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ORIGINAL

LITIGATION TECHNICAL SUPPC

ROCKY MOUNTAIN ARSENAL

FINAL

TECHNICAL PLAN

MARCH 1986

TASK NO. 11

HYDRAZINE BLENDING AND STORAGE FACILITY

CONTRACT NO. DAAK11-84-D-0017

EBASCO SERVICES INCORPORATED

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THE OBJECTIVE OF TASK 11 IS TO CONDUCT A CONTAMINATION SURVEY OF THE SOIL AND GROUND WATER IN THE VICINITY OF THE HBSF THAT WILL PROVIDE INFORMATION NECESSARY TO ASSESS THE NATURE AND EXTENT OF CONTAMINATION. THE TECHNICAL PLAN HAS BEEN DEVELOPED TO PROVIDE PERTINENT INFORMATION FOR 1) THE PREPARATION OF AN RCRA CLOSURE PLAN, WHICH REQUIRES CONTINUED GROUND WATER MONITORING, AND 2) THE OVERALL ASSESSMENT OF THE EXTENT OF THE CONTAMINATION AT RMA. THIS TECHNICAL PLAN PROVIDES RECOMMENDATIONS FOR AUGMENTING THE EXISTING MONITORING NETWORKS ALONG WITH A DESCRIPTION OF THE PROPOSED FIELD SAMPLING PROGRAM FOR TASK 11.

SECTIONS OF THIS PLAN DETAIL INFORMATION ON THE FOLLOWING PROGRAMS:

1. FIELD SAMPLING
2. CHEMICAL ANALYSIS
3. QUALITY ASSURANCE
4. DATA COMPILATION AND MANAGEMENT

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FINAL

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1.0 INTRODUCTION

1.1 Background

The Program Managers Office (PMO) for Rocky Mountain Arsenal (RMA) is overseeing efforts by two contractor teams to identify the contamination present at selected locations on Rocky Mountain Arsenal. This Technical Plan describes the work that the contractor team, headed by Ebasco Services, Incorporated, will undertake in Task 11 at the Hydrazine Blending and Storage Facility (HBSF) at RMA (site 1-7).

1.1.1 Physical Description of the HBSF

The HBSF is located east of the South Plants area in Section 1 (Figure 1.1-1). The layout of the facility is illustrated in Figure 1.1-2. The total area of site 1-7 is approximately 775,000 square feet. The HBSF consists of two yards surrounded by double fences. The yards are connected by overhead pipelines. The west yard contains loading and unloading facilities for rail cars and tank trucks, blending facilities, and drum cleaning and washing areas. The east yard contains additional storage facilities for unsymmetrical dimethyl hydrazine (UDMH), but these facilities currently contain waste water. The east and west yards are approximately 103,000 square feet and 346,000 square feet in area, respectively.

The HBSF is located on the east end of a bedrock (Denver Formation) high that has a thin alluvial cover that is 10 to 20 feet thick. The alluvium consists of silt and silty sand. The bedrock consists of clay shale and silty clay shale.

The HBSF is almost entirely in the First Creek drainage system, which flows south to north on the east edge of the Arsenal. The tank storage areas are contained by eight foot concrete retaining walls, and the current drum washing facilities and buildings at HBSF are lined. Surface water runoff contained or collected in these areas is channeled through an underground sewer to a concrete sump in the south central portion of the west yard

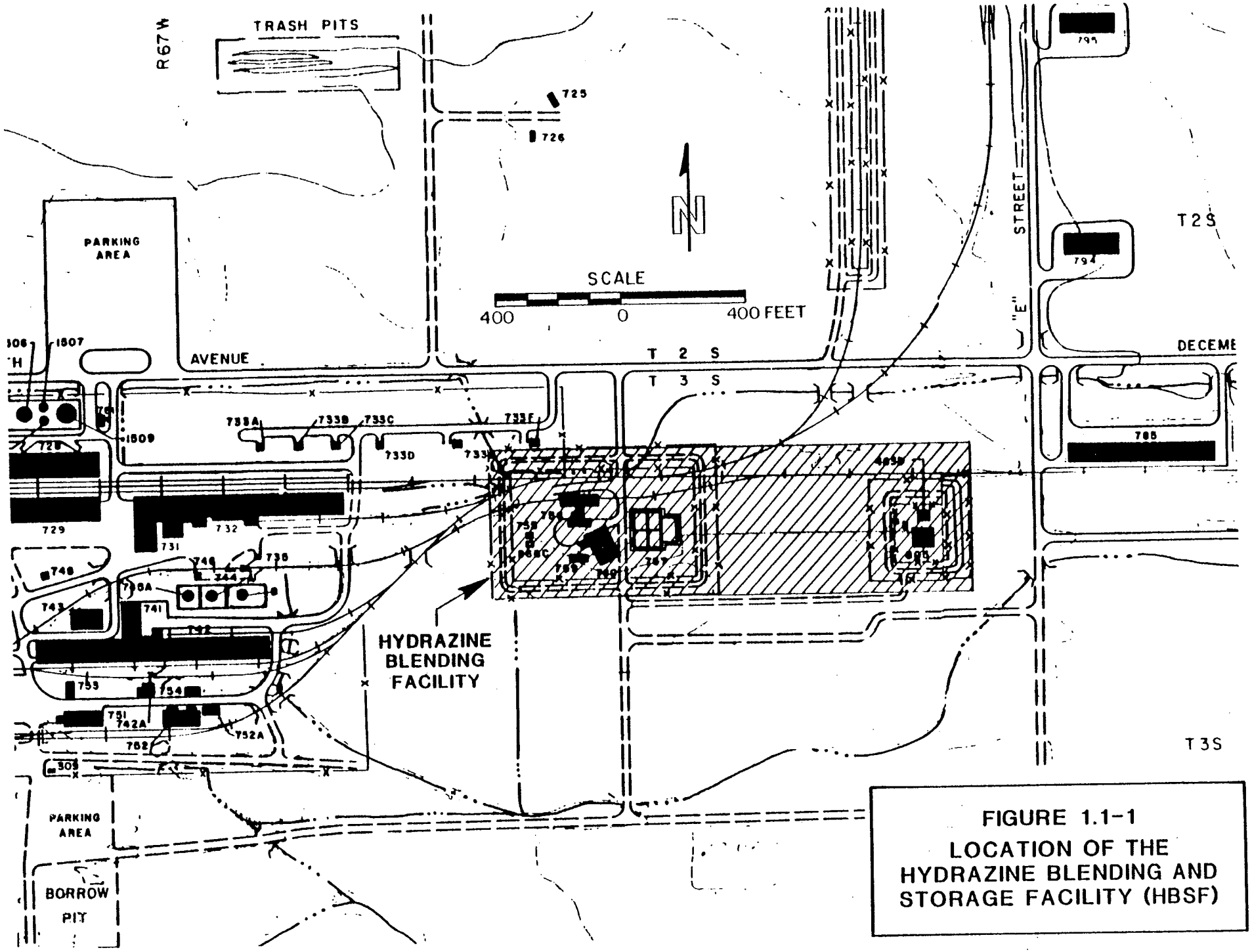
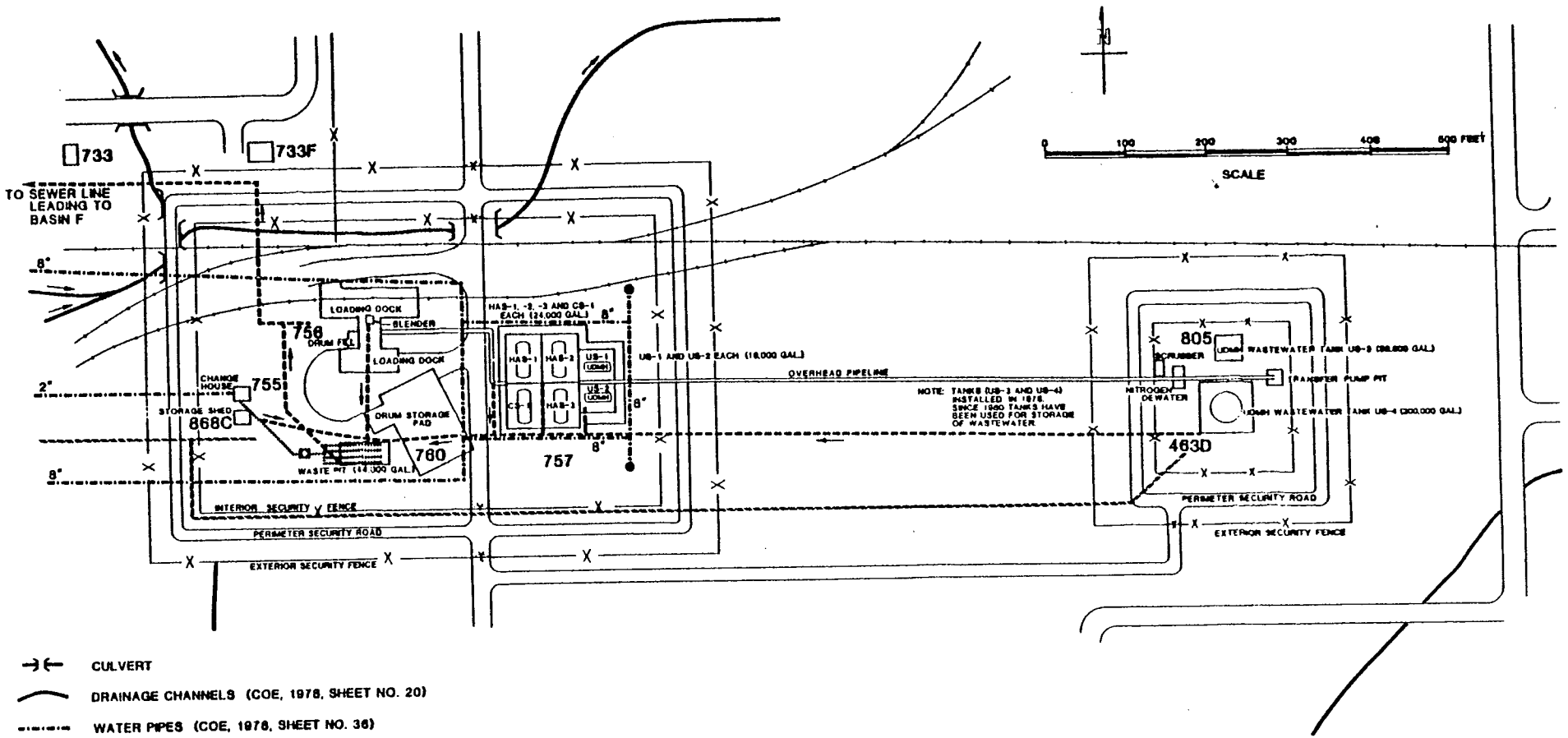


FIGURE 1.1-1
LOCATION OF THE HYDRAZINE BLENDING AND STORAGE FACILITY (HBSF)



CULVERT

DRAINAGE CHANNELS (COE, 1976, SHEET NO. 20)

WATER PIPES (COE, 1976, SHEET NO. 36)

UNDERGROUND SEWERS/SEPTIC SYSTEM (COE, 1976, SHEET NO. 37)

CONTAMINATED WASTE PIPELINES (COE, 1976, SHEET NO. 38)

OVERHEAD ELECTRICAL LINES (COE, 1976, SHEET NO. 41)

DRAINAGE DIRECTION

FIGURE 1.1-2
SCHEMATIC LAYOUT
HYDRAZINE BLENDING AND
STORAGE FACILITY
ROCKY MOUNTAIN ARSENAL

(Figure 1.1-1) where it is treated. The wastewater is then stored in the large tanks in the eastyard. Surface runoff from the remainder of the facility flows to the local drainage system and, eventually, to First Creek.

Groundwater in both the alluvium and the Upper Denver Formation apparently flows northeast from the HBSF away from the groundwater mound in the South Plants area. Confirmation of the perceived direction of groundwater flow will be obtained during the field investigation. There are 10 monitoring wells recorded within 500 feet of the HBSF, although only 4 of these wells are potentially suitable for use in this program because of the way in which they were constructed. The depths to water recorded in these wells range from 12 to 18 feet below land surface. The water table is generally in the Upper Denver Formation, though perched water tables have been found in the alluvium in the area.

1.1.2 History of the HBSF

The HBSF is owned by the U.S. Air Force and was operated by RMA between 1962 and 1982. The west yard was constructed in 1961 and the east yard in 1976. The HBSF has been used to receive, blend, store and distribute hydrazine fuels. The primary operation was the blending of anhydrous hydrazine and UDMH to produce Aerozine 50. The materials were manufactured elsewhere and shipped to RMA for blending. Blending operations were not continuous and occurred in response to requests by the U.S. Air Force.

Hydrazine and UDMH are ignitable, corrosive and toxic. They are unstable in the natural environment and when exposed to the atmosphere, decompose rapidly unless they are in extremely dilute solutions. One of the decomposition products/contaminants is N-nitrosodimethylamine (NDMA), a suspected carcinogen. In October and November 1978, a U.S. Air Force study found NDMA present in low concentrations in the HBSF plant. Procedures were developed and tested to protect workers from exposure and to reduce the occurrence of NDMA. During January - March 1982, OSHA surveyed the HBSF and found that the potential for exposure still existed. In May 1982, RMA ceased operations and closed the HBSF to all but safety-essential or emergency-response entries.

In July 1982, EPA Region VIII requested RMA to submit an RCRA Part B permit application for several hazardous waste facilities including the HBSF. RMA submitted a draft RCRA Part B application to EPA Region VIII in May 1983. A Notice of Deficiency for the draft RCRA Part B application was issued in May 1984 by EPA Region VIII.

The State of Colorado received interim authorization from the EPA in September 1984, to administer RCRA equivalent state hazardous waste regulations in lieu of federal requirements. Under state regulations the RCRA Part B application was resubmitted to the Colorado Department of Health (CDH) in November 1984. Subsequently, the U.S. Air Force decided to close the HBSF permanently and clean the facility. In June 1985, CDH tentatively denied a Colorado Hazardous Waste Permit for the HBSF and indicated that RMA would be required to submit a closure plan within 15 days after the permit denial was official. In August 1985, PMO on behalf of RMA began development of a closure plan for the HBSF. The contractor team, headed by Ebasco Services, Incorporated, undertook the development of the HBSF closure plan as part of Task 13. The information developed in Task 11 will be used as input for Task 13.

1.2 Purpose and Scope

The objective of Task 11 is to conduct a contamination survey of the soil and groundwater in the vicinity of the HBSF that will provide information necessary to assess the nature and extent of contamination in the HBSF. This information will be utilized in the general assessment of contamination at RMA overseen by PMO, and in the more specific context of Task 13, which includes an RCRA closure plan for the HBSF. The Task 11 Technical Plan has been developed to provide pertinent information for (1) the preparation of an RCRA closure plan, which requires continued groundwater monitoring, and (2) the overall assessment of the extent of contamination at RMA.

1.3 Technical Approach

The initial portion of the Task 11 work program is an extensive literature review to develop a complete history of the activities at the HBSF and of

previous studies. Data obtained from this literature review has been organized into a privileged and confidential Damage Assessment Report (DAR) that details the physical, chemical and environmental histories of the HBSF. The DAR, a privileged and confidential document, has been used to support a geotechnical program which is evaluating existing groundwater monitoring and soil sampling networks with respect to the requirements of an RCRA closure plan. This technical plan provides recommendations for augmenting the existing monitoring network(s) along with a description of the proposed field sampling program for Task 11. The data collected in the Task 11 field program will be organized, evaluated and presented in a report format consistent with use in a closure plan.

2.0 EVALUATION OF BACKGROUND DATA

2.1 Data Compilation

2.1.1 Site Reconnaissance

On September 25, 1985, members of the EBASCO team visited the area around the HBSF without entering the facility. This preliminary field reconnaissance verified the locations of existing wells and soil borings and familiarized the group with the site.

2.1.2 Literature Review

Available documents and materials related to the HBSF were collected, and interviews were conducted with RMA personnel who had first-hand knowledge of the site. The information was reviewed and organized into a source document which describes the physical environment of the HBSF, the history of operations at the HBSF, the potential contaminants associated with past operations, history of spills or releases, flooding of the operations areas with water from the fire protection system, and studies performed at the site. This material is summarized in the Task 11 Damage Assessment Report for the HBSF, submitted to the PMO in October 1985 (privileged and confidential).

2.2 Contamination Sources

The literature review identified areas in the HBSF where the hydrazine fuels have leaked or spilled, where the fuels were handled and stored and where process equipment is known or suspected of having been exposed to contaminants.

Disposal areas and potential contamination sources are described in the DAR. Preliminary information regarding surface samples taken on above ground equipment (Dames & Moore 1985) indicates no sources of contamination.

3.0 FIELD SAMPLING PROGRAM

3.1 Introduction

The purpose of the field sampling program is to obtain data to assess the extent and type of contamination at the HBSF for use by PMO in preparing a closure plan. As this program's objective is to obtain data for a closure plan, the program will differ from the other tasks. All data will be collected during the initial field effort. That is, the program will not be divided into a Phase I and II program. At the completion of this program, recommendations will be made to collect additional data, if necessary. The geotechnical program will: (1) examine the areal and vertical extent of contamination in the unsaturated zone below the HBSF and, (2) define groundwater quality data gaps and design a program to fill those gaps. It will consist of drilling a limited number of soil borings to obtain semi-quantitative geochemical data and to provide as much data as possible on the nature of the chemical compounds present and the extent of contamination. The data collected during the soil sampling program, together with water-level information from existing wells and data developed in the literature search, will serve as the basis for recommendations concerning the number and placement of additional groundwater monitoring wells needed to develop a monitoring system adequate for a closure plan of the HBSF.

Geophysical surveys will be conducted to aid in clearing drilling sites in areas where buried metal objects or underground utilities may be present.

The field sampling programs will include a health and safety survey to assess the sampling team's exposure to potential hazards during geophysical surveys, drilling and sampling.

3.1.1 Support Facilities

During the mobilization meetings at RMA held the week of October 29 - November 2, 1984, the need for RMA support facilities was identified, and

initial discussions were held with RMA Installation Services personnel regarding the location and establishment of such facilities. Such support facilities include warehouse space, office space, provision of utilities (electric power, potable water, and sewer facilities) at warehouse and office facilities, and RMA's identification of a preferred location for decontamination activities.

During subsequent meetings, the command center and support facilities were located along the northern boundary of Section 1, approximately 2,500 feet east of its intersection with D Street, north of Building 731. RMA Facilities Engineering, with the support of Stearns-Rogers, has provided hookups for electricity, potable water, and sanitary sewer facilities for the Ebasco office trailer and ESE support facilities, as well as electricity and water supplies for the existing steam-cleaning area. Personnel decontamination activities and facilities are described further in the Health and Safety Plan, described in Volume III of the Litigation Technical Support and Services Rocky Mountain Arsenal Procedures Manual to the Technical Plan (RMA Procedures Manual).

Heated and lighted warehouse space has been provided by RMA for the use of both Ebasco and ESE. The eastern half of Building 728 has been made available for this purpose. This building has been divided in half by a firewall, and RMA has further subdivided the eastern half into three approximately equal areas by chain-link fences. The central area is being used by RMA for miscellaneous equipment storage. The two outer areas will be used by Ebasco and ESE. Each of these outer areas can be accessed through 12-foot doors from separate loading docks on the north side of the building.

3.1.2 Support Activities

3.1.2.1 Topographic Surveys

Soil borings and monitoring wells will be surveyed to establish their elevation and map coordinates with respect to an established grid. Since most of the existing wells at the Arsenal have been located on the Colorado State Planar Coordinate System, this will be the preferred grid. All locations

will be surveyed to the nearest 0.1 foot (3 centimeters) vertically and 3 feet (1 meter) horizontally, consistent with PMO requirements.

3.1.2.2 Decontamination of Equipment and Materials

Decontamination of equipment and materials will follow health and safety procedures and quality-control requirements. Equipment such as drill rigs and auger flytes will be maintained and decontaminated to preclude contamination between samples and from one site to another.

Some decontamination activities will take place at the borehole locations. These activities will utilize the mobile decontamination facilities discussed in Section 3.1.1 and in the Health and Safety Plan, Volume III of the RMA Procedures Manual. Major decontamination of equipment, particularly the larger pieces of equipment, will take place at the regional steam-cleaning areas.

3.1.2.3 Waste Disposal

In accordance with EPA guidelines and PMO directives, all wastes, including liquids, soils, and other solid wastes, will be containerized and stored at a site on RMA. The following will be handled as contaminated wastes:

- all soils not used for analysis purposes;
- all non-geologic wastes from designated contaminated areas;
- disposable sampling gear; and
- liquid generated at the steam cleaning areas.

The solid materials will be placed in drums on pallets and removed at government cost to controlled disposal sites. Wastewater will be placed in two 1,500 gallon tanks. When the tanks are full, the water in the tanks will be analyzed. If it is free of contaminants, it will be discharged to the sanitary sewer. If it is contaminated, it will be disposed of at government expense to controlled disposal sites. As agreed by the contractors, contaminated wastewater disposal will be arranged by ESE.

Portable or chemical toilet wastes will be disposed of according to normal protocols.

3.1.2.4 Water Used in Geotechnical Program

Two types of water will be used for the soil sampling program. Steam cleaning, decontamination and other related activities, will utilize chlorinated potable water, which is obtained from the RMA fire department's water supply. However, in those areas where drilling/cutting fluids might contact the underlying soil, unchlorinated potable water will be used. For example, some sites require prior preparation, such as removal of concrete or asphalt above the soil boring area. Tools for cutting these hard materials often require cooling of the bits or blades with water. Unchlorinated water of potable quality will be obtained from an aquifer north of RMA through the ESE field crew.

3.2 Geophysical Program

3.2.1 Purpose

Geophysical surveys will be conducted to minimize the possibility of siting boring locations over or dangerously close to buried metal objects or underground utilities.

3.2.2 Techniques

A variety of geophysical techniques have been tested for their effectiveness at the RMA. These tests and their results are described in Volume I of the RMA Procedures Manual.

Two geophysical methods will be used to locate buried metallic objects. They are magnetics, using a magnetic field gradiometer, and resistivity, using a "pulse induction" metal detector. The same methods will be used to detect buried utilities that are within approximately 5 feet of the surface and are composed of ferrous (magnetic) material and/or electrically conductive material (iron, steel, aluminum, copper, etc.). However, neither method

will be useful in detecting and locating non-ferrous and/or non-metallic utilities. For example, some underground piping is known to consist of vitrified clay. This, as well as piping made of other, non-conductive materials, is not detectable using these techniques.

3.2.3 Geophysical Surveys

Surveys for buried objects will be conducted at all borehole locations in the HBSF. The surveys will be conducted in advance of the drilling operations to allow for assessment of the geophysical results and relocation, if necessary, of the borehole locations.

3.3 Soil Boring Program

3.3.1 Priority Level of the HBSF

Priorities for each of the sites investigated in the PMO program were based on the expectation of encountering contamination, as recorded in the literature. High priority sites are those which have an established record of groundwater contamination beneath or near the site and which have records concerning soil contamination. Low priority sites have no records of either soil or groundwater contamination but are considered potentially contaminated because of records of spills and/or waste disposal at the site. Uncontaminated sites are those at which preliminary investigation revealed no reason to suspect contamination.

The HBSF has no records of either soil or groundwater contamination from the suspected sources (hydrazine fuels). There are records of groundwater near the site containing DBCP, DCPD, DIMP and high nitrates. However, this site is considered potentially contaminated because spills at the site of chemicals stored, blended, and/or transferred have been recorded. The HBSF is therefore a high priority site.

3.3.2 Borehole Density

The general approach to the soil boring program and the method of determining borehole density were developed jointly by PMO, Ebasco and ESE.

The borehole spacing for areas less than one million square feet was determined utilizing the curve shown in Figure 3.3-1, which was developed empirically by members of the Ebasco and ESE teams. For the previous tasks the total number of borings (Phase I and Phase II) was determined by dividing the area of the site by the square of the boring spacing. Tables 3.3-1 and 3.3-2 illustrate the boring location criteria. Modifications to the boring spacing at each site, as found by the curve, were made based on the priority of the site. For high priority sites, the curve was used without modification. For low priority sites, the boring spacing determined from the curve was multiplied by a factor of 1.25. For uncontaminated sites, the boring spacing was multiplied by a factor of 1.5. A grid for each boring spacing was then made and placed over the site maps to determine the boring locations.

The distribution of borings between the two phases of previous site investigations was determined according to an empirical scheme designed for Tasks 1 and 2. At both high and low priority sites, Phase I will contain 30% of the total. As the objective of this task is different from previous tasks, only one series of borings will be completed. These borings will be placed in areas of suspected sources to determine if the potential sources have contaminated the soil.

The total area of site 1-7 is approximately 775,000 square feet. From Figure 3.3-1 the estimated borehole spacing is 125 feet, or one borehole per 15,625 square feet. Dividing the area of the site, 775,000 square feet, by the area per borehole, 15,625 square feet, yields 50 as the total number of boreholes required for Phase I and Phase II. Thirty percent of 50 is 15 boreholes to be drilled in an equivalent Phase I investigation.

The locations and depth of the proposed borings at the HBSF are shown in Figure 3.3-2. Although the locations are distributed across the entire site, an attempt has been made to locate borings where contamination, if present, is likely to occur.

Areas of suspected contamination include along the railroad tracks, beneath the overhead pipeline between the east and west yards, in the drum cleaning area, and around the concrete retaining walls surrounding each tank.

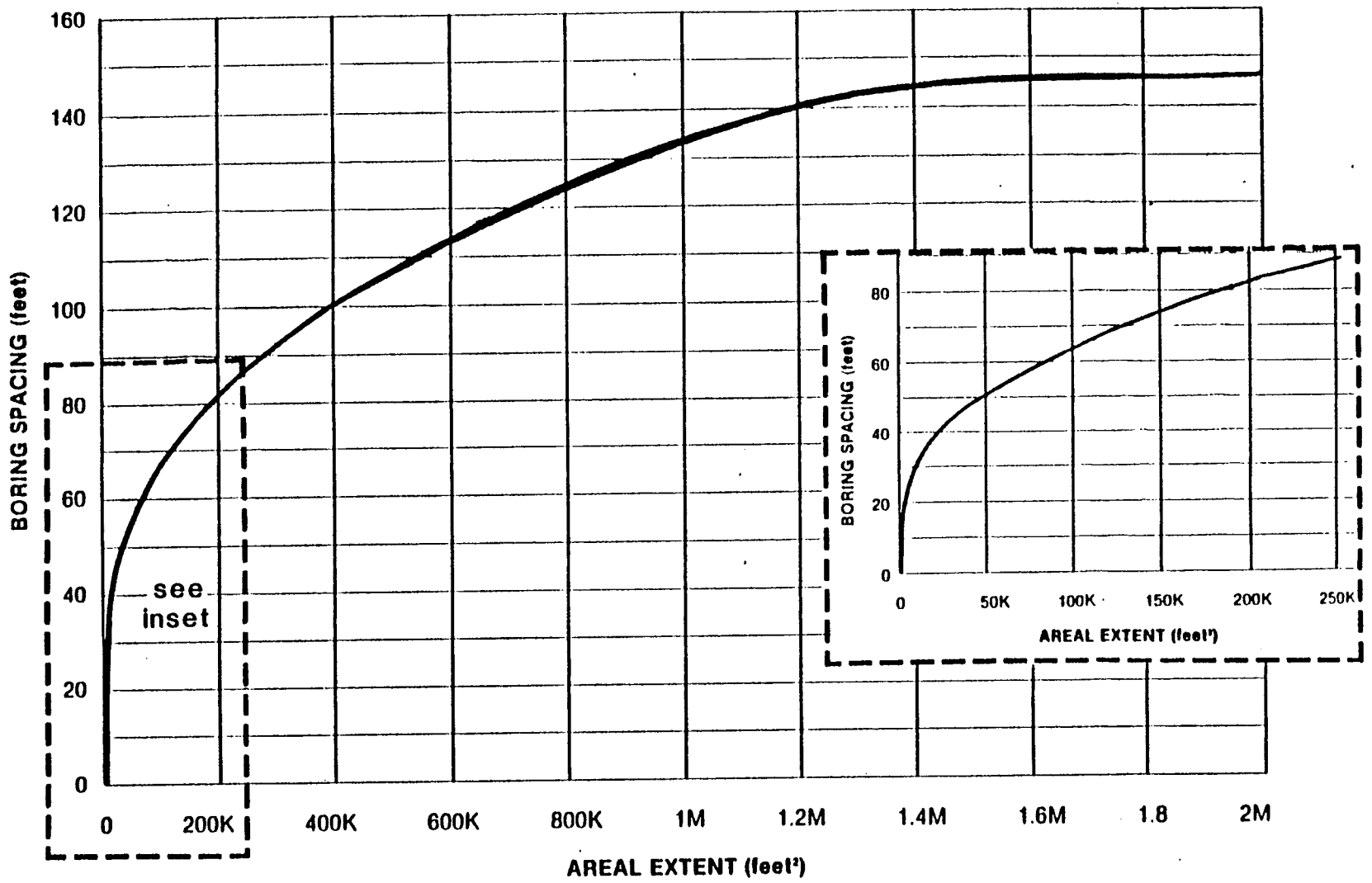


FIGURE 3.3-1

EMPIRICAL CURVE TO DETERMINE BORING SPACINGS BASED ON AREAL EXTENT OF SITES

TABLE 3.3-1

BORING DENSITY CRITERIA FOR CONTAMINATED SITES

Area of Site	Boring Spacing		Number of Borings		
	High Priority	Low Priority	Total Program	Phase I	Phase II
Less than 2,000,000 square feet	Boring Spacing[1]	Boring Spacing[1] x 1.25	No. of Borings = $\frac{\text{Total Area}}{\text{Boring Density}^{(2)}}$	30% of Total Number of Borings	70% of Total Number of Borings
Greater than 2,000,000 square feet	Boring Spacing = 150 feet	Boring Spacing = 150 x 1.25 = 188 feet	No. of Borings = $\frac{\text{Total Area}}{\text{Boring Density}^{(2)}}$	30% of Total Number of Borings	70% of Total Number of Borings

(1) Spacing values from Figure 3.3-2.

(2) Boring density = square of boring spacing.

TABLE 3.3-2

BORING DENSITY CRITERIA FOR UNCONTAMINATED SITES

Area of Site	Boring Spacing	Number of Borings — Total Program
Less than 1,000,000 square feet	Boring Spacing[1] x 1.5	No. of Borings = Total Area / Boring Density[2]
Greater than 1,000,000 square feet	Near known contaminated areas or sources of contamination: Boring Spacing = 150 feet	
	Near well-defined areas of low contamination: Boring Spacing = 750 feet	
	Near areas with no contamination history: Boring Spacing = 1,000 feet	

(1) Spacing values from Figure 3.3-2.

(2) Boring density = square of boring spacing.

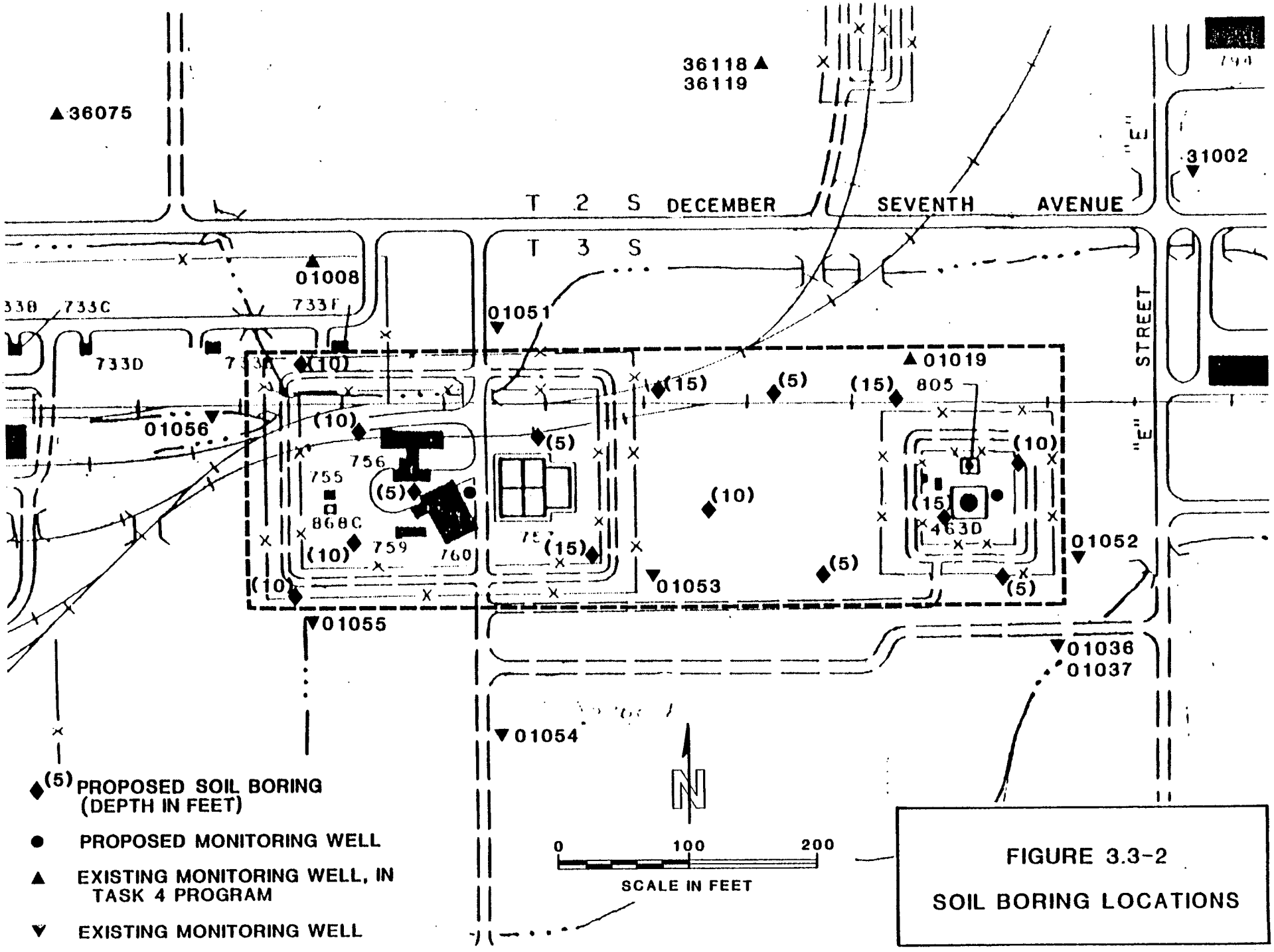


FIGURE 3.3-2

SOIL BORING LOCATIONS

3.3.3 Borehole Depths and Vertical Sampling Intervals

In high and low priority sites, 30% of the borings are drilled to the water table. The remaining 70% are drilled to shallower depths within the unsaturated zone in an even distribution. For example, where the water table is 25 feet deep, 20% will be drilled to 5 feet above the water table, 20% will be drilled to 10 feet above the water table, 20% will be drilled to 15 feet above the water table, and 10% will be drilled to 20 feet above the water table.

The vertical sampling intervals established at the onset of the investigations for Task 1 and Task 2 are indicated in Table 3.3-3.

The projected borehole depths at the HBSF are indicated in Figure 3.3-2.

3.3.4 Soil Sampling Procedure

All soil borings will be drilled and sampled using a continuous-core augering technique. This technique will allow for an examination of the entire length of the core and enable the locations of contacts to be precisely determined. Cores will be collected in five-foot long clear plastic (polybutyrate) liners. Although specific sampling intervals have been predetermined, the method of obtaining soil cores in clear polybutyrate tubes will allow the field geologist to select samples from horizons where contamination is observable. These samples will be sent to the laboratory for chemical analysis in addition to those from the predetermined sampling intervals. Field measurements of volatile organics will be performed using portable organic detection equipment such as an OVA and/or HNU to assess the presence of contamination during coring and in the non-sample portions of the cores.

A detailed description of the coring and sample handling procedures that will be adhered to during this Task 11 investigation can be found in Volume I of the RMA Procedures Manual.

As soon as the samples for chemical analysis are removed from the core and preserved, the cores will be re-sealed and stored for additional core

TABLE 3.3-3

Soil Sampling Intervals

Soil-Sampling Intervals (feet)
0.0 - 1.0
4.0 - 5.0
9.0 - 10.0
14.0 - 15.0
19.0 - 20.0
24.0 - 25.0

interpretation, as may be deemed necessary in the future. However, such additional core interpretation is effectively limited to geologic/lithologic considerations, since limited sample holding times are likely to preclude the submission of follow-up samples to the laboratory for chemical analyses.

3.3.5 Borehole Locations

The borehole locations that will be sampled are shown in Figure 3.3-2. The distribution of locations is based on information found in the literature and compiled in the Task 11 DAR (privileged and confidential).

3.3.6 Evaluation of Soil Boring Data

The primary objectives of the soil sampling program are to determine if soil contamination exists and the types of contaminants present. An evaluation of the soils and geologic data collected during the investigation will commence once the information has been processed through the Quality Assurance/Quality Control (QA/QC) and Data Management Programs, as described in Sections 5.0 and 6.0. Maps and cross-sections of soils and geologic materials will be prepared to illustrate the soil properties that have a direct impact on the retardation or mobility of the contaminants. The chemical data will be integrated with the soils and geologic data as soon as they become available. This information will be used to develop estimates of the lateral and vertical extent of the contaminants.

3.3.7 Utilization of Existing Monitoring Wells

Water levels will be measured in the existing monitoring wells located within 500 feet of the HBSF. This information will be incorporated into the Task 11 study to develop preliminary information on flow patterns in the shallow groundwater system. By incorporating the ten existing wells into the closure plan, the HBSF will be surrounded with monitoring wells both up-gradient and down-gradient of the source. Two additional wells within HBSF will be required to monitor the groundwater beneath the potential source. Groundwater flow patterns along with the semi-quantitative results of the soil boring program will be used to determine the locations of the two new wells proposed for installation at the HBSF under Task 11.

Following the measurement of water levels, the six monitoring wells with inadequate surface seals which are currently not usable in the closure plan, will be restored to proper construction specfications by reinstalling grout surface seals (Table 3.3-4). The remaining four wells will be examined to determine if they are of potential use in the program and can provide water level and water sample information.

3.3.8 Monitoring Wells

3.3.8.1 Installation and Development of Monitoring Wells

A total of twelve monitoring wells appear adequate to assess water quality for the program. These wells consist of usable existing wells and new wells. All new wells will be drilled and installed in the uppermost aquifer at locations selected following an evaluation of local groundwater flow conditions and an assessment of the data collected during the boring program.

New monitoring wells will be drilled using a 10-inch auger bit. Casing will be installed and will be four-inch Schedule 40 polyvinyl chloride (PVC). Well screens will be four-inch, flush threaded Schedule 40 PVC and will be factory slotted. A gravel pack will be installed between the casing and the borehole, and a bentonite pellet seal will be placed in the annulus above the gravel pack. A grout slurry will be pumped above the bentonite seal to land surface, and a steel protector pipe with a hinged cap and lock will be placed over the four-inch PVC well casing after grouting. Details of well construction can be found in the RMA Procedures Manual, Volume I.

The new wells will be developed as soon as practical after installation. Wastewater from well development will be drummed, and the surface in the immediate vicinity of the wells will be covered with plastic sheeting to protect the soils from wastewater contamination. Details of well development procedures can be found in the Project Quality Assurance Plan (RMA Procedures Manual, Volume II).

To increase the contact of the well with the aquifer and allow inflow of groundwater, the potentially usable existing monitor wells will be developed with a pump, if possible, or with a bottom discharge filling bailer and

TABLE 3.3-4

HBSF WELL STATUS

Well Location	Status
01051	unsealed
01052	unsealed
01053	unsealed
01054	unsealed
01055	unsealed
01056	unsealed
31002	unknown*
36075	unknown*
01008	unknown*
01019	unknown*

*Seal status yet to be determined.

surge block. Development will continue until the well water is clear to the unaided eye and the sediment in the bottom of the well is less than 5% of the screen length. If needed, air jetting may be used to physically agitate the well. No additives, such as dispersing agents, acids or disinfectants, will be used or introduced into the well.

3.3.8.2 Aquifer Testing

A requirement in closure plans is to estimate the rate of contaminant migration. Therefore, slug tests for determining the hydraulic conductivity of the shallow flow system at individual well locations will be performed on each of the new and usable pre-existing wells. This test usually involves injecting or removing a slug of water instantaneously from a well and measuring the rate of recovery of water levels in the well.

Data are interpreted by comparison with empirical equations and graphs previously developed. The hydraulic conductivities determined primarily reflect values within a few feet of the screened zone in a horizontal direction. Reliable results have been obtained in formations ranging in hydraulic conductivity from less than 0.1 gpd/ft (gallons per day per foot) to more than 100 gpd/ft. The test procedures are described in detail in Volume I of the RMA Procedures Manual.

3.3.8.3 Groundwater Sampling

One groundwater sample will be collected from each newly installed monitoring well and from each approved existing monitoring well. Sampling procedures, including field measurement of parameters which can change during sample preservation, shipment, and storage, are described in Volume I of the RMA Procedures Manual. Formal QA/QC procedures for sample handling are described in Section 8 of the QA/QC Plan (see Volume II of the RMA Procedures Manual). Table 3.3-5 is a summary of the proposed activities for Task 11.

TABLE 3.3-5

SUMMARY OF TASK 11 ACTIVITIES

Water Level Measurements

Utilizing 10 existing monitoring wells.

Soil Sampling

	Number of Borings	Boring Depths (feet)	Number of Soil Samples
	5	15 (or water table)	20
	5	10	15
	5	5	10
Total	15	150	45

Cleaning, Development, & Installation of Annular Surface Seals (Existing wells)

At a minimum of six and a maximum of ten wells near the HBSF.

Well Drilling

Two wells near the HBSF.

Groundwater Sampling

A maximum of twelve wells; ten existing and two newly installed wells near the HBSF.

4.0 CHEMICAL ANALYSIS PROGRAM

4.1 Introduction

The chemical analysis program is designed to be consistent with the sampling program for Task 11. Analytical methods for this task are described in more detail below. The referenced analytical methods in this Technical Plan were those specified during the meeting of the Analytical Services Teams for this Rocky Mountain Arsenal project. These analytical methods identified in the Task 11 Technical Plan were divided between the four contractor laboratories for method development prior to the initiation of Task 2 field activities. Once a method was developed it was distributed to all laboratories in the program for certification.

As discussed with the PMO, to be consistent with the program requirements, soil samples collected will be screened for target analytes and unknown contaminants. Analytical methods, including desired analyte concentration, high range concentration, sample holding times, reference method and principle of method, are identified in Tables 4.1-1 and 4.1-2. Furthermore, additional analyses of contaminants specific to the HBSF will be completed. These analyses are discussed below and shown in Tables 4.1-3a and 4.1-3b.

Solid (e.g., soil borings and sediments) and liquid matrices will be sampled during Task 11. Soil and solid matrix samples will be assayed semi-quantitatively by gas chromatography/mass spectroscopy (GC/MS) for volatile and semi-volatile organic target analytes. An attempt will be made to identify other major unknown peaks present in the GC/MS total ion current profile. Potential unknown analytes are those identified as: discarded commercial chemical products, off-specification species, containers residues and spill residues thereof (40 CFR 261.33); and Appendix VIII Analytes (40 CFR 261) as amenable to the GC/MS methodology cited in this document. Collected samples also will be assayed quantitatively by gas chromatography (GC) for 1,2-dibromo-3-chloropropane (DBCP); for hydrazines by high-pressure liquid chromatography (HPLC); nitrosamines by GC; by graphite furnace atomic absorption spectroscopy for arsenic; by cold vapor atomic absorption

TABLE 4.1-1

ANALYTICAL METHODS/SOLID MATRIX (SOIL, SOLIDS, SEDIMENT) FOR TASK 11

Analysis/Matrix/Analytes	Detection Limit*	High Range Concentration	Hold Time	Level of Certification	Reference Methods	Principle of Method
Volatile Organics/Solids			7 days for the solid and 30 days for the extract (1)	Semi-Quantitative (A)	EPA 624 (2) EPA 8240 with EPA 5030 extraction (1): USATHAMA Method N9 for UBTL and K9 for CAL	A 10 gram portion of the sample is obtained with a minimum of handling. The sample is shaken for 4 hours with 10 ml methanol. An aliquot of the methanol extract is injected into 5 ml of water and analyzed by purge-trap GC/MS using a packed column. Surrogates and internal standards are used. Unknowns are identified. Surrogates are: d_2 - Methylene chloride d_6 - Benzene d_{10} - Ethylbenzene The internal standard will be 1,2-dibromoethane-d_4.
1,1-Dichloroethane	0.5 µg/g	25 µg/g				
Dichloromethane	0.5 µg/g	25 µg/g				
1,2-Dichloroethane	0.5 µg/g	25 µg/g				
1,1,1-Trichloroethane	0.5 µg/g	25 µg/g				
1,1,2-Trichloroethane	0.5 µg/g	25 µg/g				
Carbon tetrachloride	0.5 µg/g	25 µg/g				
Chloroform	0.5 µg/g	25 µg/g				
Tetrachloroethylene	0.5 µg/g	25 µg/g				
Trichloroethylene	0.5 µg/g	25 µg/g				
Trans-1,2-Dichloroethylene	0.5 µg/g	25 µg/g				
Benzene	0.5 µg/g	25 µg/g				
Toluene	0.5 µg/g	25 µg/g				
Xylene (3 isomers)	0.5 µg/g	25 µg/g				
Ethylbenzene	0.5 µg/g	25 µg/g				
Chlorobenzene	0.5 µg/g	25 µg/g				
Methylisobutyl ketone	0.5 µg/g	25 µg/g				
Dimethyldisulfide	0.5 µg/g	25 µg/g				
Bicycloheptadiene	0.5 µg/g	25 µg/g				
Dicyclopentadiene	0.5 µg/g	25 µg/g				
Semi-Volatile Organics/Solids			7 days for the solid & 30 days for the extract (1)	Semi-Quantitative (A)	EPA 8270 with EPA 3540 extraction (1): USATHAMA Method L9 for UBTL, X9 for CAL and X9-A for HEA	A 15 gram portion of the sample is obtained with a minimum of handling and mixed with 30 grams of anhydrous sodium sulfate. The sample is extracted for 8 hours in soxhelet with 300 ml of methylene chloride. The extract is reduced to a final volume of 10 ml in a K-D aparatus. An aliquot of the extract is analyzed by fused silica capillary GC/MS. Surrogates and internal standards are used. Unknowns are identified.
Aldrin	0.5 µg/g	100 µg/g				
Endrin	0.5 µg/g	100 µg/g				
Dieldrin	0.5 µg/g	100 µg/g				
Isodrin	0.5 µg/g	100 µg/g				
p,p'-DDT	0.5 µg/g	50 µg/g				
p,p'-DDE	0.5 µg/g	100 µg/g				
Chlorophenylmethyl sulfide	0.5 µg/g	100 µg/g				
Chlorophenylmethyl sulfoxide	0.5 µg/g	50 µg/g				
Chlorophenylmethyl sulfone	0.5 µg/g	100 µg/g				

TABLE 4.1-1 (Continued)

Analysis/Matrix/Analytes	Detection Limit*	High Range Concentration	Hold Time	Level of Certification	Reference Methods	Principle of Method
Hexachlorocyclopentadiene	0.5 µg/g	100 µg/g				Surrogates are:
Oxathiane	0.5 µg/g	100 µg/g				d_4-1,3-Dichlorobenzene
Dithiane	0.5 ug/g	100 µg/g				d_4-Diethylphthalate
Malathion	0.5 ug/g	100 µg/g				d_4-2-Chlorophenol
Parathion	0.5 ug/g	100 µg/g				d_4 Di-n-Octyl Phthalate
Chlordane	0.5 ug/g	100 µg/g				
Azodrin	0.5 µg/g	100 µg/g				The internal standard will be d_{10} Phenanthrene
Vapona	0.5 ug/g	100 µg/g				
Supona	0.5 µg/g	100 µg/g				
DIMP	0.5 ug/g	50 µg/g				
Atrazine	0.5 µg/g	100 µg/g				
1,2-Dibromo-3-chloropropane/ Solids	0.01 ug/g	1.0 µg/g	7 days for the solid and 30 days for the extract See (1)	Quantitative (B)	Developed by MRI for USATHAMA Certification. USATHAMA Method S9 for UBTL and Z9 for CAL	A 10 gram portion of the sample is obtained with a minimum of handling. The sample is shaken with 20 ml of 50/50 hexane/acetone for 4 hours. The extract is rinsed with distilled water and analyzed by GC/ECD using a fused silica capillary column.
Hydrazines/Solids			7 days for solid, and 30 days for extract See (4)	Quantitative	Developed by UBTL for USATHAMA Certification.	A 10 gram portion of sample is extracted with 25 ml 2X distilled H_2O and 15 ml acetonitrite to a 50 ml volumetric flask, shaken, then allowed to sit until bubbles disappear. Mixture is brought to 50 ml volume with acetonitrite and assayed by HPLC.
Hydrazine	10 µg/g	100 ug/g				
1,1-Dimethylhydrazine	10 ug/g	100 µg/g				
Methylhydrazine	10 µg/g	100 µg/g				

TABLE 4.1-1 (Continued)

Analysis/Matrix/Analytes	Detection Limit*	High Range Concentration	Hold Time	Level of Certification	Reference Methods	Principle of Method
Nitrosamines/Solids						
Di-n-Propylnitrosamine	0.5 µg/g	1 µg/g	7 days for solid, and 30 days for extract See (2)	Quantitative	Developed from EPA 607 (2) by UBTL for USATHAMA Certification.	A 10 gram portion of sample is obtained with a minimum of handling. The sample is extracted 3X with 60 ml methylene chloride using a separatory funnel. The methylene chloride extract is washed with HCl (1:1) to remove free amines, dried and concentrated. Concentrate is cleaned on a florisil column and assayed by GC/NPD on a chromosorb W-AW (80/100 mesh) with 10 percent carbonax column.
N-Nitrosodimethylamine	0.5 µg/g	1 µg/g				
ICP Metal Screen/Solids			6 mos (3)	Quantitative (B)	USATHAMA Method P9 for UBTL and A9 for CAL	A 1 gram portion is digested with 3 ml repeated portions of HNO_3 and finished with HCl. The sample is filtered to a final volume of 50 ml. The sample is analyzed by ICP.
Cadmium	0.5 µg/g	500 µg/g				
Chromium	5 µg/g	500 µg/g				
Copper	5 µg/g	500 µg/g				
Lead	5 µg/g	500 µg/g				
Zinc	5 µg/g	500 µg/g				
Aluminum	Interelement Correction					
Iron	Interelement Correction					
Arsenic/Solids	1 µg/g	10 µg/g	6 mos	Quantitative (B)	EPA 7060 with EPA 3050 extraction (2): USATHAMA Method B9 for UBTL and G9 for CAL	A one gram portion of the sample is digested with H_2O_2 + HNO_3. The digest is analyzed by GF/AA.
Mercury/Solids	0.1 µg/g	1 µg/g	28 days (3)	Quantitative (B)	EPA 245.5 (3) USATHAMA Method Y9 for UBTL and J9 for CAL	A one gram portion is weighed out and treated with aqua regia followed by potassium permanganate. Excess permanganate is reduced with hydroxylamine sulfate. The mercury is reduced with stannous chloride and determined using the cold vapor technique.

TABLE 4.1-1 (Continued)

Analysis/Matrix/Analytes	Detection Limit	High Range Concentration	Hold Time	Level of Certification	Reference Methods	Principle of Method
Organics Screen/Air-Charcoal	-	-	4 weeks in freezer	None	UBTL method developed for NIOSH	The front and back sections of the charcoal tubes are combined and extracted with 1 ml of methylene chloride. The extract is analyzed by GC/MS using a fused silica capillary column. Significant unknowns are identified.
Organics Screen/Air-Tenax	-	-	4 weeks in freezer	None	UBTL method developed for NIOSH	The front and back sections of the Tenax tubes are combined and extracted with 1 ml of isooctane. The extract is analyzed by GC/MS using a fused silica capillary column. Significant unknowns are identified.
Organic Material/Soils	0.1%	99.9%	None	None	UBTL Method (4)	A sample of soil is dichromate oxidized with heat in 10 ml 0.5 N $K_2Cr_2O_7$ and 15 ml conc. H_2SO_4. Sample is cooled, diluted with deionized water to 60 ml and titrated to endpoint with 0.2 N ferrous ammonium sulfate hexahydrate with N-Phenylanthranilic acid as indicator.

*Actual detection limits for Certified Methods are identified in Volume IV of the RMA Procedures Manual (Project Specific Analytical Methods Manual) for each laboratory. Detection limits for uncertified methods and methods to be certified are desired detection limits.

References:

(1) SW-846, 2nd ed., July 1982.

(2) EPA-600/4-82-057, July 1982 Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater.

(3) EPA-600/4-79-020, Revised March 1983 Methods for Chemical Analysis of Water and Wastes.

(4) ESE-AMD.2-UD-$H_2$0.1, July 22, 1982.

(5) Methods of Soil Analysis, Part 2: Chemical and Microbiological Properties-Agronomy Monograph No. 9, 2nd Edition. Published by the American Society of Agronomy, Inc. Madison, Wisconsin, 1965. Sixth Printing 1983.

Notes:

(A) Semi-Quantitative: See Section III of the Litigation Technical Support and Services Rocky Mountain Arsenal Procedures Manual, Section 11.2.2.1.

(B) Quantitative: See Section III of the Litigation Technical Support and Services Rocky Mountain Arsenal Procedures Manual, Section 11.2.2.2.

TABLE 4.1-2

ANALYTICAL METHODS/LIQUID MATRIX FOR TASK 11

Analysis/Matrix/Analytes	Detection Limit*	High Range Concentration[a]	Hold Time	Level of Certification	Reference Methods	Principle of Method[b]
Volatile Halo Organics/Water			14 days (1)	Quantitative	EPA 601 (1)	Purge and Trap GC/Hall Detector with a packed column (1% SP-1000 on Carbopack B) 1,2-dibromo-ethane or other suitable internal standard will be used based on Phase I experience to monitor purge efficiency.
Chlorobenzene	1 µg/L	50 µg/L				
Chloroform	1 µg/L	50 µg/L				
1,1-Dichloroethane	1 µg/L	50 µg/L				
1,2-Dichloroethane	1 µg/L	50 µg/L				
1,1,1-Trichloroethane	1 µg/L	50 µg/L				
1,1,2-Trichloroethane	1 µg/L	50 µg/L				
Tetrachloroethylene	1 µg/L	50 µg/L				
Trichloroethylene	1 µg/L	50 µg/L				
1,2-trans-Dichloroethylene	1 µg/L	50 µg/L				
Dichloromethane	1 µg/L	50 µg/L				
Carbon tetrachloride	1 µg/L	50 µg/L				
Volatile Arom. Organics/Water			7 days (1)	Quantitative	EPA 602 (1)	Purge and Trap/GC/PID with a packed column (1% SP-1000 on Carbopack B, to permit runs in conjunction with EPA 601). A suitable internal standard will be used based on Phase I experience to monitor purge efficiency.
Benzene	1 µg/L	50 µg/L				
Toluene	1 µg/L	50 µg/L				
Xylenes	1 µg/L	50 µg/L				
Ethyl benzene	1 µg/L	50 µg/L				
Organochlorine Pesticides/Water			7 days for the water and 40 days for the extract (1)	Quantitative	EPA 608 (1)	An 800 ml portion of water is extracted with 3 x 50 ml methylene chloride. The extract is reduced in volume and exchanged with hexane. The final volume is 10 ml or less. The concentrated extract is analyzed by GC/EC using a fused silica capillary column. Cleanup procedure will be applied as required.(1) A suitable internal standard will be selected based on Phase I experience to monitor purge efficiency.
Aldrin	0.1 µg/L	10 µg/L				
Endrin	0.1 µg/L	10 µg/L				
Dieldrin	0.1 µg/L	10 µg/L				
Isodrin	0.1 µg/L	10 µg/L				
Chlordane	0.1 µg/L	10 µg/L				
Hexachlorocyclopentadiene	0.1 µg/L	10 µg/L				
p,p'-DDT	0.1 µg/L	10 µg/L				
p,p'-DDE	0.1 µg/L	10 µg/L				

TABLE 4.1-2 (Continued)

Analysis/Matrix/Analytes	Detection Limit*	High Range Concentration[a]	Hold Time	Level of Certification	Reference Methods	Principle of Method[b]
1,2-Dibromo-3-chloropropane/Water	0.1 µg/L	10 µg/L	Extract within 7 days, analyze within 30. See EPA 625 (1)	Quantitative	Developed by MRI for USATHAMA Certification	A 90 ml portion of sample saturated with NaCl is extracted twice with 1 ml of hexane. The combined extracts are brought to a final volume of 2 ml and analyzed by GC/EC using a packed column. A suitable internal standard will be specified based on Phase I experience to monitor purge efficiency.
Dicyclopentadiene and Bicycloheptadiene/Water	0.3 µg/L	25 µg/L	Extract within 7 days, analyze within 40. See 4 (1)	Quantitative	Developed by MRI for USATHAMA Certification	A 100 ml portion of sample is extracted with 5 ml of methylene chloride. The extract is analyzed by GC/FID using a fused silica capillary column. A suitable internal standard will be specified based on Phase I experience to monitor purge efficiency.
Organosulfur Compounds/Water			Extract within 7 days, analyze within 30. See EPA 625 (1)	Quantitative	USATHAMA 4P	An 800 ml portion is extracted three times with 50 ml methylene chloride. The volume is reduced in a K-D apparatus and exchanged for isooctane. The isooctane extract is analyzed by GC/FPD-S using a packed column (5% SP-1000 on Chromosorb). A suitable internal standard will be specified based on Phase I experience to monitor purge efficiency.
Chlorophenylmethyl sulfide	2 µg/L	50 µg/L				
Chlorophenylmethyl sulfoxide	2 µg/L	50 µg/L				
Chlorophenylmethyl sulfone	2 µg/L	50 µg/L				
1,4 oxathiane	2 µg/L	50 µg/L				
dithiane	2 µg/L	50 µg/L				
Phosphonates/Water			7 days See EPA 625 (1)	Quantitative	USATHAMA 4S for DIMP ESE will develop method for DMMP	A 800 ml portion of water is extracted three times with 50 ml methylene chloride. The volume is reduced in a K-D aparatus and exchanged with isooctane. The extract is analyzed by GC/NPD using a fused silica capillary column. A suitable internal standard will be selected based on Phase I experience to monitor purge efficiency.
Diisopropylmethylphosphonate	2 µg/L	100 µg/L				
Dimethylmethylphosphonate	2 µg/L	100 µg/L				

TABLE 4.1-2 (Continued)

Analysis/Matrix/Analytes	Detection Limit*	High Range Concentration[a]	Hold Time	Level of Certification	Reference Methods	Principle of Method[b]
Organophosphorous Pesticides/Water			7 days	Quantitative	EPA 8140(2) modified for water	An 800 ml portion of the sample is extracted three times with 50 ml methylene chloride. The extract is reduced in volume and exchanged with isooctane. The final volume is 5 ml. The extract is analyzed by GC/NPD using a fused silica capillary column. Vapona will be added if indicated by Phase I experience. A suitable internal standard will be specified based on Phase I experience to monitor purge efficiency.
Malathion	0.1 µg/L	5 µg/L	See EPA 625 (1)			
Parathion	0.1 µg/L	5 µg/L				
Azodrin	0.1 µg/L	5 µg/L				
Supona	0.1 µg/L	5 µg/L				
Vapona	0.1 µg/L	5 µg/L				
Hydrazines/Water			7 days	Quantitative	Developed by USTL for USATHAMA certification	A 25 ml of sample is pipetted into a 50 ml volumetric flask. Add 15 ml acetonitrile to the volumetric flask, shake and allow sit until bubbles disappear. Bring mixture to 50 ml volume with acetonitrile and assay by HPLC.
Hydrazine	5 µg/L	100 µg/L	See (4)			
1,1-Dimethylhydrazine	5 µg/L	100 µg/L				
Methylhydrazine	5 µg/L	100 µg/L				
Nitrosamines/Water			7 days	Quantitative	EPA 607(2)	Approximately 1 liter of water is extracted 3x with 60 ml methyline chloride by shaking for 30 seconds in a separatory funnel. The combined extract is washed with HCl (1:1) to remove free amines, dried and concentrated. Concentrate is cleaned on a florisil column and assayed by GC/NPD on a chromosorb W-AW (80/100 mesh) 10 percent carbowax column.
Di-N-Propylnitrosamine	0.5 µg/L	50 µg/L	(2)			
N-Nitrosodimethylamine	0.5 µg/L	50 µg/L				
Metals by AA/Water						A 100 ml aliquot of sample is digested with H_2O_3 and HNO_3. The digest is analysed by GF/AA.
Arsenic	10 µg/L	100 µg/L	6 mos (5)	Quantitative	EPA 206.2 (4)	

TABLE 4.1-2 (Continued)

Analysis/Matrix/Analytes	Detection Limit*	High Range Concentration[a]	Hold Time	Level of Certification	Reference Methods	Principle of Method[b]
Mercury	0.1 µg/L	10 µg/L	28 days (5)	Quantitative	EPA 245.1 (4)	A 100 ml aliquot is treated with H_2SO_4, HNO_3, $KMnO_4$, $K_2S_2O_8$. Excess $KMnO_4$ is destroyed with hydroxylamine sulfate. The mercury is reduced with stannous chloride and analyzed by CV/AA.
Metals by ICP/Water			6 mos (5)	Quantitative	EPA 200.7 (4)	All samples will be treated by adding HNO_3 + HCL and heating before analysis to dissolve precipitates that may have formed after sampling. Magnesium, calcium and sodium may be certified at lower levels if required.
Chromium	50 µg/L	5000 µg/L				
Cadmium	50 µg/L	5000 µg/L				
Lead	50 µg/L	5000 µg/L				
Zinc	50 µg/L	5000 µg/L				
Copper	50 µg/L	5000 µg/L				
Magnesium	10 mg/L	1000 µg/L				
Calcium	100 mg/L	1000 µg/LA				
Sodium	100 mg/L	1000 µg/L				
Anions/Water				Quantitative	EPA 300 (4) and Contractor developed method	The sample is filtered and analyzed by ion chromatography using suppressor/separator columns for sulfate, chloride and fluoride. Nitrate and phosphate are assayed by auto-analyzer. Sulfate, chloride and fluoride ions are determined in a single run without post-column reaction using peak areas. Nitrate and phosphate ions are determined colormetrically. Alternative analytical methods may be proposed based on Phase I experience.
Sulfate	2 mg/L	200 mg/L	28 days (4)			
Nitrate	2 mg/L	200 mg/L	48 hrs (4)			
Chloride	1 mg/L	100 mg/L	28 days (4)			
Fluoride	2 mg/L	200 mg/L	28 days (4)			
Phosphate	1 mg/L	100 mg/L	48 hrs (4)			

TABLE 4.1-2 (Continued)

Analysis/Matrix/Analytes	Detection Limit*	High Range Concentration[a]	Hold Time	Level of Certification	Reference Methods	Principle of Method[b]
GC/MS Confirm/Extracts	--	--	40 days (1)	None	EPA 624 + 625 (1)	Ten percent of total number of samples which are positive will be confirmed by GC/MS for component identity and purity. The GC/MS confirmation will be carried out using columns and conditions similar to those used in the original GC analysis. If certification of method is required the Ebasco team recommends the semi-quantitative level.

*Actual detection limits for certified methods are identified in Volume IV of the RMA Procedures Manual (Project Specific Analytical Methods Manual) for each laboratory. Detection limits for uncertified methods and methods to be certified are desired detection limits.

[a] Reflects an estimate of the linear range of the method and is proposed to minimize dilutions.

[b] To be developed during USATHAMA Phase II certification.

References:

(1) EPA-600/4-82-057, July 1982 "Methods for Organic Chemical Analysis of Principal and Industrial Wastewater".

(2) EPA SW-846, 2nd ed., "Test Methods for Evaluating Solid Waste".

(3) Personal Communication from Chris Weathington, Ebasco QA Manager.

(4) ESE-AMP.2-UD-H_2O.1, July 22, 1982.

(5) EPA-600/4-79-020, Revised March 1983, "Methods for Chemical Analysis of Water and Wastes".

TABLE 4.1-3a

SOLID MATRIX SAMPLE ANALYSIS BY ANALYTE PROFILE

	MATRIX SAMPLES		
	Surface Soils With Apparent Oil Contamination	Surface Soils Without Apparent Oil Contamination	Subsurface Soils
Volatile Organics	+	-	+
Semi-volatile Organics	+	+	+
1,2-Dibromo-3-Chloropropane	+	+	+
Hydrazines	-	-	+
Nitrosamines	+	+	+
Metals by ICP	+	+	+
Arsenic	+	+	+
Mercury	+	+	+
Moisture	+	+	+
Organic Matter	+	+	+

+ analyses will be performed.

- analyses will not be performed.

TABLE 4.1-3b

ANALYTES SPECIFIC TO THE HYDRAZINE BLENDING AND STORAGE FACILITY

Analytes	Surface Soils	Subsurface Soils	Liquids
Hydrazines			
Hydrazine	-	+	+
1,1-Dimethylhydrazine	-	+	+
Methylhydrazine	-	+	+
Nitrosamines			
Di-N-Propylnitrosamine	+	+	+
N-Nitrosodimethylamine	+	+	+

+ Analysis will be performed.

- Analysis will not be performed.

spectroscopy for mercury; and for other target metals inductively-coupled argon plasma (ICP) emission spectroscopy. Additionally, selected RMA soils also will be assayed for total soil organic matter.

Table 4.1-1 identifies the analytical method, desired analyte concentration, high range concentration, sample holding time, required level of certification, reference method and principle of method for the Task 11 survey.

The liquid matrix will be assayed by specific quantitative methods to provide data on areal extent of contamination at each specific source of interest. Table 4.1-2 identifies the analytical method, desired analyte concentration, high range concentration, sample holding time, required level of certification, reference method and principle of method for liquid matrix samples.

Sample shipping and holding temperatures are indicated in the QA/QC plan (see Volume II of the RMA Procedures Manual). Matrix samples will be assayed for analyte profiles identified in Table 4.1-3a for solid matrices and Table 4.1-3b for analytes specific to the HBSF. Analytical methods for worker exposure (e.g., volatile organics in air) will not be USATHAMA Certified. Data from these samples will be used as an initial assessment and to identify the potential for worker exposure to organic vapors. A summary of Task 11 laboratory analyses indicating preservation guidelines, analytical methods required, level of certifications, total analytical requirements, and weekly laboratory rates of analysis is given in the QA/QC Plan of the RMA Procedures Manual.

4.2 Sample Matrices and Summary of Analytical Methods

4.2.1 Sample Matrices

All soil, sludge, sediment and solid matrices will be considered as soils for analytical purposes. Prior to sample collection, all soil and solid analytical methods will be USATHAMA Certified for a representative soil. This representative soil will be a background soil collected from the RMA area. Data for soil and solid matrices will initially be reported on a dry weight basis and may be converted to a wet weight basis as required by the PMO.

4.2.2 Summary of Solid Matrix Analytical Methods

This section briefly describes the analytical methods for target analytes and their desired detection limits in the Task 11 survey. Table 4.1-1 summarizes each analytical method. USATHAMA/PMO Certified analytical methods for Task 11 are described in the order of occurrence shown in Table 4.1-1. The non-Certified Phase I method for volatile organics in air follows the certified methods described, as shown in Table 4.1-1. Lastly, a non-certified method for organic materials in soil is described. The specific protocol for each method may be reviewed in the Rocky Mountain Arsenal Procedures Manual to the Technical Plan, Volume IV: Project Specific Analytical Methods Manual (see Analytical Methods Manual).

Volatile Organics in Soil and Solid Samples by Gas Chromatography/Mass Spectrometry (GC/MS)

The volatile organics method in solids was based on EPA Method 8240 (EPA SW-846). This method was USATHAMA Certified for soils and solids at the semiquantitative level for the Task 11 Program (USATHMA Method N9 for UBTL and K9 for CAL).

Due to their volatility, analysis for these compounds will be restricted to deep soils or surface soils contaminated with oil. A volatile organics analysis will be performed on oil-contaminated surface soils because of the possibility that contaminating oils may trap volatiles in these soils. Surface soils not contaminated with oil will not be assayed for volatile organics by this technique.

In this method, a ten gram portion of the sample will be obtained with minimum handling and placed into 10 ml of methanol in a volatile organic acid (VOA) septum vial, spiked with the surrogates: methylene chloride-d_2; benzene-d_6; and ethyl benzene-d_{10}, capped with a Teflon lined lid and shaken for four hours. A 20 µg aliquot of the methanol extract will be removed, spiked with 200 µg of 1,2-dibromoethane-d_4 as an internal standard and injected into 5 ml of organics-free water contained in a syringe. The contents of the syringe will then be injected into a purging device, purged

and analyzed on a packed column (1% SP-1000 on Carbopack B) by GC/MS. Each sample will be assayed for target compounds at detection limits identified in Table 4.1-1.

In addition, the total ion current GC/MS profile will be screened for all major unknown peaks (see pg. 4-14). An attempt will be made to identify the largest of these major unknown peaks which are present in excess of ten percent of the area of the internal standard peak. Each of these major unknown peaks will be reported as the purity, fit and probability to match for the three most likely candidate compounds from the Environmental Protection Agency/National Bureau of Standards/National Institute of Health (EPA/NBS/NIH) Mass Spectral library computer program.

Semivolatile Organics in Soil and Solid Samples by Gas Chromotography/Mass Spectrometry (GC/MS)

This analytical technique was based on EPA Method 8270 in solids (EPA SW-846) and was USATHAMA Certified in soils and solids at the semiquantitative level for the Task 11 program (USATHAMA Method L9 for UBTL, X9 for CAL and X9-A for HEA).

Using this method, a fifteen gram portion of the sample will be obtained with a minimum of handling and spiked with the surrogates: 1,3-dichloro-benzene-d_4; diethylphthalate-d_4; 2-chlorophenol-d_4; and di-n-octylphthalate-d_4. The sample will be mixed with anhydrous sodium sulfate (30 grams or more depending on sample moisture content) then soxhelet extracted for eight hours with 300 ml methylene chloride. The extract is reduced to a final volume of 10 ml in a Kuderna-Danish (K-D) apparatus. An aliquot of this concentrate will be spiked with phenanthrene-d_{10} as an internal standard and analyzed on a fused silica capillary column by GC/MS. Samples will be assayed for target analytes at the detection limits shown in Table 4.1-1. In addition, the total ion current profile will be scanned for major unknown peaks. As discussed for volatile organics, an attempt will be made to identify all unknown major peaks (see pg. 4-14). All unknown peaks over 10 percent of the internal standard peak will be listed. This method was USATHAMA Certified at the semiquantitative level.

1,2-Dibromo-3-chloropropane (DBCP) in Soil and Solid Samples by Gas Chromatography (GC)

This method, used to assay for DBCP, is based on a method developed by Midwest Research Institute and is USATHAMA Certified at the quantitative level (USATHAMA Method S9 for UBTL and Z9 for CAL).

Due to the volatility of DBCP (EPA-600/4-82-057), analyses for this compound will be restricted to deep soils or surface soils contaminated with oil. Surface soils not contaminated with oil will not be assayed for DBCP.

Using this procedure, a ten gram portion of the sample will be obtained with minimum handling and shaken for four hours with 20 ml of hexane/acetone (1:1) mixture. The extract will be rinsed with distilled water, brought to a final volume of 10 ml with hexane and assayed by a GC equipped with an electron capture detector and using a fused silica capillary column. The target detection limit for this compound will be 0.01 µg/g as identified in Table 4.1-1.

Hydrazines in Soil and Solid Samples by High Pressure Liquid Chromatography (HPLC)

This High Pressure Liquid Chromatography (HPLC) method was developed from the USATHAMA method for UDMH in water by UBTL and is USATHAMA certified at the quantitative level.

Because hydrazines are powerful reducing agents, analysis for these compounds will be restricted to deep soils. Surface soils will not be assayed for hydrazines.

Using this procedure, a ten gram portion of the sample will be obtained with a minimum of handling and placed in a 50 ml volumetric flask. Twenty-five ml of 2X distilled water and 15 ml of HPLC grade acetylnitrile will be added to the volumetric flask, shaken until thoroughly mixed, and allowed to sit until all gas bubbles formed on mixing disappear. The flask contents are

brought to a final volume of 50 ml with HPLC grade acetylnitrile and assayed by HPLC.Target detection limits for these compounds will be 10 µg/g as identified in Table 4.1-1.

Nitrosamines in Soil and Solid Samples by Gas Chromatography (GC)

This gas chromatography (GC) method was developed from EPA method 607 (EPA 600/4-82-057) and will be USATHAMA certified at the quantitative level.

In the method a ten gram portion of the sample will be obtained with a minimum of handling and shaken for two minutes with 60 ml methylene chloride. The organic layer is allowed to separate from the water phase for ten minutes, then filtered through glass wood into a 250 ml Erlenmeyer flask. The extraction/filtration procedure is repeated for a second and third time. All three extracts are combined in the Erlenmeyer flask. These combined extracts are washed with 10 ml dilute HCl (1:1) to remove free amines, dried with anhydrous sodium sulfate and concentrated in a Kuderna-Danish (K-D) apparatus to a volume of 10 ml or less for storage.

Prior to analyses the extract is concentrated to 2 ml in a K-D apparatus. Concentrated extract is cleaned on a florisil column and assayed by gas chromatography on a chromosorb W-AW (80/100 mesh) coated with 10% carbowax using a nitrogen phosphorous detector.

Metals in Soil and Solid Samples by Inductively Coupled Argon Plasma (ICP) Emission Spectrometry

The ICP method, based on USATHAMA Method 7S, is USATHAMA Certified at the quantitative level (USATHAMA Method P9 for UBTL and A9 for CAL).

In this procedure, a one gram portion of sample will be digested in a watch glass covered Griffin beaker with 3 ml of concentrated nitric acid. Contents of beaker will be heated to near dryness and repeated portions of concentrated nitric acid added until the sample is completely digested. The digestion process is finished with two ml of 1:1 nitric acid and 2 ml of 1:1 hydro-

chloric acid. The sample digestate will be filtered, the beaker and watch glass rinsed with deionized water and rinsate passed through the filter. The digestate is brought to a final volume of 50 ml and assayed by ICP.

Samples will be assayed for target metals at detection limits identified in Table 4.1-1.

Arsenic in Soil and Solid Samples by Graphite Furnace Atomic Absorption (AA) Spectroscopy

The arsenic method in soils and solids was developed from EPA Method 7060 (EPA-SW-846). Using this method, a one gram sample will be digested with hydrogen peroxide and concentrated nitric acid. The digestate will be filtered and assayed by graphite furnace atomic absorption spectrometry. The target detection limit for arsenic will be 1 µg/g. This method will be USATHAMA Certified at the quantitative level (USATHAMA Method B9 for UBTL and G9 for CAL).

Mercury in Soil and Solid Samples by Cold Vapor Atomic Absorption (CVAA) Spectroscopy

This mercury method, developed from EPA Method 245.5 (EPA 600/4-82-057), was USATHAMA Certified at the quantitative level (USATHAMA Method Y9 for UBTL and J9 for CAL). In the method a one gram sample portion will be digested with aqua regia followed by treatment with potassium permanganate. Excess permanganate will be reduced with hydroxylamine sulfate. Mercury will be reduced with stannous chloride and assayed by cold vapor AA. The target detection limit for mercury will be 0.1 µg/g.

Volatile Organic Compounds in Air Using Activated Charcoal and Tenax

This method was designed by UBTL for the National Institute of Occupational Safety and Health. It is designated for use in this program as a screening tool to identify the potential for each sampling team's exposure to volatile

organic contaminants in air during the Task 11 program. The charcoal is desorbed with methylene chloride, and Tenax with isooctane. Extracts will be analyzed by packed column or fused silica capillary column GC/MS in order to identify significant unknown compounds. This method will not be USATHAMA Certified.

Organic Materials in Soil Samples

The organic materials in soil method was developed by UBTL for use in their agricultural soils analytical program. The procedure is derived from Methods in Soils Analysis, Part 2 (American Society of Agronomy [1965]). In this method, a sample of <100-mesh soil will be weighed into an Erlenmyer flask, exactly 10 ml 0.5 N Potassium dichromate solution and 15 ml concentrated sulfuric acid added.

The flask is connected to a West condenser and heated to dichromate oxidize all organic matter. The flask will then be cooled and the condenser rinsed with deionized water. Contents of the flask will be brought to a 60 ml volume with deionized water and titrated with a 0.2 N ferrous ammonium sulfate hexahydrate solution using N-phenylanthranillic acid as indicator. Concentrations of organic matter in soil ranging from 0.1 to 99.9 percent may be detected by this procedure. This method will not be USATHAMA certified.

4.2.3 Summary of Liquid Matrix Analytical Methods

Analytical methods, target analytes, and desired target detection limits for liquid matrix analytes are discussed in this section and summarized in Table 4.1-2. All liquid matrix methods will be USATHAMA Certified at the quantitative level. Referenced methods are being prepared in a specific USATHAMA format as per the instructions of the PMO by the program contractor laboratories. Liquid matrix analytical methods will be included in the Analytical Methods Manual when they have been developed for certification. This Technical Plan document will be modified at that time to reflect the inclusion of all liquid matrix reference methods.

Volatile Halogenated Organics in Liquid Samples

The analytical method for volatile halogenated organics in water will be based on EPA Method 601 (EPA-600/4-82-057). This analytical procedure will be a purge and trap method, assayed on a packed column (1% SP-1000 on Carbopack B) by GC equipped with a Hall electrolytic conductivity detector.

Water samples will be spiked with 1,2-dibromethane or other suitable internal standard based on Phase I experience to monitor purge efficiency.

Volatile halogenated organic analyses and desired detection limits are identified in Table 4.1-2.

Volatile Aromatic Organics in Liquid Samples

The volatile aromatic hydrocarbon methods will be based on EPA Method 602 (EPA-660/4-82-057) for water and EPA Method 8020 (EPA-SW-846) for soil and solids. Analysis of volatile aromatics in water will be by a purge and trap method, analyzed by GC equipped with a photoionization detector using a packed column (1% SP-1000 on Carbopack B).

Table 4.1-2 lists the volatile aromatic organic constituents and target detection limits.

Organochlorine Pesticides in Liquid Samples

The analytical methodology for organochlorine pesticides will be based on EPA Method 608 (EPA-600/4-82-057) for water and EPA Method 8080 (EPA SW-846) for soil and solid samples. An 800 ml portion of water will be extracted three times with 50 ml methylene chloride. The extract will be reduced in volume and exchanged with hexane to a final volume of 10 ml or less. The concentrated extract will be analyzed by GC with an electron capture detector using a fused silica capillary column.

Organochlorine pesticides and their target detection limits are listed in Table 4.1-2.

1,2-Dibromo-3-chloropropane (DBCP) in Liquid Samples

The procedure for the analyses of DBCP was developed by Midwest Research Institute for both water and soils. A 90 ml portion of water sample will be placed in a 100 ml volumetric flask and saturated with sodium chloride. The sample will be extracted twice with one ml hexane, the extracts combined and brought to a final volume of 2 mls. An aliquot of the extract is analyzed on a fused silica capillary column by GC equipped with an electron capture detector. The target detection limit for DBCP will be 0.1 µg/l.

Dicyclopentadiene (DCPD) and Bicycloheptadiene (BCHD) in Liquid Samples

The specific procedures for DCPD and BCHD were developed by Midwest Research Institute for both water and soil matrices.

A 100 ml portion of water sample will be extracted with five ml methylene chloride. The extract will be assayed on a fused silica capillary column by GC equipped with a flame ionization detector. The target detection limit for both DCPD and BCHD will be 10 µg/l.

Organosulfur Compounds in Liquid Samples

The organosulfur compounds that will be target analytes are listed in Table 4.1-2. Methodologies for organosulfur analyses will be developed from USATHAMA Method 4P for water.

In a water matrix an 800 ml sample will be extracted three times with 50 ml methylene chloride. The extract volume will be reduced in a K-D apparatus and exchanged for isooctane. The isooctane extract will be assayed on a packed column (5% SP-1000 on Chromosorb) by GC with a flame photometric detector. The target detection limit for organosulfur compounds in water will be 2 µg/l.

Phosphonates in Liquid Samples

The phosphonates include diisopropylmethylphosphonate (DIMP) and dimethylmethylphosphonate (DMMP). Specific analytical methodologies for phosphonates will be developed from USATHAMA Method 4S for water.

Water analysis for phosphonates will involve extracting an 800 ml sample three times with methylene chloride. The extract will be combined, the volume reduced in a K-D apparatus and exchanged with isooctane. The isooctane extract will be analyzed on a fused silica capillary column by GC equipped with a nitrogen/phosphorous detector. The target detection limit for phosphonates in water will be 2 µg/l.

Organophosphorous Pesticides in Liquid Samples

Organophosphorous compounds targeted for Phase II analyses are listed in Table 4.1-2. Analytical methods for these compounds are derived from EPA Method 8140 (EPA SW-846) for water.

In a water matrix the five organophosphorous compounds will be extracted from an 800 ml sample with three 50 ml volumes of methylene chloride. The extract will be concentrated and exchanged with isooctane to a final volume of 5 ml. An aliquot of the extract will be assayed on a fused silica capillary column by GC equipped with a nitrogen/phosphorous detector. Target detection limits for the five organophosphorous pesticides in water will be 0.1 µg/l.

Hydrazines in Liquid Samples by High Pressure Liquid Chromatography (HPLC)

This High Pressure Liquid Chromatography (HPLC) method was developed from the USATHAMA method for UDMH in water by UBTL and is USATHAMA certified at the quantitative level.

Using this procedure, 25 ml of the sample will be obtained with a minimum of handling and pipetted into a 50 ml volumetric flask. Fifteen ml of HPLC grade acetylnitrile will be added to the volumetric flask, and the mixture

shaken until thoroughly mixed and allowed to sit until all gas bubbles formed on mixing disappear. The flask contents are brought to a final volume of 50 ml with HPLC grade acetylnitrile and assayed by HPLC. Target detection limits for these compounds will be 10 µg/g as identified in Table 4.1-2.

Nitrosamines in Liquid Samples by Gas Chromatography (GC)

This gas chromatography (GC) method was developed from EPA method 607 (EPA 600/4-82-057) and will be USATHAMA certified at the quantitative level.

In the method one liter of the sample will be obtained with a minimum of handling and shaken for 30 seconds with 60 ml methylene chloride. The organic layer is allowed to separate from the water phase for ten minutes, then filtered through glass wool into a 250 ml Erlenmeyer flask. The extraction/filtration procedure is repeated for a second and third time. All three extracts are combined in an Erlenmeyer flask. These combined extracts are washed with 10 ml dilute HCl (1:1) to remove free amines, dried with anhydrous sodium sulfate and concentrated in a Kuderna-Danish (K-D) apparatus to a volume of 10 ml or less for storage.

Prior to analyses the extract is concentrated to 2 ml in a K-D apparatus. Concentrated extract is cleaned on a florisil column and assayed by gas chromatography on a chromosorb W-AW (80/100 mesh) coated with 10% carbowax column using a nitrogen phosphorous detector.

Metals in Liquid Samples

Eleven metals will be assayed in liquid matrices. The metals and principal analytical method will be as follows: arsenic and mercury by atomic absorption; and chromium, cadmium, copper, lead, zinc, magnesium, calcium and sodium by ICP.

The method for arsenic analysis will be derived from EPA Method 206.2 (EPA-600/4-79-020) for water. Using EPA Method 206.2 (EPA-600/4-79-020), a

100 ml sample of water will be digestate with hydrogen peroxide and concentrated nitric acid. The digestate will be assayed by graphite furnace atomic absorption spectrometry. Target detection limits for arsenic in water will be 10 µg/l (as identified during the Analytical Services Meeting on November 13, 1984, ESE No. 84-936-032D).

The mercury methods will be derived from EPA Method 245.1 (EPA-600/4-79-020) for water. In the water method a 100 ml sample will be treated with sulfuric acid, nitric acid, potassium permanganate and potassium persulfate. Excess permanganate will be destroyed with hydroxylamine sulfate. Mercury will be reduced with stannous chloride and assayed by cold vapor atomic absorption spectrometry. The target detection limit for mercury in water will be 0.1 µg/l (as identified during the Analytical Services Meeting on November 13, 1984, ESE No. 84-936-032D). The method for ICP metals in water was derived from EPA Method 200.7 (EPA-600/4-79-020). Target analytes and desired detection limits for ICP metals in the liquid matrix is shown in Table 4.1-2.

All water samples for ICP metals will be digested by adding nitric and hydrochloric acid and heating before analyses to dissolve any precipitates that may have formed after sampling. The sample digestate will be filtered, brought to a final volume of 50 ml and assayed by inductively coupled argon plasma emission spectrometry.

Anions in Liquid Samples

Five anions, including sulfate, nitrate, chloride, fluoride and phosphate, will be surveyed in selected samples. Detection limits for these anions are listed in Table 4.1-2. For sulfate, chloride and fluoride in water, EPA Method 300 (EPA 600/4-79-020) will be used. Nitrates and phosphates in water and all five anions in soils will be assayed by contractor developed methods using an auto analyzer and will be USATHAMA Certified.

In water, the sample will be filtered and analyzed for sulfate, chloride and fluoride directly by ion chromotography using suppressor/separator columns.

Nitrate and phosphate will be assayed on an autoanalyzer. Sulfate, chloride, and fluoride ions will be determined in a single run without post column reaction using peak areas to determine concentration. Nitrate and phosphate ions will be determined colormetrically.

GC/MS Confirmation of Liquid Samples

Approximately ten percent of the total number of liquid samples which were found to contain quantifiable target organic compounds by GC will be screened by GC/MS to confirm analyte identity and purity. The presence or absence of co-eluting unknown peaks will be the single criterion used to confirm purity of target analytes. The GC/MS confirmation will be performed within the prescribed holding time for sample extracts using columns and conditions similar to those used in the original GC analyses. This GC/MS confirmation method will provide positive or negative verification of target compound identity and purity only and will be performed as noted below. New unknowns will not be identified during the GC/MS confirmation program. It is anticipated that low concentrations of certain target analytes may not be applicable to this confirmation technique.

4.2.4 Unknown Identification in Soil, Solid, and Liquid Samples by Gas Chromotography/Mass Spectrometry (GC/MS)

The total ion current GC/MS profile will be screened for all major unknown peaks. The laboratories will report (RT Code, estimated concentrations and print MS traces) all unknowns with peaks greater than 10 percent of the internal standard response. Each of these major unknown peaks, greater than 10 percent of the internal standard response (excluding obviously meaningless peaks, e.g. column bleeds), will be reported as the purity, fit and probability to match for the three most likely candidate compounds from the Environmental Protection Agency/National Bureau of Standards/National Institute of Health (EPA/NBS/NIH) Mass Spectral library computer program.

5.0 QUALITY ASSURANCE PROGRAM

5.1 Project QA/QC Plan

An integral part of the Technical Plan is the project specific Quality Assurance/Quality Control (QA/QC) Plan describing the application of Ebasco's procedures to monitor and control field and analytical efforts at RMA. Ebasco has developed a Project QA/QC Plan applicable to geotechnical, sampling and analytical activities. For Task 11 Ebasco will adhere to and comply with the established QA/QC requirements. The plan is presented in the RMA Procedures Manual. The specific objectives of the Ebasco Quality Assurance Program for RMA are to:

- Ensure adherence to established PMO/USATHAMA QA Program guidelines and standards;
- Ensure precision and accuracy for measurement data;
- Ensure validity of procedures and systems used to achieve project goals;
- Ensure that documentation is verified and complete;
- Ensure that deficiencies affecting quality of data are quickly determined;
- Perform corrective actions that are approved and properly documented;
- Ensure that the data acquired will be sufficiently documented to be legally defensible;
- Ensure that the precision and accuracy levels attained during the PMO/USATHAMA analytical certification program are maintained during the project.

The overall project QA/QC responsibility rests with the Project QA/QC Coordinator. He will be assisted by the Field and Laboratory QA/QC Coordinators. Each field sampling team will include a Field QA/QC Coordinator. The Field QA/QC Coordinator for each team will assure that all quality control procedures are implemented for drilling, sampling, chain-of-custody and documentation.

Ebasco is using two laboratories for the performance of chemical analytical services. Both laboratories will comply with the Project QA/QC Plan. Each laboratory has appointed a Laboratory QA/QC Coordinator. Their responsibilities include:

- Monitor the quality control activities of the laboratory;
- Recommend improvement in laboratory quality control protocol, when necessary;
- Log in samples, introduce control samples in the sample train and establish sample testing lot sizes;
- Approve all data before submission to permanent storage;
- Maintain all quality control records and chain-of-custody documents;
- Assure document and sample security;
- Inform Ebasco's Project QA/QC Coordinator of non-compliance with the Project QA/QC Plan; and
- Prepare and submit a weekly report of quality control data to the Ebasco Project QA/QC Coordinator.

Prior to actual field program, a QA/QC training will be conducted by the Project QA/QC Coordinator to indoctrinate field, laboratory and project personnel in the specific procedures detailed in the Project QA/QC Plan.

Also, the Project QA/QC Coordinator has visited the laboratories to review analytical procedures with chemical analysis personnel and has instructed the Laboratory QA/QC Coordinators in the requirements of the Project QA/QC Plan and data validation procedures. In addition, the Project QA/QC Coordinator will perform audits of field and laboratory work on a bi-monthly basis to ensure compliance with the Project QA/QC Plan. Specific project QA/QC requirements are described in the following sections.

5.2 Specific Project Requirements

5.2.1 Geotechnical Requirements

The project geotechnical requirements are described in Section 7 of the QA/QC Plan (RMA Procedures Manual). These requirements are based on the geotechnical guidelines established by PMO. Specifically, this chapter addresses the geotechnical requirements for well drilling operations, borehole logging, well installation and development, well diagrams, well acceptance, topographic surveying, selected data management entries and geotechnical reports. Ebasco will have a geologist present and responsible at each operating drill rig for the logging of samples and monitoring of drilling operations.

5.2.2 Field Sampling

The management of samples, up through the point of shipment from the field to the laboratory, will be under the supervision of Ebasco's Field QA/QC Coordinators (FQA/QC). Samples must be collected in properly cleaned containers, properly labeled, preserved and transported according to the prescribed methods. Section 8.0 of the Project QA/QC Plan describes the procedures to monitor adherence to approved sampling protocol. If the FQA/QC determines that deviations from the sampling protocol have occurred, resulting in a compromise of the sample integrity, all samples taken prior to the inspection will be discarded and fresh samples will be taken. The FQA/QC is responsible for field chain-of-custody documentation and transfer and will supervise the strict adherence to chain-of-custody procedures.

5.2.3 Laboratory Quality Assurance Procedures

Section 10 of the Project QA/QC Plan describes the Laboratory Quality Assurance Procedures. Both laboratories along with their internal quality assurance programs will adhere to the Project QA/QC Program.

The Laboratory QA/QC Program begins with the receipt of the samples from the field. All samples will be shipped to UBTL for logging in, sample splitting and distribution for analyses. The Laboratory QA/QC Coordinator is responsible for monitoring the laboratory activities. He is also responsible for determining testing lot sizes and introducing laboratory control samples into the testing lot in an inconspicuous manner.

The samples must be analyzed within the prescribed holding time by the approved analytical methods. Analytical methods are described in Section 4.0 of the Technical Plan.

5.2.4 Laboratory Analytical Controls

Daily quality control of the analytical systems ensures accurate and reproducible results. Careful calibration and the introduction of the control samples are prerequisites for obtaining accurate and reliable results. Procedures for instrument calibration and analytical controls are described in Section 12 of the Project QA/QC Plan.

The Laboratory QA/QC Coordinator for each laboratory will monitor the analytical controls. The out-of-control situation can be detected by the control charts.

When an out-of-control situation is detected, efforts will be initiated to determine the cause. Corrective actions will be taken to bring the process under control. Full documentation of an out-of-control situation and the subsequent corrective action will be recorded by the Laboratory QA/QC Coordinator.

5.2.5 Laboratory Data Management, Data Review and Validation and Reporting Procedures

Sections 13 to 16 of the Project QA/QC Plan detail the procedures for laboratory data review, validation and reporting procedures. The laboratories utilize a highly automated system for analytical data collection and reduction. The analytical supervisor along with the Laboratory QA/QC Coordinator review all analytical data after data reduction and prior to the transfer of the data report to Ebasco. The laboratory data reporting procedure is described in Section 15 of the Project QA/QC Plan which is based on the established PMO reporting procedures for analyses performed at quantitative and semi-quantitative levels. Both target compounds and unknowns will be reported by formatting analytical data onto USATHAMA standardized coding forms. The laboratories will adhere to these reporting procedures.

6.1 Plan Overview

This plan presents the data management procedures to be used by Ebasco for the Environmental Program at Rocky Mountain Arsenal. As specified in the contract, all data will be presented to PMO in appropriate format and entered into the IR-DMS UNIVAC 1100/60). PMO has provided a Tektronix 4051 system and IR Data Management User's Guide, Version 85.6 (PMO 1984) to Ebasco for this purpose. Data will be controlled as necessary. Presentation of project management data and report communication is discussed in Ebasco's Management Plan.

Figure 6.1-1 shows schematically the process Ebasco will use to coordinate data management activities between itself and UBTL, CAL and IR-DMS. This is detailed in Section 6.3. As shown in Figure 6.1-1, Ebasco's primary data entry terminal for the IR-DMS will be through the Army-owned Tektronix terminal in Ebasco's Denver office. A second Army-owned terminal is maintained in Ebasco's Santa Ana office for backup data entry purposes. Specifics of data collection, data entry, data validation, and data analysis are discussed herein.

6.2 Field Activities

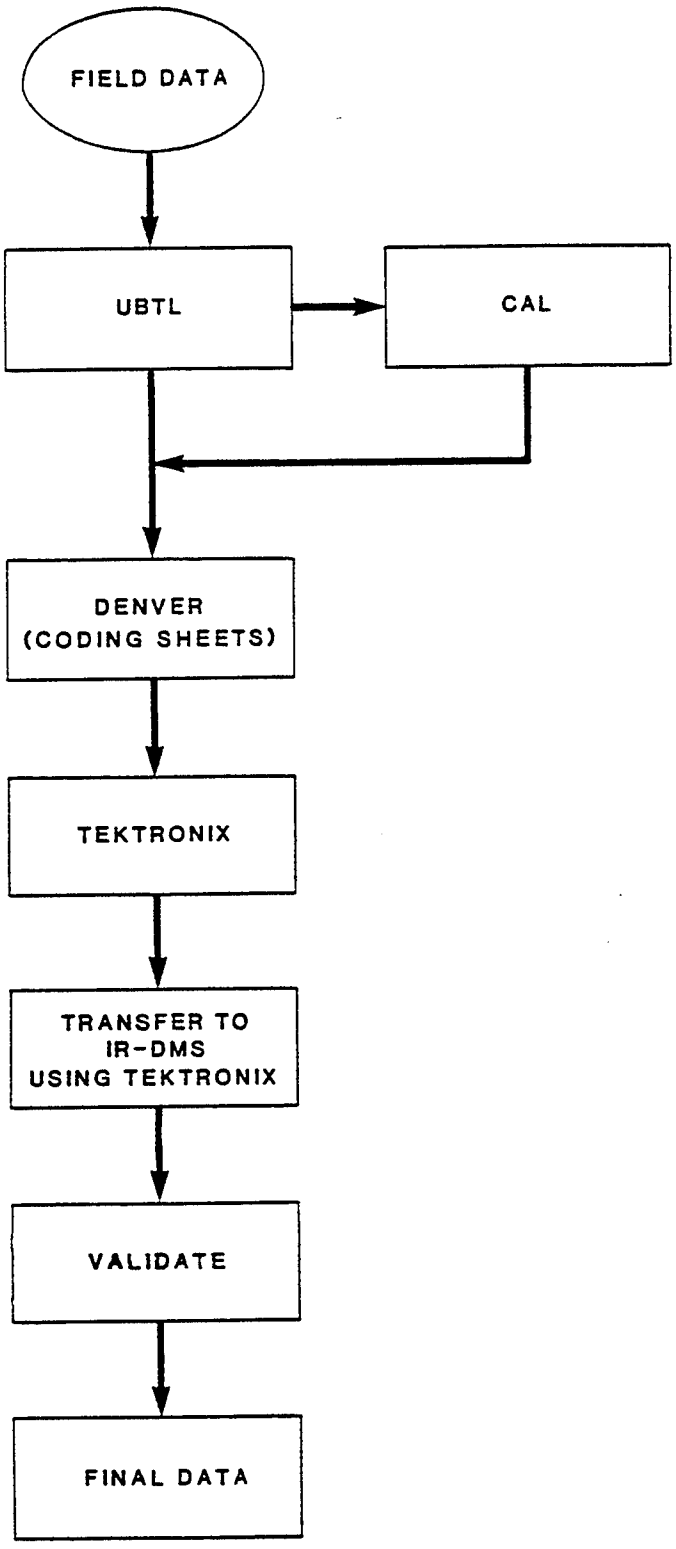
Sample Handling

The Sample Coordinator is responsible for field data collection and sample logging. In addition, the Sample Coordinator will assure that all field data are properly accounted for and transferred to the Data Manager for input into the computer at Ebasco's Denver office in a timely manner.

To accomplish this, the Sample Coordinator will assure that proper sample collection procedures, sample control identification procedures and proper chain of custody procedures are followed. (Specific procedures and reporting

FIGURE 6.1-1

DATA FLOW BETWEEN EBASCO, UBTL, CAL AND IR-DMS



forms to be used for the management of field data are detailed in the RMA Procedures Manual.)

Sample control identification numbers will be assigned to each sample collected in the field by the Sample Coordinator. These sample identifiers are to be recorded on the sample tag in the field data log book and on the sample chain of custody record at the time of sample collection. The chain of custody record will also serve as the analytical request form, verifiable by the analytical request list on the sample tag. The Sample Coordinator will check sample tags, chain of custody forms and field data logs to assure complete and correct field data entry. Field identification numbers will remain with each sample throughout the data collection, shipment, analysis and report phases of the program.

As part of the logging in of field data, the Sample Coordinator will copy each chain of custody form into the field notebook, package and seal the samples for shipment to the laboratory and assure the shipment of these samples. The Sample Coordinator will forward the necessary written field records to the Data Coordinator at Ebasco's Denver office for entry into the computer.

Geotechnical Program

Geotechnical boring logs, containing pertinent data regarding borehole lithology, will be coded immediately upon receipt from the field onto PMO data coding sheets. These data will be entered into the Field Drilling Files by the Ebasco Denver office.

Upon completion of the drilling of borings at each site, a surveying crew will determine map coordinates and ground elevations for the location of each boring. These survey data will be coded immediately onto PMO data coding sheets, and will be entered into the IR-DMS Map Files by the Ebasco Denver office. It is critical that these files be entered into the data management system before the completion of chemical analyses, as each sample location must be associated with a map location.

Laboratory

When samples are received at UBTL, the sample receipt officer will sign the chain of custody record, log in sample shipment, verify sample integrity, assign sample lots, prepare split samples and identify samples to be sent to CAL or to be retained by UBTL for chemical analysis. Each laboratory, UBTL and CAL, will submit weekly sample status reports to Ebasco's Data Manager. This weekly status report will be used to aid in planning the rate of field sampling and the distribution of laboratory workloads.

Field and laboratory sample control identification and chemical analysis data, including unknowns, will be transcribed to the data coding sheet by UBTL and CAL, then verified using the program's laboratory control procedures. The verified data coding sheets will then be delivered, by courier, to Ebasco's Data Manager for entry into the IR-DMS data base.

6.3 Data Entry and Validation

The first step in data entry into the IR-DMS Univac 1100/60 will be to create a magnetic tape copy of the coding sheets on the Tektronix 4051 terminal by keypunching. The Tektronix operator will enter only a subset of a complete file at one time. These file subsets will later be merged to a single file using the UNIVAC. After keypunching, the operator will obtain a printed copy of the data subset using the Tektronix printer, and will verify that the data in the Tektronix tape file is identical to that on the coding sheets. The operator will correct any data entry typographic errors using the Tektronix editor, then obtain a second printing of the file to confirm that the changes were properly made. Methods certification data and map location data will be entered first because validation routines make use of it.

Once the operator is certain that there are no remaining data entry errors on the Tektronix tape, the operator will use the Tektronix 4051 as a remote terminal to transfer the data to the UNIVAC 1100/60. To do this, the operator will load the data entry software, catalog a Level 1 (pre-acceptance)

file on the UNIVAC, and transmit the data over the telephone lines using a modulator-demodulator (modem). Ebasco's operators will transfer Tektronix entry tape files to Level 1 UNIVAC files at least once per week, and will maintain a log of terminal usage and communication with the UNIVAC.

Once data is transferred, the operator will make use of IR-DMS utilities provided to convert English units of measurement to SI units and to convert State Planar or UTM grid system coordinates to local origin coordinates, if necessary.

Next, the operator will invoke the IR-DMS data acceptance routines to perform the final data verification and create a Level 2 (temporary read-only) file. The acceptance routines will identify any errors in format or coding and any inconsistencies with corresponding map records previously loaded. If the acceptance routine does find errors at this stage, the operator will check the "R" file. The "R" file contains the rejected records that the acceptance routine creates. The UNIVAC editor is used to correct the verified entries, then they are resubmitted to the UNIVAC for acceptance. After acceptance, the IR-DMS automatically creates chemical and geological Level 2 files. Ebasco's operators will run the Level 1 data files through the data acceptance routines within seven days of their transfer to the UNIVAC system. They will delete Level 1 files once these data are accepted at Level 2.

Once the Level 2 file is created, the data processing operator will create a printed copy of the data set on the UNIVAC 1100/60 and submit, within ten working days of the Level 2 transfer, this copy to PMO.

The final step in the data entry and validation process, the creation of a Level 3 (final version, read-only) file, is undertaken by the PMO APG-EA data processing staff.

Ebasco intends to develop a streamlined data collection/entry procedure during the course of this program. This procedure will involve data entry and verification on the VAX computers at UBTL and CAL with subsequent data transfer to an IBM PC or Tektronix computer at Ebasco's Denver office. Data

is then entered into the UNIVAC. The system is expected to increase the efficiency and reliability of the collection/entry process without any adverse cost impacts to PMO. While this streamlined system is being developed, the data flow to the UNIVAC will be maintained via the Tektronix-UNIVAC hardware.

6.4 Analysis and Presentation

Ebasco scientists will access the PMO IR data base and will perform analyses as required to support all contamination assessment work. The data analysis efforts will include graphic representations of data using data gridding, contouring, and three-dimensional surface representations. (Specifics of the contamination assessment work are presented in Section 8.)

Several techniques will be used to access the data. If possible, IBM PCs will be used in terminal emulation mode to capture Level 3 data from the IR data base in order to perform analyses and prepare material for presentation. The Tektronix 4051 terminals in Denver and Santa Ana will also be used in a direct link to the UNIVAC to prepare analyses and graphic representations. Ebasco scientists may establish communication links between IBM PCs to interchange data and facilitate data analysis.

7.0 HEALTH AND SAFETY PROGRAM

A draft of the project Health and Safety Plan (HASP), prepared according to the Ebasco Corporate Health and Safety Program, is included in the RMA Procedures Manual. The purpose of this section is to provide an overview of the safety program that Ebasco will employ to ensure the safety of its employees and that of subcontractors engaged in the field investigation activities at RMA. All personnel working at RMA are or will be familiar with this document and they are and or will be indoctrinated in all aspects of the safety program, which complies with OSHA guidelines and criteria.

In particular, the following specifics of this document are especially important to the investigative activities. These are:

- Safety organization, administration and responsibilities;
- Initial assessment and procedures for hazard assessment;
- Safety training;
- Safety operations procedures;
- Monitoring procedures;
- Safety considerations for sampling; and
- Emergency procedures.

Overall responsibility for safety during the site investigation activities rests with the Project Health and Safety Officer. He is responsible for developing the site-specific HASP at RMA and through the on-site Health and Safety Coordinator assumes its implementation responsibility. Specifically, he and his staff are responsible for:

- Characterizing the potential specific chemical and physical hazards to be encountered;

- Developing all safety procedures and operation on-site;

- Assuring that adequate and appropriate safety training and equipment are available for project personnel;

- Arranging for medical examinations for specified project personnel;
- Arranging for the availability of on-site emergency medical care and first aid, as necessary;
- Determining and posting locations and routes to site work zones;
- Notifying installation emergency officers (i.e., police and fire departments) of the nature of the team's operations and making emergency telephone numbers available to all team members; and
- Indoctrinating all team members in safety procedures.

In implementing this safety program, the project Health and Safety Officer will be assisted by a field Health and Safety Coordinator. His function is to oversee that the established health and safety procedures are properly followed. The details of the safety organization, administration and responsibilities are described in Section I of this HASP.

Based on the evaluation of past activities, incidents, accidents and investigations, the presence of chemicals and wastes are expected to be found in the area that will be investigated under Task 11. The characteristics of these wastes are known to be toxic and hazardous to human health. The conclusion on the site hazard assessment based on historical evidence is that the overall site hazard assessment is extremely variable and is entirely location and operation dependent. Section V of the HASP describes the procedures to be employed to determine hazard of a specific building or a sampling location for the identification of the preliminary level of protection requirement.

Section VI of the HASP explains the training program that is planned for the RMA project. Basically, the training will focus on the general health and safety consideration and provide site specific safety instructions.

Section VII describes in detail the safety operations procedures. The important aspects of the safety operations procedures are:

- o Zone approach for field work;
- o Personal protection; and
- o Communications.

A three zone approach (Support Zone, Contamination Reduction Zone and Exclusion Zone), where possible, will be utilized for field work at RMA. The Support Zone will contain the Command Post with appropriate facilities such as communications, first aid, safety equipment, support personnel, hygiene facilities, etc. This zone will be manned at all times when field teams are operating downrange. Adjacent to the Support Zone will be the Contamination Reduction Zone (CRZ) which will contain the contamination reduction corridor for the decontamination of equipment and personnel (the actual decontamination procedures are discussed in Section X of the HASP). A hotline for operations within the HBSF will be established as the fence line of the HBSF. All areas beyond the CRZ will be considered the Exclusion Zone. For well drilling or soil boring operations the Exclusion Zone will be established as a 30 foot radius from the drill rig. These support facilities are discussed and illustrated in Section III.

The level of protection to be worn by field personnel will be defined and controlled by the on-site Health and Safety Coordinator and will be specifically defined for each operation in an information sheet (Facility Information Sheet). The preliminary Facility Information Sheet (FIS) will be developed based upon historical information and data. This will be upgraded and utilized for future operations based upon the results of the Health and Safety portion of the Soil Sampling programs. All operations targeted within the HBSF will be conducted in level "B" protective equipment. Level "B" protection requirement is based on several factors including: previous data for the area indicating the need for level "B"; an extremely low Threshold Limit Value (TLV) of 0.1 ppm for hydrazine (ACGIH 1985); and the absence of a non-SCBA type respirator for hydrazine. In the case of all but the geophysical survey operations, the level "B" protection will employ the use of dual purpose SCBA used mainly in the airline mode. This will include the technician assigned the responsibility of tending the breathing air cascade manifold system. Dual purpose SCBA will provide the necessary mobility to the field team in order to stage equipment down range

and deploy the cascade manifold system. It should be noted that the breathing air tender will have his own breathing air cylinder separate from the cascade system due to equipment limitations. The geophysical survey within the confines of the HBSF will be conducted at level "B" using SCBA because of the necessary mobility associated with the task. If determined necessary, changing to Level C or A protection can be easily achieved in the field in a matter of hours. Basic level of protection (i.e., Levels A, B, C or D) for general operations are defined in Section VII.

Maintaining proper communications among team members (investigation team and Health and Safety team members) during field investigation work is of utmost importance for the protection of investigation team members. The methods of communication that will be employed are:

- Walkie Talkies;
- Air Horns;
- Hand Signal; and
- Voice Amplification System.

For external communication telephones and sirens will be utilized.

Section VIII explains the health and safety monitoring procedures. A continuous monitoring of the working environment will be performed to ensure the adequacy of the level of personnel protection. Depending on the history of the sampling location the presence of the following parameters will be monitored:

- Army Agents;
- Oxygen Level;
- Explosive Conditions;
- Organic Vapors Level;
- Inorganic Gases Level; and
- Dust Analyses.

The type of on-site monitoring instruments to be utilized includes but is not limited to the following and will be based on the potential for the instrument specific contaminants to be present:

- o M18A2 Chemical Agent Kit for Army Agents;
- o M8 Alarm for nerve agent;
- o Oxygen meter for oxygen level;
- o Combustible gas indicator for explosive condition;
- o PID and FID meters for organic vapors; and
- o For inorganic gases, a gold film mercury monitor, a chlorine monitor, a carbon monoxide monitor and a hydrogen sulfide monitor.

Air monitoring will be conducted using both direct reading instrumentation (the HNu and OVA predominately) and portable sampling pumps with Tenax and acid washed fire brick sampling media. Samples collected with the portable sampling pumps will be submitted for lab analysis when: 1) direct reading instruments indicate the presence of airborne contaminants greater than the background level established outside of the HBSF; 2) operations involve fluids that employees may contact; 3) any employee experiences respirator leakage; and/or 4) any employee experiences symptoms of exposure.

Based on the monitoring results (real time and field or laboratory analyses of the health and safety samples) the on-site Health and Safety Coordinator can stop field investigation work or upgrade and or downgrade the level of personal protection.

Section IX of the HASP explains the safety considerations during actual sampling events. It describes the safety procedures to be followed for drilling operations, soil, surface water and liquid waste sampling, building sampling, and sampling in a confined space.

The geophysical survey to be conducted for the HBSF area will be similar to that which has been conducted for other RMA tasks, with the exception that these will be conducted under level "B" protection. Because of the need to change SCBA bottles, this operation will require significant logistical

support. In addition, it should be noted that the advanced training requirements apply in this situation.

Approximately 15 boreholes will be drilled in the HBSF area. These borings will be done in accordance with the existing RMA HASP except that all cuttings will be drummed for disposal.

The Technical Plan calls for the installation of two monitoring wells for the HBSF area. Precautions similar to those employed for boring will be employed, including the drumming of all cuttings generated as part of the well drilling.

During the development and testing of the wells, special attention must be given to any fluids that are used and/or produced. All the fluids generated during well development must be collected in drums for subsequent disposal. Additionally, employees that may be subject to splash by liquids from well development must be protected from contact with those liquids by the use of butyl rubber aprons.

In addition to the two new wells, several existing monitoring wells will be sampled. As in the case of well development, all fluids produced must be collected for subsequent disposal and the employees must be protected from making contact with those same fluids. Monitoring of each well will precede this operation and personnel sampling will be performed.

The mobile decon trailer will be stationed in the CRZ, outside and upwind of the HBSF during the course of all operations conducted within that area. While hydrazine and its products are not considered "Army Agents" the same decon solutions that we have used to neutralized potential agent contamination will be used for the hydrazine group. The H&S Supervisor will assure that those decon solutions are placed at both the gross boot and glove wash stations of the decon line.

The emergency procedures are described in Section XII to XIV of the HASP. Section XII explains the basic emergency scenarios and activities to be undertaken during each of these emergency situations; Section XIII describes

how to get emergency services (i.e. medical, fire protection, ambulance, etc.) and Section XIV outlines the evacuation procedures in case of emergency such as fire, explosion, and/or a significant release of toxic gases.

APPENDIX A

BIBLIOGRAPHY

8.0 CONTAMINATION ASSESSMENT

The primary objective of the Task 11 Contaminant Assessment Program is to present and qualify information developed under the various Task 11 work elements in support of a closure plan for the facility. In addition, data developed under Task 11 also will enhance the data base for litigation. The program implemented to achieve these objectives will identify the nature and extent of contamination that may be present in the soil and groundwater, will evaluate the factors that govern contaminant distribution within the HBSF, and will develop information on the severity of the contamination. The investigation will be conducted to identify which portions of the site, if any, are contaminated, and if so, the nature of the contamination. Information will be developed through the use of a limited number of borings and monitoring wells from which samples will be screened for pollutants. The results of the investigation will be utilized to define the extent of any additional data requirements necessary to develop a closure plan for the facility. The specific data sources to the closure plan are delineated in sections 8.2 and in Task 13.

8.1 Program Outline

Specifically, the Contamination Assessment Program will consist of the following subtasks:

1. Description of the local geologic and hydrogeologic conditions;

2. Description of the type, magnitude, areal distribution and vertical extent of contamination in the soils of the HBSF and in the uppermost aquifer beneath the HBSF;

3. Identification of probable sources including the development of information on the originator, user, manufacturer or disposer of hazardous materials in the HBSF related to these sources;

4. Estimation of the degree of hazard(s) presented by any contamination found to be present;

5. Preliminary evaluation of the fate and transport or migration potential of any contamination detected at the HBSF; and

6. Development of a plan for continued monitoring associated with postclosure.

8.1.1 Local Geologic and Hydrogeologic Conditions

Current and available historic hydrologic data along with geologic logs developed from Task 11 drilling activities will be compiled and interpreted to develop an understanding of the local hydrogeologic conditions. Data will be presented as maps and cross sections of the local soils and geologic materials. The assembled data will be those soil properties which impact the retardation or mobility of contaminants. Groundwater flow rates and directions within the uppermost aquifer below the HBSF will be estimated. Local aquifer characteristics (hydraulic conductivity and transmissivity) will be determined from slug tests and estimates of porosity and storage coefficients will be made.

8.1.2 Type, Magnitude, Area, Distribution and Vertical Extent of Contamination

The results of the soil boring analyses will be examined to determine the presence, magnitude, and extent of soil and shallow groundwater contamination within the HBSF. The chemical data will be integrated with the hydrogeologic data to access the types and concentrations of contaminants present, estimate the lateral and vertical extent of the contaminants and define potential source boundaries. Maps (equipotential and concentration contour) and cross-sections will be prepared, where appropriate, to illustrate the spatial distribution of contamination and to delineate the existence of distinct contaminant concentration gradients in the proximity of the HBSF.

8.1.3 Probable Cause(s) of Detected Contamination

The probable cause of any contamination that may be detected will be examined by comparing the data obtained in this study with the historic

conditions at the HBSF. The geologic logs of the boreholes and the new wells, the soil chemistry, the groundwater quality and all available groundwater flow information for the HBSF will be examined with regard to the historic use of the HBSF, the recorded spills or leaks at the HBSF and the pattern of movement of the wastes at the HBSF.

8.1.4 Hazard Evaluation

The soils and groundwater quality data developed under this Task 11 plan will be compared to concentration limits developed under Task 13 and by PMO/USAMBRDL to determine the extent of contamination in the HBSF. A predetermined level of concentration for each of the chemical compounds (i.e., hydrazine, UDMH and NDMA) will be established under Task 13. Separately, PMO/USAMBRDL is developing contamination criteria levels for various contaminants present at the RMA including the contaminants of concern at the HBSF. Upon completion, the study by PMO/USAMBRDL will also be part of the closure plan. The PMO/USAMBRDL study will perform risk analyses for each of the contaminants to determine the concentration levels for each of the contaminants below which they can be classified as clean.

8.1.5 Contaminant Mobility, Persistance and Reactivity

The mobility, persistance and reactivity of contaminants detected in the course of this study will be described from the literature in the resulting contamination assessment. The description will include information developed during the study and will assist in the evaluation of the probable cause of the contamination as discussed in part 8.3.

8.1.6 Continued Monitoring

Postclosure monitoring of groundwater quality can be performed under Task 4, if necessary. Task 4 currently is monitoring the groundwater quality of the existing wells on a quarterly basis until fall 1986. However, the chemicals directly related to the HBSF, such as the hydrazines and NDMA, currently are not included in the routine Task 4 analyses. Should continued moitoring of the groundwater quality become necessary, a postclosure monitoring plan will be developed under Task 11.

8.2 Data Applications

The information developed through the implementation of the various work elements identified above is intended to support the Task 13 closure plan by providing information which addresses the following requirements of 40 CFR 264 Subpart G (264.110 - 264.120):

264.111(a) and (b) Performance standard. Data developed under Task 11 will serve as the basis for determining the level (scope) of clean-up that will be necessary under the closure plan to prevent any future threat to human health and/or the environment.

264.112(a)(2) Waste inventory. Task 11 will delimit the areal and vertical extent of the contaminated soil in the facility that will need to be removed under the proposed clean closure plan. An estimate of the volume to be removed will be made under a future task.

264.112(a)(4) Closure schedule. Task 11 will develop information which will aid in determining the time required to complete the appropriate portions of the closure plan.

264.117(a)(1) Postclosure care. Task 11 will provide the initial round of soil and groundwater quality data that may serve as the basis for a postclosure monitoring program should a clean closure approach not be possible.

264.118(a)(1) Postclosure monitoring. Task 11 will develop information which will be used, if necessary, to prepare a postclosure monitoring plan. The manner in which those remaining data collection, reporting and evaluation requirements of 40 CFR 264 Subpart G not addressed by the Technical Plan for Task 11 will be fulfilled to achieve complete regulatory compliance is described below.

The manner in which those remaining data collection, reporting, and evaluation requirements of 40 CFR 264 Subpart G not addressed by the Technical Plan for Task 11 will be fulfilled to achieve complete regulatory compliance is described below.

264.112(a)(2) Waste inventory. Preliminary inventories of the fuels, waste, and wastewater in storage at the HBSF have been provided by RMA for use in Task 13. A preliminary inventory of the contaminated above ground equipment has been provided by the U.S. Air Force contractor, Dames & Moore for Task 13. Final inventories of fuels, waste, and wastewater in storage, of contaminated equipment above ground, and of contaminated equipment below ground will be accomplished under a yet to be assigned task.

264.112(a)(4) Closure schedue. Input on the time required to complete the portions of the closure plan not relating to soil or groundwater contamination will be provided to Task 13 from the RMA and the U.S. Air Force who have joint responsibility for the facility.

164.114 Disposal or decontamination. Task 13 will describe the method(s) for identifying contaminated equipment and structures and the procedures which will be implemented to dispose of or decontaminate such structures.

264.117(a)(1) Postclosure care. In the event that contaminated groundwater attributable to past facility operations is identified at the site, continued postclosure monitoring may be required. Should this be the case monitoring would be performed using the existing monitoring well network as part of PMO/USATHAMA's ongoing arsenal wide monitoring program (Task 4).

264.118(a)(1) and (2) Postclosure plan. A postclosure plan which describes postclosure monitoring activities and frequenices along with appropriate maintenance functions will be prepared by Ebasco with input from the U.S. Air Force and RMA. The postclosure plan will be operated by an undertermined contractor to the PMO.

BIBLIOGRAPHY

Barkley, N., Project Officer U.S. EPA Municipal Environmental Research Laboratory, Solid and Hazardous Waste Research Division, Cincinnati, Ohio. Personal Communication, May, 1984.

Blackwell, P. A., Army Materiel Command Contamination Survey, Rocky Mountain Arsenal Colorado, August, 1973.

Bouwer, H., and R. C. Rice, A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resources Research, 12, p. 423-428, 1976.

Bredehoeft, J. D., and S. S. Papadopulos, A method for determining the hydraulic properties of tight formations, Water Resources Research, 16, p. 233-238, 1980.

Dames & Moore, Inc. 1985. IRP Phase II Confirmation/Quantification, Stage I, Draft. Prepared for the HBSF, RMA. October 25.

Department of the Army, Rocky Mountain Arsenal, Denver, Colorado Map of South Plants Area Sanitary and Contaminated Waste Lines. May 9, 1979. Microfilm Document RIA004, Pages 0048-0056.

Department of the Army, Rocky Mountain Arsenal. SOP for Disposal of Contaminated Buildings, June 29, 1984. DA RMA, Commerce City, Colorado.

Department of Earth Sciences, University of Waterloo, Waterloo, Ontario: Field Methods in Contaminant Hydrogeology, 1981.

Everett, L. G. and Wilson, L. G., 1984. Unsaturated Zone Monitoring for Hazardous Waste Land Treatment Units: Kaman Tempo, Santa Barbara, California.

Geraci, C. L., National Institute for Occupational Safety and Health, Cincinnati, Ohio, Personal Communication, May 1984.

Geraghty and Miller, Inc., Damage Assessment Report, Volume III, Study Area 2, Working Draft, October 15, 1984. Denver, Colorado.

Gilbert, R. O. 1982. Some Statistical Aspects of Finding Hot Spots and Buried Radioactivity. TRAN-STAT: Statistics for Environmental Studies, No. 19, PNL-SA-1027, Battelle Memorial Institute, Pacific Northwest Laboratory. Available from National Technical Information Service, Springfield, Virginia. DE83 002742.

Goodwin, B. E., J. R. Aronson, R. P. O'Neil and E. M. Smith, Surface Sampling Techniques, Final Report, Volume I, September, 1982. Report DRXTH-TA-CR-82179. U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland.

Harland Bartholomew & Associates and Gilbert/Commonwealth, Commonwealth Associates, Inc. 1982. Property Inventory and Survey Report for Selected Shell Constructed Buildings within the Shell Oil Company Leasehold Area at U.S. Army Rocky Mountain Arsenal, Commerce City, Colorado. Volumes I-VII.

Hvorslev, M. J., Time lag and soil permeability in groundwater observations, U.S. Army Corps of Engineers Waterways Experiment Station Bull. 36, 1951.

Kuznear, C., and W. L. Trautmann, History of Pollution Sources and Hazards at Rocky Mountain Arsenal, September 1980. Rocky Mountain Arsenal Information Center, Commerce City, Colorado.

Lohman, S. W., Groundwater Hydraulics, U.S. Geological Survey Professional Paper 708, 70 p., 1972.

Master Plan Basic Information Maps prepared by the U.S. Army Corps of Engineers, Omaha Nebraska and the Office of the Post Engineer, Rocky Mountain Arsenal.

General Sanitary Sewer Map, Area 5 Drawing No. 18-02-10, 2 October 1978 Sheet 37 of 67.

General Contaminated Waste Map, Area 5 Drawing No. 18-02-10, 2 October 1978 Sheet 38 of 67.

General Storm Drainage and Tree Cover Map, Area 5. Drawing No. 18-02-01, 2 October, 1978 Sheet 43 of 67.

RMA Facilities Engineering Division - Building Plan Inventory List.

Resource Consultants, Surface Water Hydrologic Analyses, Rocky Mountain Arsenal, Denver, Colorado, Prepared for Steams-Roger Engineering Corp. and USATHAMA, March, 1982, Plate II.

Resource Consultants, 1:100 Scale Topographic Sheets, Sections 1 and 2, RMA, Colorado.

Roach, A., U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland. Personal Communication, October, 1984.

Shell Chemical Company, 1979. Chemical Sewer Project, Denver, Colorado. Prepared by Kintech Services, Incorporated.

Singer, D. A. 1972. ELIPGRID, A Fortran IV Program for Calculating the Probability of Success in Locating Elliptical Targets with Square, Rectangular, and Hexagonal Grids. Geocom Bulletin, Vol. 5, No. 5-6, May-June 1972. p. 111-126.

Turpin, R., Safety and Occupational Health Manager, U.S. EPA Environmental Response Team, Edison, New Jersey. Personal Communication, October, 1984.

U.S. Army Toxic and Hazardous Materials Agency, Sampling and Chemical Analyses Quality Assurance Program For U.S. Army Toxic and Hazardous Materials Agency, April 1982.

U.S. Army Toxic and Hazardous Materials Agency, Installation Assessment of Rocky Mountain Arsenal, Report No. 107, March 1977. Aberdeen Proving Ground, Maryland.

U.S. EPA Environmental Monitoring and Support Laboratory. Methods for Chemical Analysis of Water and Wastes, Revised March 1983. EPA-600/4-79-020.

U.S. EPA Environmental Monitoring and Support Laboratory. Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, July 1982. EPA-600/4-82-057.

U.S. EPA Municipal Environmental Research Laboratory. Draft Users Guide for Decontaminating Buildings, Structures and Equipment at Superfund Sites. July 1984, Solid and Hazardous Waste Research Division, Cincinnati, Ohio, Contract # 68-03-3190.

U.S. EPA Office of Solid Waste and Emergency Response. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, July 1982. EPA SW-846 2nd Edition.

U.S. EPA Municipal Environmental Research Laboratory. Samplers and Sampling Procedures for Hazardous Waste Streams EPA-600/2-80-018, January 1980.

Whitten, C. B., and Shamburger, J. H. DBCP Source Definition, USAEWES, September 1, 1985.

Zirschky, J. and R. O. Gilbert, 1984. Detecting hot spots at hazardous-waste sites. Chemical Engineering July 9, 1984.