENZ        9.30  PPM    98       1555111

*** ANALYSIS        *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE      TIME    C/A  PEAK       CONCNT        RT          AREA      NAME
-----------------------------------------------------------------------------------
254                      C  O-XYLENE      9.60  PPM   192       1352618
255  Apr 22,91  08:06    C  BENZENE       9.80  PPM    61       1352434     BTEX
255                      C  TOLUENE       9.80  PPM    90       1992416
255                      C  E-BENZ        9.30  PPM   174       1528783
256  Apr 22,91  08:10    C  BENZENE       9.80  PPM    59       1523792     BTEX
256                      C  TOLUENE       9.80  PPM    87       2050163
256                      C  E-BENZ        9.30  PPM   128       1567348
257  Apr 22,91  08:28    A  BENZENE       0.05  PPM    58          8315     ROOM BLANK
257                      A  TOLUENE       0.01  PPM    85          2447
258  Apr 22,91  09:01    A  UNKNOWN       2.44  PPM    67        379905     TSA1001GC
258                      A  UNKNOWN       0.81  PPM    84        125625
259  Apr 22,91  09:19    A  UNKNOWN       3.39  PPM    67        527061     TSA1002GC
259                      A  TOLUENE       0.79  PPM    85        166804
260  Apr 22,91  09:31    A  UNKNOWN      13.19  PPM    67       2045498     TSA1003GC
260                      A  UNKNOWN       6.33  PPM    83        982718
261  Apr 22,91  09:39    A  UNKNOWN       2.92  PPM    67        454443     TSA1004GC
261                      A  UNKNOWN       3.26  PPM    83        330693
262  Apr 22,91  09:50    A  UNKNOWN       2.54  PPM    67        395560     TSA1005GC
262                      A  TOLUENE       0.61  PPM    85        122925
263  Apr 22,91  10:02    A  UNKNOWN       3.62  PPM    67        523395     TSA1006GC
263                      A  UNKNOWN       0.75  PPM    83        118921

*** ANALYSIS        *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE      TIME    C/A  PEAK       CONCNT        RT          AREA      NAME
-----------------------------------------------------------------------------------
264  Apr 22,91  10:11    A  UNKNOWN       2.63  PPM    67        408952     TSA1007GC
264                      A  UNKNOWN       0.72  PPM    84        111914
265  Apr 22,91  10:21    A  UNKNOWN       0.75  PPM    67        113127     TSA1008GC
265                      A  TOLUENE       0.21  PPM    85         44976
266  Apr 22,91  10:31    A  UNKNOWN       0.78  PPM    67        120223     TSA1009GC
266                      A  TOLUENE       0.19  PPM    85         40766
267  Apr 22,91  10:41    A                0.00  PPB    30             0     TSA1010GC
268  Apr 22,91  10:53    A  UNKNOWN       0.48  PPM    67         74465     TSA1011GC
268                      A  TOLUENE       0.19  PPM    86         40248
269  Apr 22,91  11:05    A  UNKNOWN       0.97  PPM    67        151031     TSA1012GC
269                      A  TOLUENE       0.32  PPM    86         67126
270  Apr 22,91  11:14    A  UNKNOWN       0.04  PPM    67          5680     TSA1013GC
270                      A  TOLUENE       0.57  PPM    87        120720
271  Apr 22,91  11:25    A  TOLUENE       0.56  PPM    87        118117     TSA1014GC
272  Apr 22,91  11:35    A  TOLUENE       0.50  PPM    87        105255     TSA1015GC
273  Apr 22,91  11:52    C  BENZENE       9.80  PPM    59       2698505     BTEX
273                      C  TOLUENE       9.80  PPM    86       4521871
273                      C  E-BENZ        9.30  PPM   166       4035762
273                      C  O-XYLENE      9.60  PPM   720       1224502
274  Apr 22,91  12:39    A  TOLUENE       0.53  PPM    85        113113     TSA1016GC
275  Apr 22,91  12:49    A  TOLUENE       0.17  PPM    85         82383     TSA1017GC
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*** ANALYSIS           *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE       TIME    C/A  PEAK        CONCNT       RT          AREA       NAME
--------------------------------------------------------------------------------------
276   Apr 22,91  13:01     A  TOLUENE     0.16  PPM      86         81605     TSA1018GC
277   Apr 22,91  13:14     A  UNKNOWN     0.06  PPM      67         17639     TSA1019GC
277                        A  TOLUENE     0.21  PPM      86        105067
278   Apr 22,91  13:27     A  TOLUENE     0.12  PPM      86         57808     TSA1020GC
279   Apr 22,91  13:41     A  TOLUENE     0.04  PPM      86         20807     TSA1100GC
280   Apr 22,91  13:52     A  TOLUENE     0.10  PPM      86         23926     TSA1101GC
281   Apr 22,91  14:04     A  TOLUENE     0.04  PPM      85         22138     TSA1102GC
282   Apr 22,91  14:18     A  TOLUENE     0.13  PPM      85         63153     TSA1103GC
283   Apr 22,91  14:29     A  TOLUENE     0.10  PPM      85         51154     TSA1104GC
284   Apr 22,91  14:41     A  TOLUENE     0.10  PPM      85         48590     TSA1105GC
285   Apr 23,91  08:13     C  BENZENE     9.80  PPM      61         38526     BTEX
285                        C  TOLUENE     9.80  PPM      93       1141461
285                        C  E-BENZ      9.30  PPM     176       1849849
285                        C  O-XYLENE    9.60  PPM     190       1398187
286   Apr 23,91  08:18     C  BENZENE     9.80  PPM      61       1508281     BTEX
286                        C  TOLUENE     9.80  PPM      92       2250723
286                        C  E-BENZ      9.30  PPM     179       1483628
287   Apr 23,91  08:25     C  BENZENE     9.80  PPM      59       2198547     BTEX
287                        C  TOLUENE     9.80  PPM      87       3371572
287                        C  E-BENZ      9.30  PPM     169       1948421
288   Apr 23,91  08:44     A  BENZENE     0.06  PPM      58         12644     TSA1106GC

*** ANALYSIS           *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE       TIME    C/A  PEAK        CONCNT       RT          AREA       NAME
--------------------------------------------------------------------------------------
288                        A  TOLUENE     0.52  PPM      85        178868
289   Apr 23,91  08:53     A  TOLUENE     0.07  PPM      86         22893     TSA1107GC
290   Apr 23,91  09:07     A  TOLUENE     0.06  PPM      86         19990     TSA1108GC
291   Apr 23,91  09:21     A  TOLUENE     0.05  PPM      87         15945     TSA1109GC
292   Apr 23,91  09:32     A              0.00  PPB      30             0     TSA1110GC
293   Apr 23,91  09:42     A              0.00  PPB      30             0     TSA1111GC
294   Apr 23,91  09:56     A  TOLUENE     0.02  PPM      85          5516     TSA1707GC
295   Apr 23,91  10:07     A              0.00  PPB      30             0     TSA0710GCL
296   Apr 23,91  10:55     A  UNKNOWN     0.12  PPM      66         27174     TSA0907GCL2
296                        A  UNKNOWN     0.26  PPM      84         57813
297   Apr 23,91  11:06     A              0.00  PPB      30             0     TSA0116GCL2
298   Apr 23,91  11:17     A  UNKNOWN     3.61  PPM      67        809014     TSA1708GC
298                        A  UNKNOWN     3.13  PPM      80        702329
299   Apr 23,91  11:28     A  UNKNOWN     5.15  PPM      67       1155427     TSA0317GCL
299                        A  UNKNOWN     4.15  PPM      80        930676
300   Apr 23,91  11:41     A  UNKNOWN     2.84  PPM      67        637084     TSA0403GCL
300                        A  UNKNOWN     3.82  PPM      80        856154
301   Apr 23,91  11:54     A  UNKNOWN     8.57  PPM      67       1823233     TSA1004GCL
301                        A  UNKNOWN     4.01  PPM      83        900422
302   Apr 23,91  12:36     C  BENZENE     9.80  PPM      58       3211847     BTEX
302                        C  TOLUENE     9.80  PPM      86       5195988

*** ANALYSIS           *** PRESS <esc> TO STOP OR ANY OTHER KEY TO CONTINUE ***
TRACE  DATE       TIME    C/A  PEAK        CONCNT       RT          AREA       NAME
--------------------------------------------------------------------------------------
302                        C  E-BENZ      9.30  PPM     166       3294093
302                        C  O-XYLENE    9.60  PPM     718         29002
303   Apr 23,91  13:10     A  UNKNOWN     2.31  PPM      67       1740366     TSA1003GCL
303                        A  UNKNOWN     2.22  PPM      81        745336
304   Apr 23,91  13:20     A  UNKNOWN     4.70  PPM      67       1540063     TSA1709GC
304                        A  UNKNOWN     3.01  PPM      82        658748
305   Apr 23,91  13:32     A  UNKNOWN     3.23  PPM      67        881478     TSA1006GCL
305                        A  UNKNOWN     0.59  PPM      86        183425
306   Apr 23,91  13:41     A  BENZENE     5.89  PPM      58       1930956     BTEX STD
306                        A  TOLUENE     5.78  PPM      86       1680216
306                        A  E-BENZ      2.52  PPM     165        891591
307   Apr 23,91  13:45     A  BENZENE     6.86  PPM      58       2246959     BTEX STD
307                        A  TOLUENE     6.09  PPM      86       2698786
307                        A  E-BENZ      5.57  PPM     165       1524826
308   Apr 23,91  13:49     A  BENZENE     5.68  PPM      58       2355813     BTEX STD
308                        A  TOLUENE     5.34  PPM      86       2832457
308                        A  E-BENZ      4.12  PPM     165       1437245
309   Apr 23,91  13:54     A  BENZENE     9.61  PPM      58       3150260     BTEX STD
309                        A  TOLUENE     9.76  PPM      86       5173392
309                        A  E-BENZ      9.56  PPM     165       3387608
309                        A  UNKNOWN     0.20  PPM     716         65698
```

```
*** SCENTOGRAPH                OPERATING PARAMETERS
  1-Calibrant              ( Enter up to 12 letters) ... BTEX
  2-Sample Time                     ( 0 - 999 Sec)   ... 5
  3-Delay Time                    ( 0.0 - 2.0 Sec)   ... 0.5
  4-Desorption Time               ( 0.0 - 4.0 Sec)   ... 4.0
  5-Inhibit Time                    ( 0 - 999 Sec)   ... 30
  6-Oven Temperature              (  30 - 180 xC )   ... 100
  7-Chart Duration                  ( 1 - 40 Min)    ... 15
  8-Analyses per Calibration             ( 1 - 99)   ... 99
  9-Auto Analysis Duration          ( 0 - 999 Min)   ... MANUAL
 10-Backflush Option                ( 0=off, 1=on)   ... BACKFL OFF
 11-Column                 ( Enter up to 12 letters) ... 10%SP-1000
 12-Detector                ( Enter up to 8 letters) ... AID
 13-Number of Calibration Peaks          ( 1 - 16)   ... 4
 14-Peak Number .....................................
    Substance Name          ( Enter up to 8 letters) ...
    Concentration Range             ( 1=PPM, 0=PPB)  ...
    Calibration Concentration .......................
    Alarm Level Concentration .......................
    Second Alarm Level Concentration ................

15-Next Screen           16-Channel Information Setup Screen
ENTER FIELD TO BE UPDATED?

*** SCENTOGRAPH         .     OPERATING PARAMETERS - SECONDARY SCREEN
 17-Final temperature                   ( 30 - 180 xC) ... 100
 18-Temperature slope duration in seconds              ... 0
 19-Initial Gain for sample runs                       ... 1.0
 20-Time Weight Average             (0-off, 1 - 24)    ... 0
 21-Column Pressure in PSI's                           ... 29
 22-Enable alarm                    ( 0=off, 1=on )    ... OFF
 23-Enable External Purge           ( 0=off, 1-300)    ... OFF
 24-Compound database name                             ...
 25-Compound database entry              ( 1 - 100)    ...
```

APPENDIX D

RESULTS TABLES FOR CHEMICAL ANALYSES

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - VOLATILE ORGANIC DATA

Page 1 of 6

AREA	TSA	TSA	TSA	TSA	TSA	TSA	TSA
LOCATION	VER: NO VOC DET	VER: NO VOC DET	VER: NO VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET
TYPE OF LOCATION	BIASED	BIASED	BIASED	BIASED	BIASED	BIASED	BIASED
SAMPLE NUMBER	TSA1401V	TSA1402V	TSA1403V	TSA1501V	TSA1501V2	TSA1502V2	TSA1502VR2
MEDIA	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
SDG NUMBER	TSA1401VS	TSA1401VS	TSA1403V	TSA1401VS	TSA1403V	TSA1403V	TSA1401VS
FIELD MEASUREMENTS							
Depth (ft)	14-14.5	7.5-8.5	8-9	8-8.5	7.5-8.5	16.5-17.5	17-17.5
TARGET COMPOUNDS							
Chloromethane	10 UJ	---	11 UR	10 UJ	11 UR	11 UR	10 UJ
Bromomethane	10 UJ	---	11 UR	10 UJ	11 UR	11 UR	10 UJ
Vinyl Chloride	10 UJ	---	11 UR	10 UJ	11 UR	11 UR	10 UJ
Chloroethane	10 UJ	---	11 UR	10 UJ	11 UR	11 UR	10 UJ
Methylene Chloride	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	51 J
Acetone	8 J	---	11 UR	7 J	11 UR	11 UR	10 UJ
Carbon Disulfide	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
1,1-Dichloroethene	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
1,1-Dichloroethane	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
1,2-Dichloroethene_(total)	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
Chloroform	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
1,2-Dichloroethane	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
2-Butanone	10 UJ	---	11 UR	10 UJ	11 UR	11 UR	10 UJ
1,1,1-Trichloroethane	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
Carbon Tetrachloride	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
Vinyl Acetate	10 UJ	---	11 UR	10 UJ	11 UR	11 UR	10 UJ
Bromodichloromethane	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
1,2-Dichloropropane	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
cis-1,3-Dichloropropene	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
Trichloroethene	2 J	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
Dibromochloromethane	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
1,1,2-Trichloroethane	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
Benzene	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
Trans-1,3-Dichloropropene	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
Bromoform	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
4-Methyl-2-Pentanone	10 UJ	---	11 UR	10 UJ	11 UR	11 UR	10 UJ
2-Hexanone	10 UJ	---	11 UR	10 UJ	11 UR	11 UR	10 UJ
Tetrachloroethene	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
1,1,2,2-Tetrachloroethane	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
Toluene	5 UJ	2 J	5 UR	5 UJ	6 UR	6 UR	2 J

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - VOLATILE ORGANIC DATA (Continued)

AREA	TSA	TSA	TSA	TSA	TSA	TSA	TSA
LOCATION	VER: NO VOC DET	VER: NO VOC DET	VER: NO VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET
TYPE OF LOCATION	BIASED	BIASED	BIASED	BIASED	BIASED	BIASED	BIASED
SAMPLE NUMBER	TSA1401V	TSA1402V	TSA1403V	TSA1501V	TSA1501V2	TSA1502V2	TSA1502VR2
MEDIA	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
SDG NUMBER	TSA1401VS	TSA1401VS	TSA1403V	TSA1401VS	TSA1403V	TSA1403V	TSA1401VS
Chlorobenzene	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
Ethylbenzene	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
Styrene	5 UJ	---	5 UR	5 UJ	6 UR	6 UR	5 UJ
Xylene (total)	5 UJ	---	4 JX	5 UJ	6 UR	6 UR	5 UJ
Dilution Factor	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Total (Allowed) Hold Time	22(14)d*	13(14)d	36(14)d*	22(14)d*	36(14)d*	36(14)d*	28(14)d*

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - VOLATILE ORGANIC DATA (Continued)

Page 3 of 6

AREA	TSA	TSA	TSA	TSA	TSA	TSA	TSA
LOCATION	VER: VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET
TYPE OF LOCATION	BIASED	BIASED	BIASED	BIASED	BIASED	BIASED	BIASED
SAMPLE NUMBER	TSA1503V	TSA1504V	TSA1505V	TSA1506V	TSA1507V	TSA1508V	TSA1509V
MEDIA	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
SDG NUMBER	TSA1401VS	TSA1401VS	TSA1401VS	TSA1403V	TSA1403V	TSA1403V	TSA1403V
FIELD MEASUREMENTS							
Depth (ft)	17-17.5	8.5-9.5	7-8	3.5-4.5	4-5	3-4	3-4.5
TARGET COMPOUNDS							
Chloromethane	10 UJ	---	---	11 UR	11 UR	11 UR	11 UR
Bromomethane	10 UJ	---	---	11 UR	11 UR	11 UR	11 UR
Vinyl Chloride	10 UJ	---	---	11 UR	11 UR	11 UR	11 UR
Chloroethane	10 UJ	---	---	11 UR	11 UR	11 UR	11 UR
Methylene Chloride	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
Acetone	10 UJ	---	---	11 UR	11 UR	11 UR	11 UR
Carbon Disulfide	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
1,1-Dichloroethene	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
1,1-Dichloroethane	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
1,2-Dichloroethene_(total)	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
Chloroform	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
1,2-Dichloroethane	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
2-Butanone	10 UJ	---	---	11 UR	11 UR	11 UR	11 UR
1,1,1-Trichloroethane	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
Carbon Tetrachloride	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
Vinyl Acetate	10 UJ	---	---	11 UR	11 UR	11 UR	11 UR
Bromodichloromethane	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
1,2-Dichloropropane	7 J	---	---	6 UR	5 UR	6 UR	5 UR
cis-1,3-Dichloropropene	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
Trichloroethene	5 J	---	---	6 UR	5 UR	6 UR	5 UR
Dibromochloromethane	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
1,1,2-Trichloroethane	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
Benzene	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
Trans-1,3-Dichloropropene	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
Bromoform	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
4-Methyl-2-Pentanone	10 UJ	---	---	11 UR	11 UR	11 UR	11 UR
2-Hexanone	10 UJ	---	---	11 UR	11 UR	11 UR	11 UR
Tetrachloroethene	4 J	---	---	6 UR	5 UR	6 UR	5 UR
1,1,2,2-Tetrachloroethane	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
Toluene	5 UJ	2 J	2 J	6 UR	5 UR	6 UR	5 UR

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - VOLATILE ORGANIC DATA (Continued) Page 4 of 6

AREA	TSA	TSA	TSA	TSA	TSA	TSA	TSA
LOCATION	VER: VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET
TYPE OF LOCATION	BIASED	BIASED	BIASED	BIASED	BIASED	BIASED	BIASED
SAMPLE NUMBER	TSA1503V	TSA1504V	TSA1505V	TSA1506V	TSA1507V	TSA1508V	TSA1509V
MEDIA	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
SDG NUMBER	TSA1401VS	TSA1401VS	TSA1401VS	TSA1403V	TSA1403V	TSA1403V	TSA1403V
Chlorobenzene	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
Ethylbenzene	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
Styrene	5 UJ	---	---	6 UR	5 UR	6 UR	5 UR
Xylene (total)	5 UJ	---	---	4 JX	5 UR	6 UR	3 JX
Dilution Factor	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Total (Allowed) Hold Time	22(14)d*	13(14)d	13(14)d	36(14)d*	36(14)d*	36(14)d*	36(14)d*

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - VOLATILE ORGANIC DATA (Continued)

AREA	TSA	TSA
LOCATION	VER: VOC DET	TSA
TYPE OF LOCATION	BIASED	COMPOSITE/DRUM
SAMPLE NUMBER	TSA1510V	TSA2201V
MEDIA	SOIL	WATER
UNITS	ug/kg	ug/L
SDG NUMBER	TSA1403V	TSA1403V
FIELD MEASUREMENTS		
Depth (ft)	3.5-4.5	-
TARGET COMPOUNDS		
Chloromethane	11 UR	---
Bromomethane	11 UR	---
Vinyl Chloride	11 UR	---
Chloroethane	11 UR	---
Methylene Chloride	5 UR	0.6 J
Acetone	11 UR	---
Carbon Disulfide	5 UR	---
1,1-Dichloroethene	5 UR	---
1,1-Dichloroethane	5 UR	---
1,2-Dichloroethene_(total)	5 UR	---
Chloroform	5 UR	---
1,2-Dichloroethane	5 UR	---
2-Butanone	11 UR	0.6 J
1,1,1-Trichloroethane	5 UR	---
Carbon Tetrachloride	5 UR	---
Vinyl Acetate	11 UR	---
Bromodichloromethane	5 UR	---
1,2-Dichloropropane	5 UR	---
cis-1,3-Dichloropropene	5 UR	---
Trichloroethene	5 UR	---
Dibromochloromethane	5 UR	---
1,1,2-Trichloroethane	5 UR	---
Benzene	5 UR	---
Trans-1,3-Dichloropropene	5 UR	---
Bromoform	5 UR	---
4-Methyl-2-Pentanone	11 UR	---
2-Hexanone	11 UR	---
Tetrachloroethene	5 UR	---
1,1,2,2-Tetrachloroethane	5 UR	---
Toluene	5 UR	5

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - VOLATILE ORGANIC DATA (Continued)

AREA	TSA	TSA
LOCATION	VER: VOC DET	TSA
TYPE OF LOCATION	BIASED	COMPOSITE/DRUM
SAMPLE NUMBER	TSA1510V	TSA2201V
MEDIA	SOIL	WATER
UNITS	ug/kg	ug/L
SDG NUMBER	TSA1403V	TSA1403V
Chlorobenzene	5 UR	---
Ethylbenzene	5 UR	---
Styrene	5 UR	---
Xylene (total)	5 UR	---
Dilution Factor	1.000	1.000
Total (Allowed) Hold Time	36(14)d*	9(14)d

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - VOLATILE ORGANIC REPLICATE DATA

AREA	TSA
LOCATION	QC
TYPE OF LOCATION	REPLICATE
SAMPLE NUMBER	TSA1901V
MEDIA	SOIL
UNITS	ug/kg
SDG NUMBER	TSA1403V
FIELD MEASUREMENTS	
Depth (ft)	3-4.5
TARGET COMPOUNDS	
Chloromethane	11 UR
Bromomethane	11 UR
Vinyl Chloride	11 UR
Chloroethane	11 UR
Methylene Chloride	5 UR
Acetone	11 UR
Carbon Disulfide	5 UR
1,1-Dichloroethene	5 UR
1,1-Dichloroethane	5 UR
1,2-Dichloroethene_(total)	5 UR
Chloroform	5 UR
1,2-Dichloroethane	5 UR
2-Butanone	11 UR
1,1,1-Trichloroethane	5 UR
Carbon Tetrachloride	5 UR
Vinyl Acetate	11 UR
Bromodichloromethane	5 UR
1,2-Dichloropropane	5 UR
cis-1,3-Dichloropropene	5 UR
Trichloroethene	5 UR
Dibromochloromethane	5 UR
1,1,2-Trichloroethane	5 UR
Benzene	5 UR
Trans-1,3-Dichloropropene	5 UR
Bromoform	5 UR
4-Methyl-2-Pentanone	11 UR
2-Hexanone	11 UR
Tetrachloroethene	5 UR
1,1,2,2-Tetrachloroethane	5 UR
Toluene	5 UR

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - VOLATILE ORGANIC REPLICATE DATA (Continued) Page 2 of 2

AREA	TSA
LOCATION	QC
TYPE OF LOCATION	REPLICATE
SAMPLE NUMBER	TSA1901V
MEDIA	SOIL
UNITS	ug/kg
SDG NUMBER	TSA1403V
Chlorobenzene	5 UR
Ethylbenzene	5 UR
Styrene	5 UR
Xylene (total)	5 JX
Dilution Factor	1.000
Total (Allowed) Hold Time	36(14)d*

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - VOLATILE ORGANIC RINSATE DATA

Page 1 of 1

AREA	TSA
LOCATION	QC
TYPE OF LOCATION	RINSATE
SAMPLE NUMBER	TSA2001VR
MEDIA	WATER
UNITS	ug/L
SDG NUMBER	TSA1401VW
TARGET COMPOUNDS	
Chloroform	37
Xylene (total)	4 J
Dilution Factor	1.000
Total (Allowed) Hold Time	11(14)d

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - VOLATILE ORGANIC TRIP BLANK DATA

AREA	TSA	TSA	TSA	TSA	TSA
LOCATION	QC	QC	QC	QC	QC
TYPE OF LOCATION	TRIP BLANK	TRIP BLANK	TRIP BLANK	TRIP BLANK	TRIP BLANK
SAMPLE NUMBER	TSA2101VT	TSA2102VT	TSA2103VT	TSA2103VT	TSA2104VT
MEDIA	WATER	WATER	WATER	WATER	WATER
UNITS	ug/L	ug/L	ug/L	ug/L	ug/kg
SDG NUMBER	TSA1401VW	TSA1401VW	TSA1403V	TSA2103VT	TSA1403V
TARGET COMPOUNDS					
Chloromethane	10 UJ	---	10 UR	---	---
Bromomethane	10 UJ	---	10 UR	---	---
Vinyl Chloride	10 UJ	---	10 UR	---	---
Chloroethane	10 UJ	---	10 UR	---	---
Methylene Chloride	5 UJ	---	1 J	---	1 J
Acetone	10 UJ	---	10 UR	---	---
Carbon Disulfide	5 UJ	---	5 UR	---	---
1,1-Dichloroethene	5 UJ	---	5 UR	---	---
1,1-Dichloroethane	5 UJ	---	5 UR	---	---
1,2-Dichloroethene_(total)	5 UJ	---	5 UR	---	---
Chloroform	44 J	46	30 J	37	33
1,2-Dichloroethane	5 UJ	---	5 UR	---	---
2-Butanone	10 UJ	---	10 UR	---	---
1,1,1-Trichloroethane	5 UJ	---	5 UR	---	---
Carbon Tetrachloride	5 UJ	---	5 UR	---	---
Vinyl Acetate	10 UJ	---	10 UR	---	---
Bromodichloromethane	5 UJ	---	5 UR	---	---
1,2-Dichloropropane	5 UJ	---	5 UR	---	---
cis-1,3-Dichloropropene	5 UJ	---	5 UR	---	---
Trichloroethene	5 UJ	---	5 UR	---	---
Dibromochloromethane	5 UJ	---	5 UR	---	---
1,1,2-Trichloroethane	5 UJ	---	5 UR	---	---
Benzene	5 UJ	---	5 UR	---	---
Trans-1,3-Dichloropropene	5 UJ	---	5 UR	---	---
Bromoform	5 UJ	---	5 UR	---	---
4-Methyl-2-Pentanone	10 UJ	---	10 UR	---	---
2-Hexanone	10 UJ	---	10 UR	---	---
Tetrachloroethene	5 UJ	---	5 UR	---	---
1,1,2,2-Tetrachloroethane	5 UJ	---	5 UR	---	---
Toluene	5 UJ	---	5 UR	---	---

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - VOLATILE ORGANIC TRIP BLANK DATA (Continued)

Page 2 of 2

AREA	TSA	TSA	TSA	TSA	TSA
LOCATION	QC	QC	QC	QC	QC
TYPE OF LOCATION	TRIP BLANK	TRIP BLANK	TRIP BLANK	TRIP BLANK	TRIP BLANK
SAMPLE NUMBER	TSA2101VT	TSA2102VT	TSA2103VT	TSA2103VT	TSA2104VT
MEDIA	WATER	WATER	WATER	WATER	WATER
UNITS	ug/L	ug/L	ug/L	ug/L	ug/kg
SDG NUMBER	TSA1401VW	TSA1401VW	TSA1403V	TSA2103VT	TSA1403V
Chlorobenzene	5 UJ	---	5 UR	---	---
Ethylbenzene	5 UJ	---	5 UR	---	---
Styrene	5 UJ	---	5 UR	---	---
Xylene (total)	5 UJ	---	5 UR	---	---
Dilution Factor	1.000	1.000	1.000	1.000	1.000
Total (Allowed) Hold Time	26(14)d*	12(14)d	21(14)d*	6(14)d	9(14)d

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - INORGANIC DATA

AREA LOCATION TYPE OF LOCATION SAMPLE NUMBER MEDIA UNITS SDG NUMBER	TSA BACKGROUND BIASED TSA1301M SOIL mg/kg TSA1301M	TSA BACKGROUND BIASED TSA1302M SOIL mg/kg TSA1301M	TSA BACKGROUND BIASED TSA1303M SOIL mg/kg TSA1301M	TSA BACKGROUND BIASED TSA1304M SOIL mg/kg TSA1301M	TSA BACKGROUND BIASED TSA1305M SOIL mg/kg TSA1301M	TSA BACKGROUND BIASED TSA1306M SOIL mg/kg TSA1301M
FIELD MEASUREMENTS						
Depth (ft)	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5
ANALYTES						
Aluminum	19400	17800	17400	15200	15700	14700
Antimony	19.4 BNJ	28.1 BNJ	21.5 BNJ	27.3 BNJ	15.1 BNJ	21.8 BNJ
Arsenic	18.5 BJ	17.1 UUJ	17.1 UUJ	17.1 UUJ	17.1 UUJ	18.3 BJ
Barium	248	261	285	295	233	214
Beryllium	1.4	1.4	2.2	1.4	1.4	1.3
Cadmium	1.8 BNUJ	1.5 BNUJ	1.4 BNUJ	1.0 BNUJ	1.6 BNUJ	1.7 BNUJ
Calcium	73200	76600	158000	72900	80000	59900
Chromium	34.0	33.7	28.1	31.1	32.6	33.4
Cobalt	14.1	12.8	15.0	11.7	13.0	11.3
Copper	17.4	11.4	0.85 BU	10.5	9.7	12.4
Cyanide						
Iron	22600 J	20700 J	17000 J	19400 J	19400 J	19800 J
Lead	15.6	13.9	11.5	12.2	13.8	15.5
Magnesium	12900 J	13400 J	13800 J	13700 J	13800 J	13500 J
Manganese	548	477	331	418	390	411
Mercury	0.05 BU	0.03 BU	0.04 BU	0.04 BU	0.04 BU	0.04 BU
Nickel	27.4	27.5	21.3	27.9	26.5	27.5
Potassium	2730	2630	2500	2560	2750	2300
Selenium	18.9 BJ	18.4 UUJ	18.4 UUJ	18.4 UUJ	18.4 UUJ	18.3 UUJ
Silver	0.60 BNUJ	1.8 BNUJ	1.8 BNUJ	0.60 BNUJ	0.60 BNUJ	0.59 UNUJ
Sodium	978 B	1470	1040	1290	815 B	433 B
Thallium	38.0 BUJ	37.3 BUJ	29.3 BUJ	3.2 UUJ	45.8 BUJ	30.0 BUJ
Vanadium	37.0	37.3	31.9	38.8	40.8	38.0
Zinc	67.6 EJ	63.2 EJ	50.8 EJ	64.5 EJ	62.7 EJ	64.7 EJ
% Solids	83.2	83.4	78.1	83.5	82.5	84.0
Total (Allowed) Hold Time[a]	19(180)d	19(180)d	19(180)d	19(180)d	19(180)d	19(180)d
Total (Allowed) Hold Time[b]	14(26)d	14(26)d	14(26)d	14(26)d	14(26)d	14(26)d
Total (Allowed) Hold Time[c]	21(180)d	21(180)d	21(180)d	21(180)d	21(180)d	21(180)d

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a. ICP
b. CVAAS
c. GFAAS

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - INORGANIC DATA (Continued)

Page 2 of 4

AREA LOCATION TYPE OF LOCATION SAMPLE NUMBER MEDIA UNITS SDG NUMBER	TSA BACKGROUND BIASED TSA1307M SOIL mg/kg TSA1301M	TSA BACKGROUND BIASED TSA1308M SOIL mg/kg TSA1301M	TSA BACKGROUND BIASED TSA1309M SOIL mg/kg TSA1301M	TSA BACKGROUND BIASED TSA1310M SOIL mg/kg TSA1301M	TSA VER: NO VOC DET BIASED TSA1401M SOIL mg/kg TSA1401M	TSA VER: NO VOC DET BIASED TSA1402M SOIL mg/kg TSA1401M
FIELD MEASUREMENTS						
Depth (ft)	0-0.5	0-0.5	0-0.5	0-0.5	14-14.5	7.5-8.5
ANALYTES						
Aluminum	15500	18200	20200	19800	21800	17800
Antimony	24.1 BNJ	27.0 BNJ	25.4 BNJ	27.7 BNJ	33.9 NJ	21.0 BNJ
Arsenic	30.3 BJ	17.0 UUJ	17.0 UUJ	17.0 UUJ	20.4 BJ	17.2 UUJ
Barium	239	260	337	328	309	260
Beryllium	1.2	1.8	2.2	2.2	1.4	0.92 B
Cadmium	1.5 BNUJ	1.5 BNUJ	1.8 BNUJ	1.3 BNUJ	1.5 BU	1.9 BU
Calcium	55400	119000	153000	148000	51300	31100
Chromium	39.2	35.3	34.5	33.6	37.5	33.1
Cobalt	15.7	9.4 B	13.7	12.2	16.7 UJ	14.8 UJ
Copper	12.8	6.7	5.3 U	45.1	18.2 *J	20.2 *J
Cyanide						
Iron	20500 J	19500 J	20000 J	19600 J	25200	23800
Lead	15.5	15.0	14.1	16.8	18.1	16.9
Magnesium	13700 J	13100 J	14800 J	14500 J	11900 J	10200 J
Manganese	466	359	361	330	502	493
Mercury	0.04 BU	0.04 BU	0.04 BU	0.04 BU	0.03 UJ	0.04 U
Nickel	29.3	24.3	30.3	31.0	31.1	30.1
Potassium	2570	3150	3950	3840	4250	3220
Selenium	18.4 UUJ	18.2 UUJ	18.3 UUJ	18.3 UUJ	18.3 UUJ	18.5 UUJ
Silver	1.8 BNUJ	0.59 UNUJ	0.60 BNUJ	0.59 UNUJ	1.8 BNUJ	2.2 BNUJ
Sodium	432 B	399 B	369 B	362 B	450 B	733 B
Thallium	24.3 BUJ	45.2 BUJ	33.9 BUJ	51.8 BUJ	13.3 BUJ	7.2 BUJ
Vanadium	40.0	33.6	34.3	33.8	40.6	34.3
Zinc	66.5 EJ	62.4 EJ	70.6 EJ	95.9 EJ	96.9 EJ	84.4 EJ
% Solids	83.3	78.8	72.8	74.6	82.9	89.2
Total (Allowed) Hold Time[a]	19(180)d	19(180)d	19(180)d	19(180)d	54(180)d	41(180)d
Total (Allowed) Hold Time[b]	14(26)d	14(26)d	14(26)d	14(26)d	28(26)d*	15(26)d
Total (Allowed) Hold Time[c]	21(180)d	21(180)d	21(180)d	21(180)d	67(180)d	54(180)d

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a. ICP
b. CVAAS
c. GFAAS

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - INORGANIC DATA (Continued)

Page 3 of 4

AREA	TSA	TSA	TSA	TSA	TSA	TSA
LOCATION	VER: NO VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET
TYPE OF LOCATION	BIASED	BIASED	BIASED	BIASED	BIASED	BIASED
SAMPLE NUMBER	TSA1403M	TSA1501M	TSA1502M	TSA1503M	TSA1504M	TSA1505M
MEDIA	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SDG NUMBER	TSA1301M	TSA1401M	TSA1401M	TSA1401M	TSA1401M	TSA1401M
FIELD MEASUREMENTS						
Depth (ft)	8-9	8-8.5	17-17.5	17-17.5	8.5-9.5	7-8
ANALYTES						
Aluminum	18100	14400	22000	19800	23600	18200
Antimony	28.6 BNJ	16.1 BNJ	13.5 BNJ	25.2 BNJ	41.1 NJ	26.5 BNJ
Arsenic	33.7 BJ	11.2 UUJ	17.0 UUJ	16.9 UUJ	17.2 UUJ	17.1 UUJ
Barium	263	176	265	269	312	277
Beryllium	1.2	0.87	1.3	1.2	1.4	1.1
Cadmium	1.4 BNUJ	1.3 BU	2.2 BU	1.0 BU	1.7 BU	2.0 BU
Calcium	51000	28500	40200	41500	50500	48300
Chromium	35.3	25.2	36.4	37.0	35.2	32.9
Cobalt	14.9	10.7 UJ	13.2 UJ	15.8 UJ	15.5 UJ	13.0 UJ
Copper	33.2	16.4 *J	28.3 *J	19.4 *J	17.6 *J	16.7 *J
Cyanide						
Iron	23300 J	16900	25800	24800	24200	22600
Lead	17.8	20.7	16.5	19.2	19.6	19.2
Magnesium	11700 J	13100 J	11600 J	12000 J	12500 J	11600 J
Manganese	465	403	541	513	641	449
Mercury	0.04 BU	0.03 UJ	0.03 UJ	0.03 UJ	0.3 U	0.3 U
Nickel	33.2	30.5	35.1	32.2	30.6	27.9
Potassium	3490	4070	4610	3970	3900	3000 E
Selenium	18.1 UUJ	18.4 UUJ	18.3 UUJ	18.2 UUJ	18.5 UUJ	18.5 UUJ
Silver	0.59 BNUJ	2.0 BNUJ	0.59 BNUJ	0.59 BNUJ	1.8 BNUJ	2.2 BNUJ
Sodium	543 B	878 B	588 B	623 B	281 B	834 B
Thallium	37.1 BUJ	32.1 BUJ	23.6 BUJ	31.8 BUJ	29.4 BUJ	27.5 BUJ
Vanadium	38.6	39.3	41.2	40.7	39.1	33.3
Zinc	97.7 EJ	99.8 EJ	105 EJ	102 EJ	95.5 EJ	86.8 EJ
% Solids	89.2	84.8	88.1	83.6	89.4	86.0
Total (Allowed) Hold Time[a]	20(180)d	54(180)d	54(180)d	54(180)d	41(180)d	41(180)d
Total (Allowed) Hold Time[b]	15(26)d	28(26)d*	28(26)d*	28(26)d*	15(26)d	15(26)d
Total (Allowed) Hold Time[c]	22(180)d	67(180)d	67(180)d	67(180)d	54(180)d	54(180)d

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a. ICP
b. CVAAS
c. GFAAS

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - INORGANIC DATA (Continued)

AREA	TSA	TSA	TSA	TSA	TSA	TSA
LOCATION	VER: VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET	TSA
TYPE OF LOCATION	BIASED	BIASED	BIASED	BIASED	BIASED	COMPOSITE/DRUM
SAMPLE NUMBER	TSA1506M	TSA1507M	TSA1508M	TSA1509M	TSA1510M	TSA2201M
MEDIA	SOIL	SOIL	SOIL	SOIL	SOIL	WATER
UNITS	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	ug/L
SDG NUMBER	TSA1301M	TSA1301M	TSA1301M	TSA1301M	TSA1301M	TSA2201M
FIELD MEASUREMENTS						
Depth (ft)	3.5-4.5	4-5	3-4	3-4.5	3.5-4.5	-
ANALYTES						
Aluminum	24400	24500	19000	18300	22000	37900
Antimony	28.1 BNJ	15.9 BNJ	28.9 BNJ	21.8 BNJ	15.3 BNJ	65.0 B
Arsenic	16.8 UUJ	17.1 UUJ	17.0 UUJ	17.0 UUJ	17.2 UUJ	85.9 UUJ
Barium	326	401	282	278	264	545
Beryllium	1.4	1.4	0.84 B	0.87 B	0.89 B	2.9 BU
Cadmium	1.8 BNUJ	1.4 BNUJ	1.2 BNUJ	3.5 BNUJ	1.4 BNUJ	5.8 BU
Calcium	52700	53200	28900	33400	30800	115000
Chromium	38.8	40.5	30.9	34.1	38.4	107 NJ
Cobalt	17.6	23.9	13.3	19.5	14.5	29.0 BU
Copper	21.5	22.7	20.0	17.4	17.7	53.9
Cyanide						
Iron	25800 J	26500 J	24600 J	24400 J	24800 J	39300
Lead	17.6	19.1	14.9	15.6	15.2	85.9 BJ
Magnesium	12700 J	12800 J	9800 J	10200 J	10400 J	21800
Manganese	732	1230	537	488	158	1050
Mercury	0.04 BU	0.03 BU	0.03 BU	0.03 BU	0.04 BU	---
Nickel	32.2	36.3	29.9	27.6	26.2	107
Potassium	4040	4340	2910	2970	3310	8290
Selenium	18.0 UUJ	18.4 UUJ	18.3 UUJ	23.2 BJ	18.5 UUJ	92.5 UUJ
Silver	0.58 UNUJ	0.60 BNUJ	0.60 BNUJ	1.8 BNUJ	0.60 BNUJ	9.1 BNUJ
Sodium	317 B	488 B	696 B	980 B	863 B	50400
Thallium	14.5 BUJ	31.1 BUJ	24.2 BUJ	23.0 BUJ	27.4 BUJ	---
Vanadium	40.4	44.6	30.7	32.4	41.6	96.6
Zinc	87.6 EJ	89.9 EJ	82.0 EJ	79.8 EJ	75.1 EJ	260 EJ
% Solids	88.2	88.7	90.3	92.0	92.0	
Total (Allowed) Hold Time[a]	20(180)d	20(180)d	20(180)d	20(180)d	20(180)d	23(180)d
Total (Allowed) Hold Time[b]	15(26)d	15(26)d	15(26)d	15(26)d	15(26)d	14(26)d
Total (Allowed) Hold Time[c]	22(180)d	22(180)d	22(180)d	22(180)d	22(180)d	15(180)d

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a. ICP
b. CVAAS
c. GFAAS

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - INORGANIC FIELD BLANK DATA

Page 1 of 1

AREA	TSA
LOCATION	QC
TYPE OF LOCATION	FIELD BLANK
SAMPLE NUMBER	TSA1801MF
MEDIA	WATER
UNITS	ug/L
SDG NUMBER	TSA1801MF
ANALYTES	
Aluminum	---
Antimony	---
Arsenic	85.9 UJ
Barium	5.4 BU
Beryllium	---
Cadmium	---
Calcium	68.6 BU
Chromium	---
Cobalt	---
Copper	---
Cyanide	
Iron	6.2 BU
Lead	2.0 BU
Magnesium	42.2 BU
Manganese	6.3 BUJ
Mercury	0.08 BU
Nickel	---
Potassium	---
Selenium	92.5 UJ
Silver	23.3 BNJ
Sodium	225 BU
Thallium	16.3 UJ
Vanadium	---
Zinc	13.7 BU
Total (Allowed) Hold Time[a]	26(180)d
Total (Allowed) Hold Time[b]	14(26)d
Total (Allowed) Hold Time[c]	19(180)d

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a. ICP
b. CVAAS
c. GFAAS

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - INORGANIC REPLICATE DATA

Page 1 of 1

AREA	TSA
LOCATION	QC
TYPE OF LOCATION	REPLICATE
SAMPLE NUMBER	TSA1901M
MEDIA	SOIL
UNITS	mg/kg
SDG NUMBER	TSA1301M
FIELD MEASUREMENTS	
Depth (ft)	3-4.5
ANALYTES	
Aluminum	20800
Antimony	28.9 BNJ
Arsenic	17.0 UUJ
Barium	287
Beryllium	0.94 B
Cadmium	2.5 BNUJ
Calcium	39400
Chromium	37.4
Cobalt	16.8
Copper	17.2
Cyanide	
Iron	24300 J
Lead	14.5
Magnesium	10700 J
Manganese	536
Mercury	0.04 BU
Nickel	28.9
Potassium	3460
Selenium	27.3 BJ
Silver	0.59 UNUJ
Sodium	954 B
Thallium	10.1 BUJ
Vanadium	38.4
Zinc	77.4 EJ
% Solids	91.8
Total (Allowed) Hold Time[a]	20(180)d
Total (Allowed) Hold Time[b]	15(26)d
Total (Allowed) Hold Time[c]	22(180)d

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a. ICP
b. CVAAS
c. GFAAS

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - INORGANIC RINSATE DATA

AREA	TSA
LOCATION	QC
TYPE OF LOCATION	RINSATE
SAMPLE NUMBER	TSA2001MR
MEDIA	WATER
UNITS	ug/L
SDG NUMBER	TSA1801MF
ANALYTES	
Aluminum	---
Antimony	---
Arsenic	85.9 UJ
Barium	4.6 BU
Beryllium	---
Cadmium	3.0 BU
Calcium	136 B
Chromium	---
Cobalt	---
Copper	2.5 BU
Cyanide	
Iron	9.2 BU
Lead	2.2 BU
Magnesium	83.2 BU
Manganese	2.0 BUJ
Mercury	0.08 BU
Nickel	---
Potassium	---
Selenium	92.5 UJ
Silver	3.2 BNJ
Sodium	292 BU
Thallium	16.3 UJ
Vanadium	---
Zinc	12.3 BU
Total (Allowed) Hold Time^a	26(180)d
Total (Allowed) Hold Time^b	14(26)d
Total (Allowed) Hold Time^c	19(180)d

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a. ICP
b. CVAAS
c. GFAAS

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - PCB DATA

Page 1 of 3

AREA	TSA	TSA	TSA	TSA	TSA	TSA
LOCATION	VER: NO VOC DET	VER: NO VOC DET	VER: NO VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET
TYPE OF LOCATION	BIASED	BIASED	BIASED	BIASED	BIASED	BIASED
SAMPLE NUMBER	TSA1401B	TSA1402B	TSA1403B	TSA1501B	TSA1502B	TSA1503B
MEDIA	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
SDG NUMBER	TSA1401B	TSA1402B	TSA1403B	TSA1401B	TSA1401B	TSA1401B
FIELD MEASUREMENTS						
Depth (ft)	14-14.5	7.5-8.5	8-9	8-8.5	17-17.5	17-17.5
TARGET COMPOUNDS						
None detected.						
Total (Allowed) Hold Time	8(14)d	8(14)d	13(14)d	8(14)d	8(14)d	8(14)d
Dilution Factor	1.0	1.0	1.0	1.0	1.0	1.0

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - PCB DATA (Continued)

Page 2 of 3

AREA	TSA	TSA	TSA	TSA	TSA	TSA
LOCATION	VER: VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET	VER: VOC DET
TYPE OF LOCATION	BIASED	BIASED	BIASED	BIASED	BIASED	BIASED
SAMPLE NUMBER	TSA1504B	TSA1505B	TSA1506B	TSA1507B	TSA1508B	TSA1509B
MEDIA	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
UNITS	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
SDG NUMBER	TSA1402B	TSA1402B	TSA1403B	TSA1403B	TSA1403B	TSA1403B
FIELD MEASUREMENTS						
Depth (ft)	8.5-9.5	7-8	3.5-4.5	4-5	3-4	3-4.5
TARGET COMPOUNDS						
None detected.						
Total (Allowed) Hold Time	8(14)d	8(14)d	13(14)d	13(14)d	13(14)d	13(14)d
Dilution Factor	1.0	1.0	1.0	1.0	1.0	1.0

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - PCB DATA (Continued)

Page 3 of 3

AREA	TSA	TSA
LOCATION	VER: VOC DET	TSA
TYPE OF LOCATION	BIASED	COMPOSITE/DRUM
SAMPLE NUMBER	TSA1510B	TSA2201B
MEDIA	SOIL	WATER
UNITS	ug/kg	ug/L
SDG NUMBER	TSA1403B	TSA2201B
FIELD MEASUREMENTS		
Depth (ft)	3.5-4.5	-
TARGET COMPOUNDS		
None detected.		
Total (Allowed) Hold Time	13(14)d	9(7)d
Dilution Factor	1.0	1.0

TABLE _._._ TSA SOIL OVERBURDEN SAMPLING - PCB REPLICATE DATA

AREA	TSA
LOCATION	QC
TYPE OF LOCATION	REPLICATE
SAMPLE NUMBER	TSA1901B
MEDIA	SOIL
UNITS	ug/kg
SDG NUMBER	TSA1403B
FIELD MEASUREMENTS	
Depth (ft)	3-4.5
TARGET COMPOUNDS	
None detected.	
Total (Allowed) Hold Time	13(14)d
Dilution Factor	1.0

APPENDIX E

LABORATORY REPORT FROM THE RML

EG&G Idaho
"Providing research and development services to the government"

INTEROFFICE CORRESPONDENCE

Date: May 10, 1991

To: R. G. Schwaller, MS 140

From: T. J. Haney, MS 7111

Subject: GAMMA ANALYSIS OF SIXTEEN TSA SOIL OVERBURDEN SAMPLES-TJH-47-91

Fourteen soil samples and two water samples from the TSA Soil Overburden study were submitted to the Radiation Measurements Laboratory (RML) for an analysis to determine whether any gamma-ray-emitting radionuclide contaminants were present. The soils were counted in a 500 cm^3 squat jar soil geometry for two hours and the water samples were counted for sixteen hours in a 540 ml liquid bottle geometry. The samples were counted on RML gamma spectrometers and were analyzed by the gamma-spectrometric analysis program VAX/CBAT. The results are reported on the attached Table 1.

It should be noted that Cs-137 exists in surface soils (~top 5cm) due to fallout. Typical concentrations are approximately .8 pCi/gm, but can vary by a factor of two. The "1986 Environmental Monitoring Program Report for the Idaho National Engineering Laboratory (DOE/ID-12082 [86])", prepared by RESL is an excellent reference for information related to background radioactivities found in both on and off-site soils.

The analysis results were carefully examined by experienced and trained gamma spectroscopists. The results reported are those radionuclide results which were found by the analyst to be true-positive and "real" according to criteria found in RML Procedure DM-1: "Evaluation and Verification of Data for Radionuclide Identification/Selection."

The total uncertainty reported for gamma-emitters includes the statistical uncertainty and the estimate of the uncertainty in the sample geometry (5%) and in the detector efficiency (5%). The uncertainties were propagated in quadrature and are expressed as one standard deviation.

vax

cc: J. R. Bishoff
E. W. Killian
L. D. Koeppen
W. R. Paskey
C. L. Rowsell
E. R. Spruill
Central Files
T. J. Haney File

Table 1

RML GAMMA-RAY ANALYSIS RESULTS OF TSA SOIL OVERBURDEN SAMPLES

Sample ID	RML ID	Manmade Radionuclides	Activity (T) (pCi/gm)
TSA1401G	D2040391025	None Detected	N/A
TSA1402G	D1041291030	None Detected	N/A
TSA1403G	D3042591024	None Detected	N/A
TSA1501G	D1040391024	Cs-137	(1.1±.3)E-01
TSA1502G	D2040391022	Cs-137	(1.2±.2)E-01
TSA1503G	D1040391022	None Detected	N/A
TSA1504G	D1041591025	None Detected	N/A
TSA1505G	D2041291031	None Detected	N/A
TSA1506G	D2042591023	None Detected	N/A
TSA1507G	D1042591022	None Detected	N/A
TSA1508G	D3042691028	None Detected	N/A
TSA1509G	D3042591034	Cs-137	(4.0±.8)E-02
TSA1510G	D1042591028	None Detected	N/A
TSA1901G	D1042691027	None Detected	N/A

RML GAMMA RAY ANALYSIS RESULTS OF TSA SOIL OVERBURDEN LIQUID SAMPLES

Sample Id	RML Id	Manmade Radionuclides	Activity (T) (pCi/ml)
TSA2001GR	A6041591032	None Detected	N/A
TSA2201G	A5050691035	None Detected	N/A