SAP

AR0083

CDM

Revised Final
Approved 8-26-91
Copy # 3 of 3

Revised Final
Remedial Investigation and Feasibility Study Sampling and Analysis Plan

For

Fresno Sanitary Landfill
Fresno, California

Camp Dresser & McKee

Revised Final
Remedial Investigation and Feasibility Study Sampling and Analysis Plan

For

Fresno Sanitary Landfill
Fresno, California

Prepared For:

City of Fresno
2326 Fresno Street
Fresno, California 93721

Prepared By:

Camp Dresser & McKee Inc.
100 Pringle Avenue, Suite 300
Walnut Creek, California 94596

May 6, 1991
(Revised August 12, 1991)

CDM
environmental engineers, scientists,
planners, & management consultants

CAMP DRESSER & McKEE INC.

One Walnut Creek Center
100 Pringle Avenue, Suite 300
Walnut Creek, California 94596
415 933-2900 Fax No. 415 933-4174

August 12, 1991

Mr. George Slater
Assistant Director, Public Works
City of Fresno
2101 G Street, Building A
Fresno, CA 93706

Submittal of Final Sampling and
Analysis Plan (SAP) and Response to
Additional Comments on the RI/FS SAP
Fresno Sanitary Landfill

Dear Mr. Slater:

Camp Dresser & McKee Inc. (CDM) has reviewed the additional RI/FS Sampling and Analysis Plan comments submitted by the Environmental Protection Agency (EPA) and received on July 12, 1991. Please find attached the response to those comments and the Revised Final SAP document. A copy of these deliverables has also been transmitted to Bret Moxley of the EPA.

Please do not hesitate to call if you have any questions regarding this matter.

Very truly yours,

CAMP DRESSER & McKEE INC.

Wayne Pickus

Wayne Pickus
Project Manager
CE No. C 037025

Enclosure

2416-112-RI-RIREP
WP#4.030

TABLE OF CONTENTS

3.0 FIGURES

REFERENCES

APPENDICES

LIST OF FIGURES (See Section 3)

LIST OF TABLES

Section One

1.0 OBJECTIVE

1.1 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared by Camp Dresser & McKee Inc. (CDM), as a requirement of the ongoing Remedial Investigation/ Feasibility Study (RI/FS) for the Fresno Sanitary Landfill (FSL) site. The City of Fresno (City) is conducting the RI/FS on the FSL site at the request of the U.S. Environmental Protection Agency (EPA) to investigate the nature and extent of contamination at the FSL site, to assess the potential risk to human health and the environment, and to develop and evaluate potential remedial alternatives. Overall guidance for the RI/FS process is provided by the project Work Plan, which has been prepared by CDM and previously submitted to EPA. The Work Plan describes all RI/FS tasks which are required to fulfill EPA guidance for site assessment. In contrast, the SAP provides a mechanism for planning field activities and consists of a Field Sampling Plan (FSP) component and a Quality Assurance Project Plan (QAPP) component. If there exists a discrepancy between the Work Plan and the SAP, the SAP will take precedence.

The field sampling plan described in this document has been designed to address the activities involved in sampling and data gathering for the FSL field program. In addition, the SAP includes a Quality Assurance Project Plan (QAPP), which contains quality assurance and quality control protocols. The SAP has been prepared in accordance with appropriate EPA guidance documents.

1.2 PROJECT ORGANIZATION

The FSL RI/FS project organization is shown in Figure 1-1. Key personnel and their respective responsibilities for the implementation of the FSL RI/FS are identified below.

- Mr. John Mitchell - City of Fresno (City) Environmental Program Manager.

- Mr. George Slater - City of Fresno (City) Project Manager.

- Mr. Bret Moxley - EPA Remedial Project Manager (RPM). As stated in the FSL Consent Decree, EPA will be performing the risk assessment for the FSL site.

- Mr. Wayne Pickus - CDM Project Manager, responsible for day to day management and communication with the City of Fresno (City) and meeting overall project objectives. Mr. Pickus will also be responsible for directing engineering and scientific efforts in the development of the FS report.

- Ms. Sara Black - CDM Project Hydrogeologist. As the FSL Project Hydrogeologist, Ms. Black will be responsible for implementing and supervising the RI field programs.

- Ms. Laurie Mann - CDM Quality Assurance and Quality Control (QA/QC). Ms. Mann is responsible for QA/QC development and reporting activities for the project.

- Technical Review - The CDM technical review committee will be responsible for reviewing all deliverables prior to their submission to the regulatory agencies.

- Field Personnel - CDM field personnel are responsible for data collection activities under the RI field programs.

1.3 OBJECTIVES OF THE SAMPLING AND ANALYSIS PLAN

The objectives of the SAP are to ensure that sample collection and analytical activities are performed in accordance with EPA criteria and technically acceptable protocols. The SAP describes the data collection methods, field procedures, analytical methods, and data quality objectives for all environmental investigations performed under the RI/FS for the FSL. The following sections describe the specific objectives of the field sampling plan component and the Quality Assurance Project Plan (QAPP) component of the FSL SAP.

1.3.1 Objectives of the Field Sampling Plan

The specific objectives of this field sampling effort are as follows:

1. Determine the pathways of subsurface migration of landfill gas.
2. Define the extent and nature of off-site migration of the landfill gas.
3. Determine if leachate is a mechanism for contaminant transport.
4. Refine the hydrogeologic characteristics of the site, including both the vadose zone and the saturated zone.
5. Determine the extent and nature of groundwater contamination.
6. Continue to monitor water quality of residential wells.
7. Determine impact of subsurface gas on ambient air quality.
8. Determine extent and nature of off-site soil contamination.

In order to achieve these objectives, a number of field investigations are proposed and described in this SAP. These field activities include a soil gas investigation, a hydrogeologic investigation, a groundwater investigation, a residential well sampling program, an air investigation, and a surface and subsurface soil investigation. The results of these investigations will be incorporated into the Fresno Sanitary Landfill RI/FS.

1.3.2 Objectives of the Quality Assurance Project Plan (QAPP)

The objectives of a QAPP is to ensure that data collected during an RI/FS investigation is scientifically valid, are of known quality which meets established objectives, and are legally defensible, if necessary. The most important section of a QAPP are the Data Quality Objectives (DQOs) which are quantitative and qualitative statements of the type of data needed to support a decision, based on the level of uncertainty that a decision-maker is willing to accept and the resources available. DQOs for each field investigation are discussed in subsequent sections.

1.4 ORGANIZATION OF THE SAMPLING AND ANALYSIS PLAN

This document describes the specific quality assurance and field sampling procedures for each investigation described in Section 1.3.1. Each task discussed in Sections 4 through 10 is divided into two subsections consisting of data quality objectives (DQOs) and sampling rationale. Detailed analytical procedures for each task have been grouped into Appendices B-1 and B-2. In this manner, both the FSP component and QAPP criteria are addressed for each investigation presented in this report, as recommended by EPA guidance.

The site history is presented in Section 2.0. All figures are contained in Section 3.0. Section 4.0 presents DQOs, sampling rationale, and analytical and quality control procedures for the soil gas investigation. The same format is then followed for Section 5.0 - Leachate Investigation, Section 6.0 - Hydrogeologic Investigation, Section 7.0 - Groundwater Investigation, Section 8.0 - Residential Well Sampling, Section 9.0 - Surface and Subsurface Soil Investigation, Section 10.0 - Ambient Air Sampling, and Section 11.0 - RI Derived Waste.

Section 12.0 presents field methods and procedures, Section 13.0 discusses data quality management, and Section 14.0 describes quality assurance oversight.

Section Two

2.0 BACKGROUND

2.1 SITE LOCATION AND HISTORY

The Fresno Sanitary Landfill (FSL) is located four miles southwest of the City of Fresno in Fresno County, California, as depicted in Figure 3-1. The landfill consists of approximately 145 acres and is bounded on the north by Jensen Avenue, on the east by West Avenue, on the south by North Avenue and the west by agricultural fields. The area surrounding the landfill is primarily agricultural with several residences adjacent to the north and south boundaries.

The FSL is owned and was operated by the City of Fresno as a Class III municipal landfill, as defined in the current California Code of Regulations, Title 23, Chapter 3, subchapter 15 (Discharge of Waste to Land). The FSL is reported to be the oldest compartmentalized municipal landfill in the Western United States (CH2M Hill, 1989). Operations began in the north section of the landfill in 1937. Short trenches were dug to a depth of 3 feet (eventually increased to a depth of 25 feet); waste was dumped into the trench by collection trucks, the pile was leveled off and compacted; a second trench was dug adjacent to the first trench, and the dirt from the second trench was used to cover the waste fill. The landfill area was never lined.

According to the FSL Closure and Post-Closure Maintenance Plan prepared by Emcon in December 1989, from 1937 to 1964 the landfill received only domestic wastes from various sources. From 1964 until the site closed in 1989, the landfill received only municipal wastes collected by the City. The average waste stream consisted of 16,500 tons per month; the total waste quantity is approximately 4.7 million tons (assuming an in-place refuse density of 1,200 lbs/cubic yard), or 7.9 million cubic yards (Emcon, 1989). According to Emcon's report, the landfill accepted approximately 500 pounds per day of waste from local convalescent homes and the Fresno Dialysis Center, with approval from the County Health Department. The time periods that these wastes were received is not known.

At the time of its inception, the landfill was primarily located north of Annadale Avenue. The depth of the landfill was approximately 10 to 15 feet below the surrounding terrain. The City expanded the landfill to the south of Annadale in 1945. Prior to this expansion an irrigation canal extended in an east-west direction through what is now the south portion of the landfill. After expansion, this canal was replaced with a pipeline that is currently in use and is covered by landfill material. In June 1984, the edge of the pipeline was excavated and a video camera was drawn through the pipeline to check the pipe's integrity. This effort showed that the pipe sagged considerably. This sag is probably due to ground settling from the weight of the landfill overburden.

The City began the process of closing the landfill by filing a Negative Declaration with the California Regional Water Quality Control Board (RWQCB) in August 1981. The FSL was first evaluated by the Superfund program as a result of a CERCLA Section 103 (c) notification filed by the City of Fresno Solid Waste Management Division on May 27, 1981. The California Department of Health Services (DOHS) conducted a preliminary inspection of the site in June 1984 in response to complaint letters from nearby residents. The Preliminary Assessment determined that off-site migration of methane gas and a variety of volatile organic chemicals in the groundwater had been documented.

The problem of methane gas was first identified in June 1983, when the Fresno City Public Works Department and the County Health Department conducted a preliminary investigation using portable equipment. A methane monitoring system consisting of 17 methane monitoring wells have since been installed. In November 1984, the City installed methane migration barriers along the northern and southern boundaries of the landfill. The barriers are trenches 26 feet deep containing a vertical sheet of plastic and filled with rock, which have two horizontal perforated PVC pipes at depths of 12 and 19 feet which vent passively to the surface.

Groundwater monitoring efforts have included sampling domestic-private, irrigation, and monitoring wells near the landfill. Sampling has been conducted by the City, DOHS, and the RWQCB. Samples have been analyzed for general mineral constituents, physical parameters, anions/cations, trace metals, EPA Method 601 and 602-volatile organics (VOCs), and pesticides. VOCs are reported to be in the shallow aquifer at levels reported to be in excess of ARARs (CH2M Hill 1989).

Most recently EPA's Technical Assistance Team has sampled soil gases beyond the methane barriers for VOCs including vinyl chloride. Recent data show that methane and other VOCs have migrated past the methane barrier on the south of the landfill. Additional information on the extent of contamination at the FSL site is discussed in Section 2.3.

2.2 SITE CHARACTERISTICS

2.2.1 Climate and Meteorology

The Fresno Sanitary Landfill (FSL) site is situated in the eastern San Joaquin Valley. Coastal mountain ranges to the west insulate the valley from the cooling effects of the Pacific Ocean. Thus, the area is subject to hot dry summers and moderate winters. Average monthly temperature extremes range from 36.3°F in December to a high of 97.9°F in July (EMCON, 1989).

The rainfall in the San Joaquin Valley is sparse. The State of California Department of Water Resources (DWR) reports a maximum annual precipitation of 19.14 inches recorded in 1969 at the Fresno weather station, located 8 miles northeast of the FSL. Average annual precipitation recorded from 1951 through 1980 at the Fresno station is 10.52 inches, 90 percent of which normally occurs between November and April. DWR has reported a mean annual precipitation at the FSL of approximately 9.5 inches (Emcon 1989).

The nearest wind monitoring station is at Chandler Field, located approximately 2 miles north of the landfill. The prevailing wind is reported to be from the northwest.

2.2.2 Regional Geology and Hydrology

The FSL is situated on the east side of the San Joaquin Valley. The San Joaquin Valley, named for the river which drains it, comprises the southern half of the Great Valley or Central Valley of California. The Central Valley is a large elongate northwest-trending asymmetric structural trough that has been filled with a thick sequence of sediments, in some areas up to 60,000 feet thick (Hackel, 1966). In the Fresno vicinity, granitic and metamorphic rocks of the Sierra Nevada foothills, which extend beneath the Central Valley, are found at a depth of about 4,500 feet.

In the vicinity of Fresno, the near-surface geologic units include Older Alluvium of Quaternary age, which extends to a depth of about 500 feet, according to Page and LeBlanc, 1969 (as referenced by EAS, 1988). There are also less extensive deposits of Younger Alluvium, flood-basin deposits, and sand dunes on the valley floor. These unconsolidated materials are underlain by undifferentiated continental deposits of Quarternary age, which overlie granitic basement. The Older Alluvium, which underlies the FSL, consists of interbedded layers and lenses of clay, silt, sand, and gravels, which increase in thickness and decrease in grain size toward the west or center of the valley, away from the source area of the Sierra foothills.

The Older Alluvium is the principal groundwater aquifer in the Fresno area, according to Page and LeBlanc, as reported in ESA (1988), groundwater beneath Fresno is unconfined. Regionally confined groundwater does not occur in the vicinity of the FSL, apparently because regional confining clay layers, such as the Corcoron Clay found in the central part of the Great Valley, do not extend eastward as far as Fresno.

Existing hydrogeologic data do not indicate any well-developed, continuous aquifers or aquitards at discrete depths. However, previous site investigators have identified three general hydrostratigraphic units: shallow, intermediate, and deep. These units do not appear to correspond to specific aquifer zones as permeable sand units, but were apparently selected for well completion intervals in order to vertically characterize what appears to be a single interconnected aquifer system.

In general, groundwater flow is from east to west, away from the foothills and toward the valley axis. However, ESA (1988) reports that pumping depressions near the City of Fresno and to the west locally influence the direction of groundwater movement. At the FSL, groundwater flow is generally westward. USGS also reported that the permeability of the aquifer is between 1 and 3 feet per day, which yields an anticipated groundwater flow rate (disregarding irrigation pumping) of 1 foot per year (BSK 1987).

According to the County of Fresno Water Resources Management Plan, the Fresno area has been in a state of overdraft which has been reflected in a continuously falling water table. Hydrographs constructed with data from 1924 to the mid-1960's show a drop of 50 to 60 feet in the shallow groundwater table during that time period. The Water Management Plan indicates that groundwater levels in 1978 had fallen to the lowest level in recorded history but since that time, there has been a slight upward trend in the area (Emcon 1988).

2.2.3 Surface Water and Drainage

The surrounding terrain in the vicinity of the Fresno Sanitary Landfill is flat and contains large areas of surface-irrigated agricultural land. It is reported that previous ponding problems have occurred near the landfill. BSK (1987) reported that drain water accumulated near the landfill particularly on the north end of the western side. The area along West Avenue, where Annadale Avenue would intersect, also is reported to have poor drainage during major precipitation events (BSK, 1987).

Finally, the Fresno Colony Canal passes in close proximity to the landfill. It runs east-west, parallel to the Annadale alignment until reaching West Avenue, where it turns south and runs parallel to West Avenue.

2.3 HISTORY AND EXTENT OF CONTAMINATION

2.3.1 Groundwater

Previous investigations of the FSL site found that groundwater beneath the site exhibited elevated concentrations of volatile organic compounds (VOCs). The extent of groundwater contamination was documented beyond the landfill boundary both up and downgradient of the site.

Twenty four monitoring wells (13-shallow, 5-intermediate, and 5-deep) have been installed at the FSL site. Also, 10 private wells (5-intermediate, 5-deep) located on the north and south perimeter of the landfill have also been monitored. The location of each well or well cluster is shown on Figure 3-2 in Section 3.

Between 1974 and 1990 the monitoring and private wells were sampled and analyzed for various constituents including VOCs, pesticides, metals, and water quality parameters. The existing analytical data on the FSL site indicate that volatile organic compounds (VOCs), namely trichloroethene (TCE), tetrachloroethene (PCE), vinyl chloride (VC), and dichlorodifluoromethane (CCl_2F_2) were consistently detected in groundwater samples collected from on-site wells. With the exception of CCl_2F_2, the level of these compounds detected in the groundwater of the site present a potential human health risk as reflected by their maximum contaminant level (MCLs). The MCLs for TCE, PCE, and VC are 5, 2, and 0.5 μg/l, respectively. Figures 3-3, 3-4, and 3-5 in Section 3.0 show the concentrations of the above four compounds, as well as other VOCs detected in the shallow, intermediate, and deep wells. A complete analytical data summary is included in the RI/FS Work Plan.

Figure 3-3 shows the shallow well locations at the FSL site and presents existing analytical data on the VOC compounds of interest. A review of the data shows that the reported VOCs have been found at concentrations exceeding MCLs both up and downgradient of the FSL site. Some of the highest concentrations are reported for wells MW-1, W-4, DW-1A, and EW-1, located downgradient of the FSL site.

Figure 3-4 shows the intermediate monitoring well locations and selected private wells, and presents existing data on the four VOC compounds. A review of the data shows that the reported VOCs have been found at concentrations exceeding MCLs both up and downgradient of the FSL site. However, the concentrations reported are lower than those reported in the shallow wells. Again the highest concentrations are found in wells located on the downgradient or western perimeter of the landfill.

Figure 3-5 shows the deep well locations and presents existing data on the VOC compounds reported on the figure. Private wells are also reported on the figure. A review of the data shows that the VOC concentrations are lower than those found in both the intermediate and shallow wells. Also, only PCE and CCl_2F_2 are detected in the private wells, located to the north and south of the site; TCE and VC are not detected in the deep-private wells. For the upgradient deep wells UW-1C and UW-2C, no VOCs were detected in the 1990 data. However, VC, TCE, and PCE and were detected in these wells in 1989, with VC the only compound exceeding its MCL.

A review of VOC data collected and analyzed between 1974 and 1990 for all the wells reported on Figures 3-3, 3-4, and 3-5 shows that other VOC compounds besides the ones reported in the figures have been detected in the wells on and near the FSL site. The compounds, namely dichloroethylene (DCE), dichloroethane (DCA), dichloropropane (DCPA), dichloropropene (DCPE), dichlorobenzenes (DCBS), trichlorofluoromethane, and methylene chloride have been reported at concentrations above instrument detection limits.

Also, existing analytical data on the FSL site show a number of purgeable aromatic compounds detected above instrument detection limits. These compounds include benzene, chlorobenzene, 1,2-dichlorobenzene (1,2-DCB), and 1,4-dichlorobenzene (1,4-DCB). Benzene was detected in wells OW-1 (City of Fresno 1990) and EW-1 (ESA 1989) at concentrations exceeding its MCL of 1 μg/l. The MCL for 1,4-dichlorobenzene is 75 μg/l. This compound was detected in well DW-1B (COF 10/89), DW-2A (COF 10/90), and W-2 (COF 10/90) at concentrations below 1 ppb. Existing analytical data on the FSL site for pesticide compounds show no pesticides were detected above instrument detection limits.

There is limited available groundwater analytical data for metals. A number of metals were detected below MCL levels. These metals include arsenic, barium, fluoride, selenium, lead, and zinc. Nitrate was the only compound detected above MCLs. Private wells 1304 Jensen, 2121 Jensen, and 1635 Jensen are reported by BSK (1987) to have nitrate concentrations in excess of the MCL standard (45,000 μg/l). In addition, monitoring well W-2 (BSK 1987) also had nitrate concentrations exceeding MCLs. Previous investigations have attributed the nitrate levels to the extensive agriculture in the vicinity of the FSL site.

Finally, existing groundwater analytical data for general water quality parameters show a general trend of higher dissolved solids (TDS) and hardness values in shallow wells than in the deep wells. The pH levels range from 6 to 8 for the majority of monitoring wells sampled. Also, iron is detected above its secondary MCL of 300 μg/l (0.3 mg/l) in a number of monitoring wells.

2.3.2 Soil Gas

This section summarizes existing analytical data for the FSL site gathered during previous soil gas investigations. Results from VOC and methane analysis of interior gas wells, perimeter gas wells, and temporary off-site probes, as well as monthly methane monitoring of perimeter wells, are discussed. All analytical data are included in the RI/FS Work Plan.

Five interior gas monitoring wells (Figure 4-1) were sampled in 1987 as part of the EMCON Air Quality Solid Waste Assessment Test (SWAT) investigation. Each sample was collected in a 10-liter Tedlar bag, and analyzed at a fixed-base laboratory for VOCs and major landfill gas components (methane, oxygen, nitrogen and carbon dioxide). Methane concentrations ranged from 27.2% to 57.02%. VOCs exceeding the detection limits included vinyl chloride, benzene, 1,2-dichloroethane, methylene chloride, tetrachloroethene (PCE), trichloroethane and trichloroethene (TCE). Vinyl chloride was detected in 4 of the 5 on-site gas wells (W-1, W-3, W-4, and W-5) at concentrations ranging from 1.4 to 2.9 ppm. Methylene chloride was detected in all wells at concentrations ranging from 3.7 to 34 ppm. PCE and TCE levels ranged from less than 1 ppm in W-1, W-2 and W-3 to between 2 and 6 ppm in W-4 and W-5. Benzene was detected in W-3, W-4, and W-5 at levels ranging from 0.8 to 2 ppm. For all VOCs, the highest concentrations were found in W-4 and W-5, while the lowest were found in W-2.

In 1990, Lockheed conducted a soil gas survey that included the collection of samples from 42 off-site temporary probes, and from the 17 perimeter wells illustrated in Figure 4-1. Each of the perimeter wells (MMW1-MMW17) has three nested points screened at approximately 5 feet, 25 feet and 40 feet. Methane levels from perimeter wells located within the landfill ranged from 37% to 57%, and vinyl chloride concentrations up to 56 ppm were detected. Elevated methane and vinyl chloride concentrations just outside the barrier suggested gas migration below or around the barrier. These concentrations dropped off rapidly, within 100 feet. The gas monitoring wells farthest from the landfill (MMW11 and MMW13) did not show detectable concentrations of either vinyl chloride or methane at any depth. In general, results of samples collected from the shallowest depths of the perimeter wells outside of the landfill were low relative to the deeper concentrations. The vinyl chloride detection limit for this study was 50 ppb.

The 42 temporary probes were driven to depths of 5-7 feet. Two samples collected from the vineyard to the east of the landfill contained measurable amounts of methane and vinyl chloride. All other points of detected contamination were within approximately 100 feet of the north and south barriers. Based on the results of previous soil-gas surveys, the Lockheed report states that variability of sampling results is within 25%.

Monthly monitoring of the 17 perimeter wells was initiated by the City of Fresno in 1989. The data illustrates that methane barriers are effectively blocking off-site migration of landfill gas at the north barrier. This is not consistent with the results of the Lockheed survey. Measurable methane concentrations at MMW15 indicate that a leak exists in the barrier at the south side.

The City of Fresno was issued Administrative Order No. 90-23, effective February 15, 1991, by the U.S. EPA directing the City to develop a vacuum system for the existing methane barriers. The design of this vacuum system is discussed in the CDM document entitled "Methane Barrier Vacuum System Design Report and Operations Plan for the Fresno Sanitary Landfill" dated March 4, 1991. The vacuum system will be operational in early spring, 1991.

2.3.3 Air

This section summarizes existing ambient air analytical data for the FSL site gathered during the 1987 EMCON Air Quality Solid Waste Assessment Test (SWAT) investigation. Sample locations and analytical results are included in the RI/FS Work Plan.

EMCON collected 24-hour time-integrated ambient air samples on three consecutive days from one upwind and one downwind location. Each sample was collected 9 feet above the ground in a 10-liter Tedlar bag. The air samples contained benzene, methylene chloride, tetrachloroethylene, carbon tetrachloride, 1,1,1- trichloroethane, and trichloroethylene. The concentrations of the compounds ranged from 0.07 to 2.6 ppb, except for one methylene chloride value of 1,300 ppb. The methylene chloride value may be anomalous since it was only detected in one sample. The quality of this data is not known since neither sample duplicates nor field blanks were collected.

An integrated surface sampler was also used to collect a surface air sample of approximately 8 liters. The sampling probe was held 2-3 inches above the landfill surface while the technician walked a 2,600 linear foot grid over a 25 minute time period. The bag sample was analyzed in the field for total organics as methane. A fixed base laboratory performed analyses for volatile organic compounds.

The concentration of total organics as methane was at the detection limit of the OVA instrument (1 ppm). Trichloroethane was detected by the fixed base laboratory at 1.10 ppb. TCE, TCA, and PCE were detected at levels ranging from 0.08 to 0.30 ppb. The quality of this data is not known since neither sample duplicates nor field blanks were collected.

Section Three

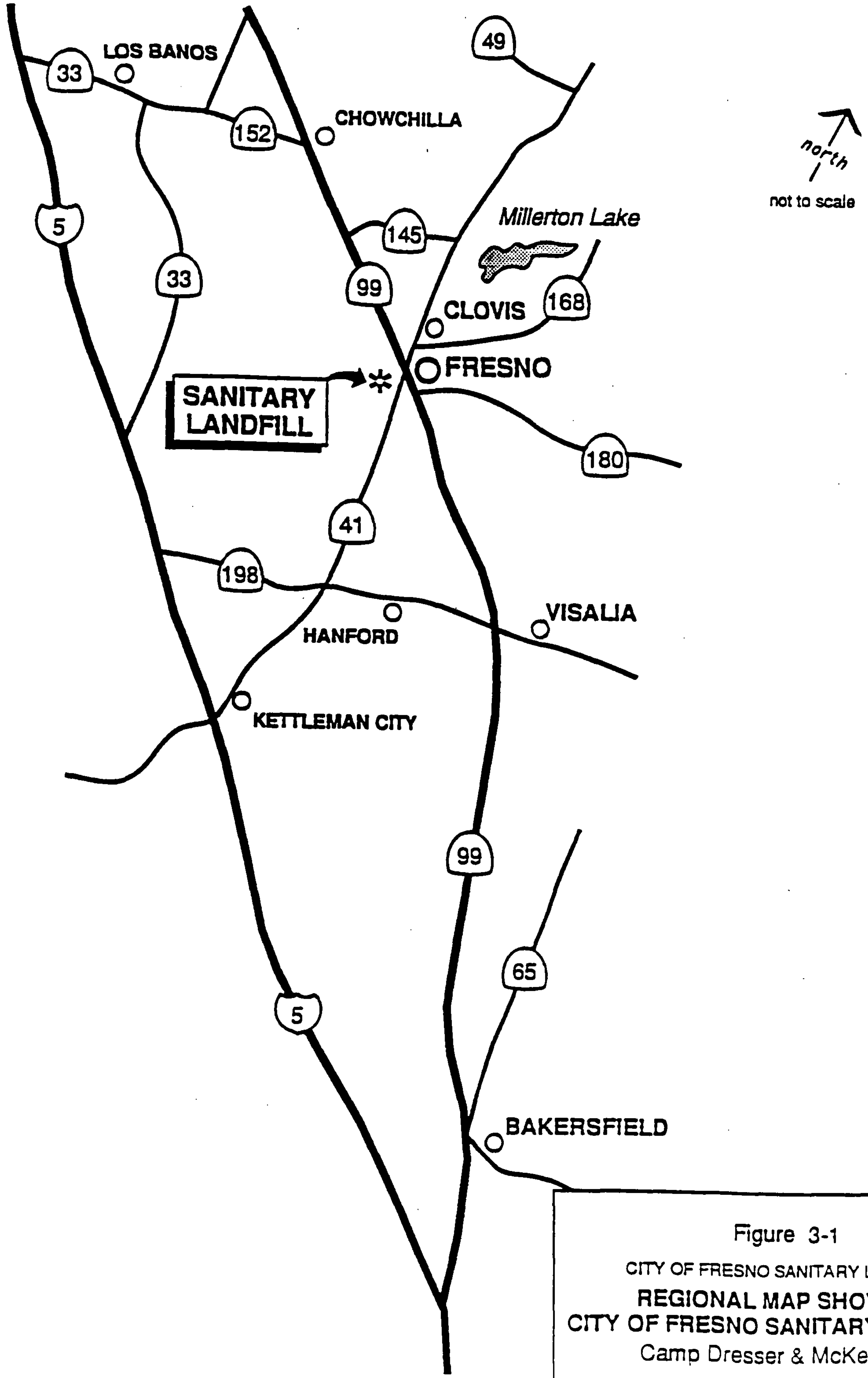
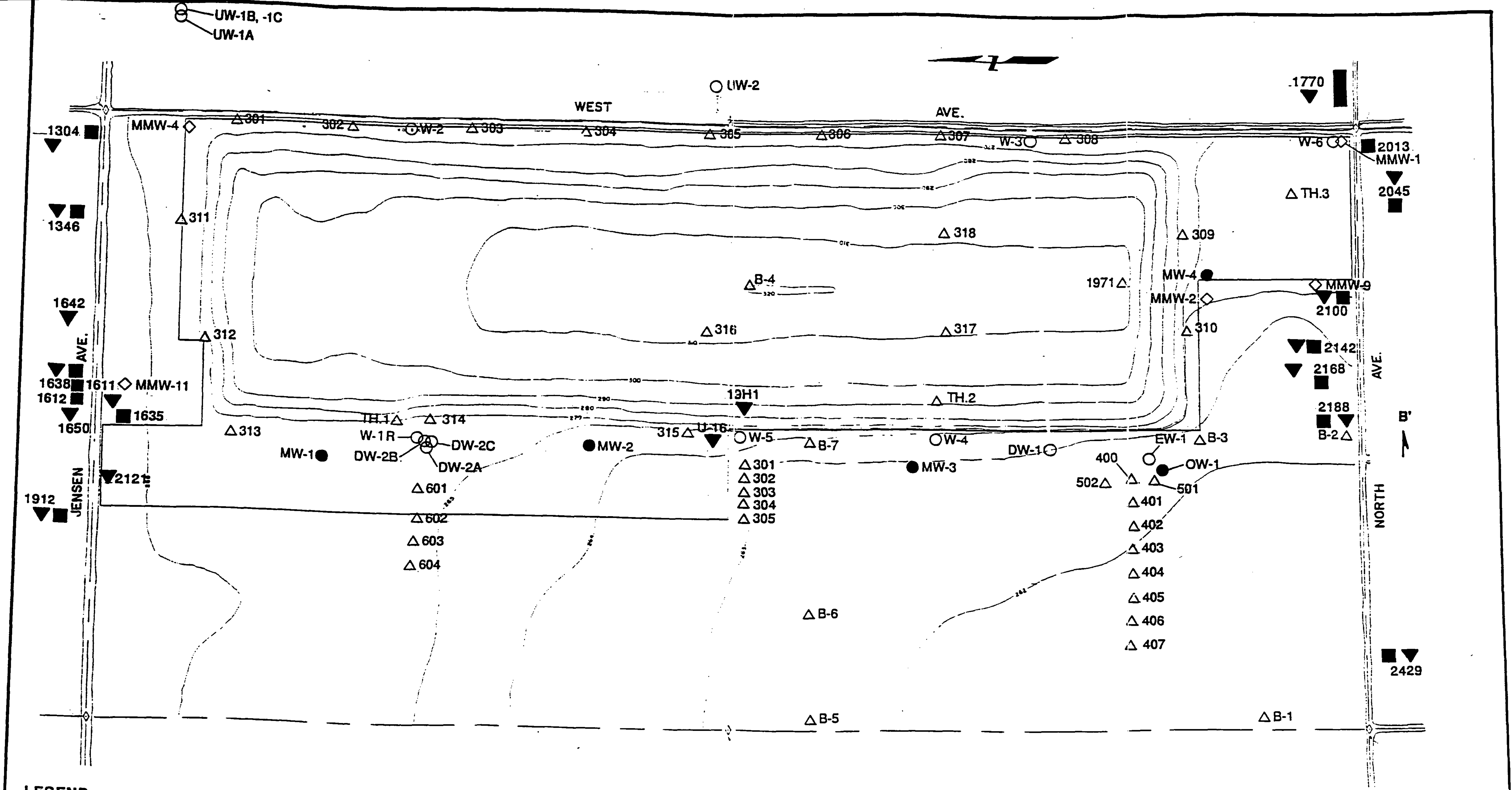


Figure 3-1

CITY OF FRESNO SANITARY LANDFILL

REGIONAL MAP SHOWING CITY OF FRESNO SANITARY LANDFILL

Camp Dresser & McKee Inc.



LEGEND

● Ground-water monitoring well established during ESA investigation

○ Ground-water monitoring well established by others

◇ Methane monitoring well established by others

▼ Approximate locations of private wells

△ Sealed test boring by others (approximate location)

■ Approximate location of private residence

0 400 800 ft.

Base map and locations of existing wells from City of Fresno Department of Public Works, June 1988. Original map scale is 1 in. = 200 ft.

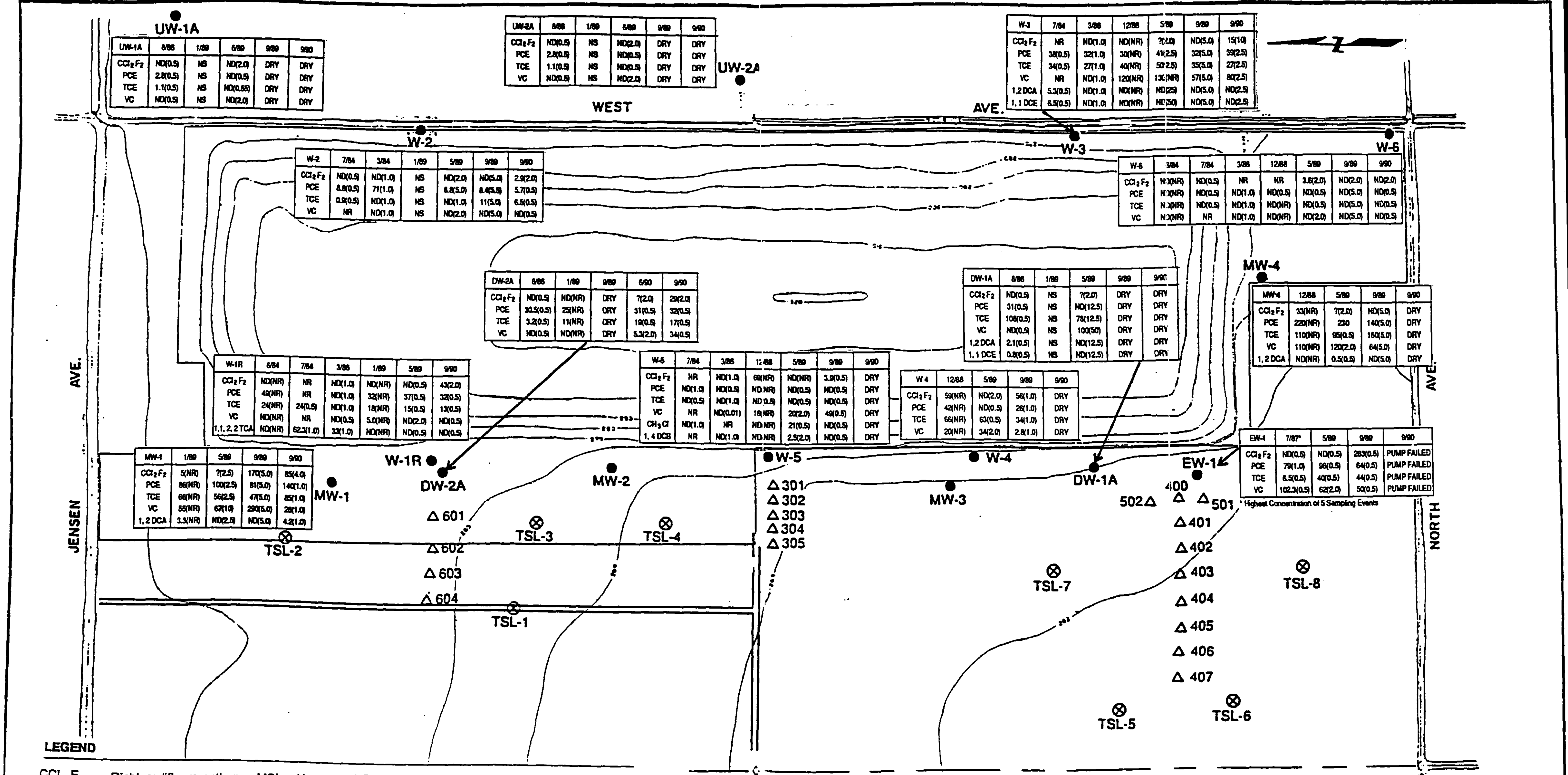
Reference: ESA, 1989

Figure 3-2

CITY OF FRESNO SANITARY LANDFILL

SITE LOCATION MAP

Camp Dresser & McKee Inc.



UW-1A	8/86	1/89	6/89	9/89	9/90
CCl_2F_2	ND(0.5)	NS	ND(2.0)	DRY	DRY
PCE	2.8(0.5)	NS	ND(0.5)	DRY	DRY
TCE	1.1(0.5)	NS	ND(0.55)	DRY	DRY
VC	ND(0.5)	NS	ND(2.0)	DRY	DRY

UW-2A	8/86	1/89	6/89	9/89	9/90
CCl_2F_2	ND(0.5)	NS	ND(2.0)	DRY	DRY
PCE	2.8(0.5)	NS	ND(0.5)	DRY	DRY
TCE	1.1(0.5)	NS	ND(0.5)	DRY	DRY
VC	ND(0.5)	NS	ND(2.0)	DRY	DRY

W-3	7/84	3/86	12/88	5/89	9/89	9/90
CCl_2F_2	NR	ND(1.0)	ND(NR)	?(2.0)	ND(5.0)	15(10)
PCE	38(0.5)	32(1.0)	30(NR)	41(2.5)	32(5.0)	39(2.5)
TCE	34(0.5)	27(1.0)	40(NR)	50(2.5)	35(5.0)	27(2.5)
VC	NR	ND(1.0)	120(NR)	130(NR)	57(5.0)	80(2.5)
1,2 DCA	5.3(0.5)	ND(1.0)	ND(NR)	ND(25)	ND(5.0)	ND(2.5)
1, 1 DCE	6.5(0.5)	ND(1.0)	ND(NR)	ND(50)	ND(5.0)	ND(2.5)

W-2	7/84	3/84	1/89	5/89	9/89	9/90
CCl_2F_2	ND(0.5)	ND(1.0)	NS	ND(2.0)	ND(5.0)	2.9(2.0)
PCE	8.8(0.5)	71(1.0)	NS	8.8(5.0)	8.4(5.5)	5.7(0.5)
TCE	0.9(0.5)	ND(1.0)	NS	ND(1.0)	11(5.0)	6.5(0.5)
VC	NR	ND(1.0)	NS	ND(2.0)	ND(5.0)	ND(0.5)

W-6	3/84	7/84	3/86	12/88	5/89	9/89	9/90
CCl_2F_2	ND(NR)	ND(0.5)	NR	NR	3.6(2.0)	ND(2.0)	ND(2.0)
PCE	ND(NR)	ND(0.5)	ND(1.0)	ND(0.5)	ND(0.5)	ND(5.0)	ND(0.5)
TCE	ND(NR)	ND(0.5)	ND(1.0)	ND(NR)	ND(0.5)	ND(5.0)	ND(0.5)
VC	ND(NR)	NR	ND(1.0)	ND(NR)	ND(2.0)	ND(5.0)	ND(0.5)

DW-2A	8/86	1/89	9/89	6/90	9/90
CCl_2F_2	ND(0.5)	ND(NR)	DRY	?(2.0)	29(2.0)
PCE	30.5(0.5)	25(NR)	DRY	31(0.5)	32(0.5)
TCE	3.2(0.5)	11(NR)	DRY	19(0.5)	17(0.5)
VC	ND(0.5)	ND(NR)	DRY	5.3(2.0)	34(0.5)

DW-1A	8/86	1/89	5/89	9/89	9/90
CCl_2F_2	ND(0.5)	NS	?(2.0)	DRY	DRY
PCE	31(0.5)	NS	ND(12.5)	DRY	DRY
TCE	108(0.5)	NS	78(12.5)	DRY	DRY
VC	ND(0.5)	NS	100(50)	DRY	DRY
1,2 DCA	2.1(0.5)	NS	ND(12.5)	DRY	DRY
1, 1 DCE	0.8(0.5)	NS	ND(12.5)	DRY	DRY

MW-4	12/88	5/89	9/89	9/90
CCl_2F_2	33(NR)	?(2.0)	ND(5.0)	DRY
PCE	220(NR)	230	140(5.0)	DRY
TCE	110(NR)	95(0.5)	160(5.0)	DRY
VC	110(NR)	120(2.0)	64(5.0)	DRY
1, 2 DCA	ND(NR)	0.5(0.5)	ND(5.0)	DRY

W-1R	6/84	7/84	3/86	1/89	5/89	9/90
CCl_2F_2	ND(NR)	NR	ND(1.0)	ND(NR)	ND(0.5)	43(2.0)
PCE	49(NR)	NR	ND(1.0)	32(NR)	37(0.5)	32(0.5)
TCE	24(NR)	24(0.5)	ND(1.0)	18(NR)	15(0.5)	13(0.5)
VC	ND(NR)	NR	ND(0.5)	5.0(NR)	ND(2.0)	ND(0.5)
1,1, 2, 2 TCA	ND(NR)	62.3(1.0)	33(1.0)	ND(NR)	ND(0.5)	ND(0.5)

W-5	7/84	3/86	12/88	5/89	9/89	9/90
CCl_2F_2	NR	ND(1.0)	69(NR)	ND(NR)	3.9(0.5)	DRY
PCE	ND(1.0)	ND(0.5)	ND(NR)	ND(0.5)	ND(0.5)	DRY
TCE	ND(0.5)	ND(1.0)	ND(0.5)	ND(0.5)	ND(0.5)	DRY
VC	NR	ND(0.01)	16(NR)	20(2.0)	49(0.5)	DRY
CH_3Cl	ND(1.0)	NR	ND(NR)	21(0.5)	ND(0.5)	DRY
1, 4 DCB	NR	ND(1.0)	ND(NR)	2.5(2.0)	ND(0.5)	DRY

W 4	12/88	5/89	9/89	9/90
CCl_2F_2	59(NR)	ND(2.0)	56(1.0)	DRY
PCE	42(NR)	ND(0.5)	26(1.0)	DRY
TCE	66(NR)	63(0.5)	34(1.0)	DRY
VC	20(NR)	34(2.0)	2.8(1.0)	DRY

MW-1	1/89	5/89	9/89	9/90
CCl_2F_2	5(NR)	?(2.5)	170(5.0)	85(4.0)
PCE	86(NR)	100(2.5)	81(5.0)	140(1.0)
TCE	66(NR)	56(2.5)	47(5.0)	85(1.0)
VC	55(NR)	67(10)	290(5.0)	28(1.0)
1, 2 DCA	3.3(NR)	ND(2.5)	ND(5.0)	4.2(1.0)

EW-1	7/87*	5/89	9/89	9/90
CCl_2F_2	ND(0.5)	ND(0.5)	283(0.5)	PUMP FAILED
PCE	79(1.0)	96(0.5)	64(0.5)	PUMP FAILED
TCE	6.5(0.5)	40(0.5)	44(0.5)	PUMP FAILED
VC	102.3(0.5)	62(2.0)	50(0.5)	PUMP FAILED

* Highest Concentration of 5 Sampling Events

LEGEND

CCl_2F_2	Dichlorodifluoromethane MCL = None	ND	Not Detected at Indicated Detection Level
CH_3Cl	Chloromethane MCL = None	NR	Not Reported
1, 2 DCA	1, 2 Dichloroethane MCL = 0.5ug/l	NS	Not Sampled
1, 1 DCE	1, 1 Dichloroethene MCL = 6ug/l	( )	Method Detection Level
1, 4 DCB	1, 4, Dichlorobenzene MCL = 75ug/l	?	Undetermined Concentration
PCE	Tetrachloroethene MCL = 2ug/l	●	Groundwater Monitoring Well by ESA
TCE	Trichloroethene MCL = 5ug/l	⊗	Temporary Sampling Locations by ESA
VC	Vinyl Chloride MCL = 0.5ug/l	△	Temporary Sampling Locations by BSK
1,1,2,2TCA	1,1,2,2 Trichlorethane MCL = 1ug/l		

Note: Concentration of Compounds Reported in ug/l (ppb)

0 400 800 ft.

Notes: Numerous methane monitoring wells exist within landfill boundary (not shown).

Base map and locations of existing wells from City of Fresno Department of Public Works June 1988. Original map scale is 1 in. = 200 ft.

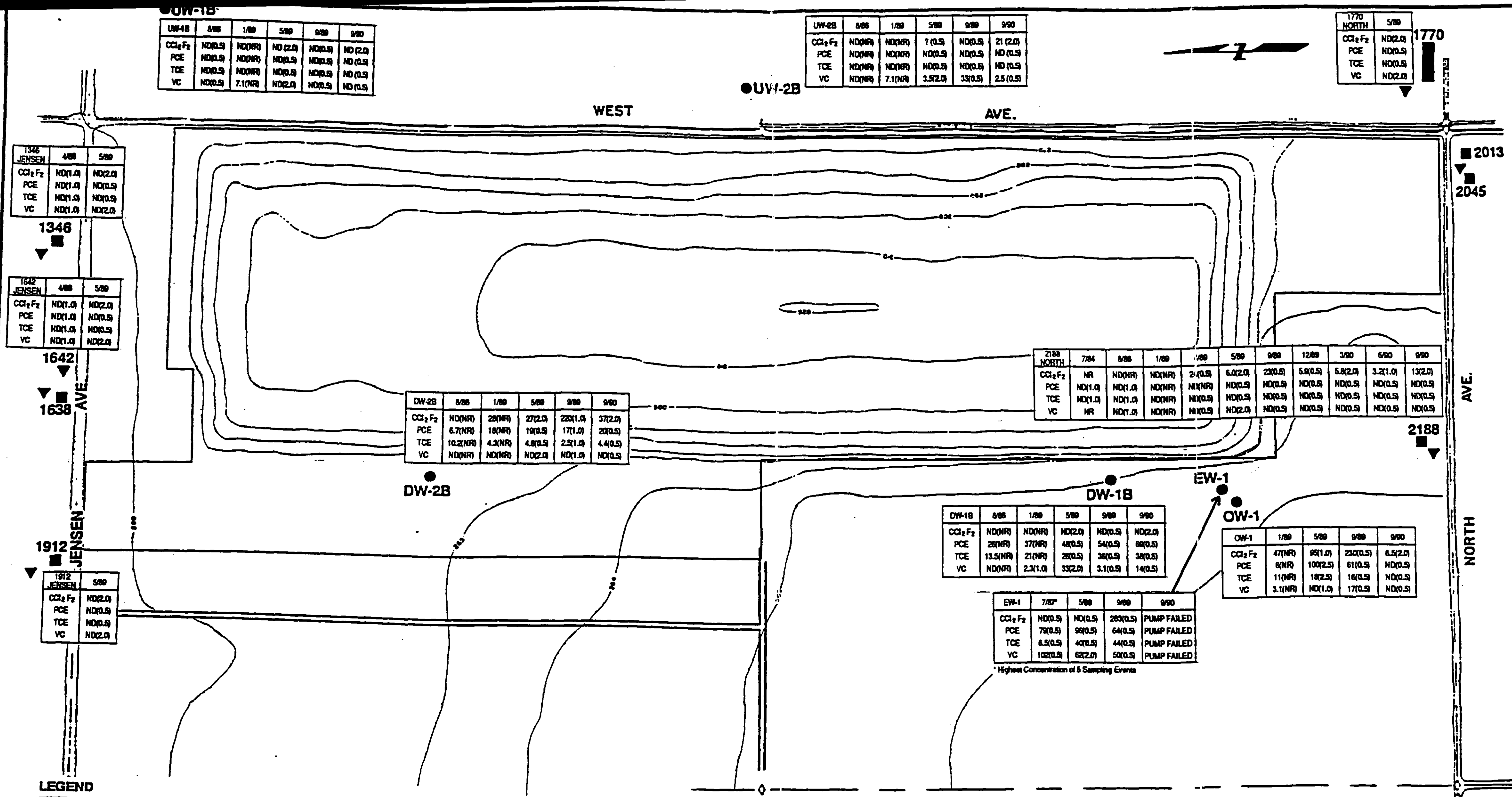
Reference: ESA, 1988

Figure 3-3

CITY OF FRESNO SANITARY LANDFILL

DATA SUMMARY OF SHALLOW WELL LOCATIONS (UP To 70 FT.)

Camp Dresser & McKee Inc.



UW-1B	8/86	1/89	5/89	9/89	9/90
CCl_2F_2	ND(0.5)	ND(NR)	ND (2.0)	ND(0.5)	ND (2.0)
PCE	ND(0.5)	ND(NR)	ND(0.5)	ND(0.5)	ND (0.5)
TCE	ND(0.5)	ND(NR)	ND(0.5)	ND(0.5)	ND (0.5)
VC	ND(0.5)	7.1(NR)	ND(2.0)	ND(0.5)	ND (0.5)

UW-2B	8/86	1/89	5/89	9/89	9/90
CCl_2F_2	ND(NR)	ND(NR)	? (0.5)	ND(0.5)	21 (2.0)
PCE	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND (0.5)
TCE	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND (0.5)
VC	ND(NR)	7.1(NR)	3.5(2.0)	33(0.5)	2.5 (0.5)

1770 NORTH	5/89
CCl_2F_2	ND(2.0)
PCE	ND(0.5)
TCE	ND(0.5)
VC	ND(2.0)

1346 JENSEN	4/88	5/89
CCl_2F_2	ND(1.0)	ND(2.0)
PCE	ND(1.0)	ND(0.5)
TCE	ND(1.0)	ND(0.5)
VC	ND(1.0)	ND(2.0)

1642 JENSEN	4/88	5/89
CCl_2F_2	ND(1.0)	ND(2.0)
PCE	ND(1.0)	ND(0.5)
TCE	ND(1.0)	ND(0.5)
VC	ND(1.0)	ND(2.0)

2188 NORTH	7/84	8/86	1/89	4/89	5/89	9/89	12/89	3/90	6/90	9/90
CCl_2F_2	NR	ND(NR)	ND(NR)	24(0.5)	6.0(2.0)	23(0.5)	5.9(0.5)	5.8(2.0)	3.2(1.0)	13(2.0)
PCE	ND(1.0)	ND(1.0)	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)
TCE	ND(1.0)	ND(1.0)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)
VC	NR	ND(1.0)	ND(NR)	ND(0.5)	ND(2.0)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)

DW-2B	8/86	1/89	5/89	9/89	9/90
CCl_2F_2	ND(NR)	28(NR)	27(2.0)	220(1.0)	37(2.0)
PCE	6.7(NR)	18(NR)	19(0.5)	17(1.0)	20(0.5)
TCE	10.2(NR)	4.3(NR)	4.6(0.5)	2.5(1.0)	4.4(0.5)
VC	ND(NR)	ND(NR)	ND(2.0)	ND(1.0)	ND(0.5)

DW-1B	8/86	1/89	5/89	9/89	9/90
CCl_2F_2	ND(NR)	ND(NR)	ND(2.0)	ND(0.5)	ND(2.0)
PCE	26(NR)	37(NR)	48(0.5)	54(0.5)	69(0.5)
TCE	13.5(NR)	21(NR)	26(0.5)	36(0.5)	38(0.5)
VC	ND(NR)	2.3(1.0)	33(2.0)	3.1(0.5)	14(0.5)

OW-1	1/89	5/89	9/89	9/90
CCl_2F_2	47(NR)	95(1.0)	230(0.5)	6.5(2.0)
PCE	6(NR)	100(2.5)	61(0.5)	ND(0.5)
TCE	11(NR)	18(2.5)	16(0.5)	ND(0.5)
VC	3.1(NR)	ND(1.0)	17(0.5)	ND(0.5)

1912 JENSEN	5/89
CCl_2F_2	ND(2.0)
PCE	ND(0.5)
TCE	ND(0.5)
VC	ND(2.0)

EW-1	7/87*	5/89	9/89	9/90
CCl_2F_2	ND(0.5)	ND(0.5)	283(0.5)	PUMP FAILED
PCE	79(0.5)	96(0.5)	64(0.5)	PUMP FAILED
TCE	6.5(0.5)	40(0.5)	44(0.5)	PUMP FAILED
VC	102(0.5)	62(2.0)	50(0.5)	PUMP FAILED

* Highest Concentration of 5 Sampling Events

LEGEND

CCl_2F_2	Dichlorodifluoromethane MCL = None
PCE	Tetrachloroethene MCL = 2ug/l
TCE	Trichloroethene MCL = 5ug/l
VC	Vinyl Chloride MCL = 0.5ug/l
ND	Not Detected at Indicated Detection Level
NR	Not Reported
NS	Not Sampled

( )	Method Detection Level
?	Undetermined Concentration
●	Groundwater Monitoring Well by ESA
▼	Private Well
■	Private Residence
⊛	Private Wells, Well Log Data Not Reported

Note: Concentration of Compounds Reported in ug/l (ppb)

0 400 800 ft.

Notes: Numerous methane monitoring wells exist within landfill boundary (not shown).

Base map and locations of existing wells from City of Fresno Department of Public Works June 1988. Original map scale is 1 in. = 200 ft.

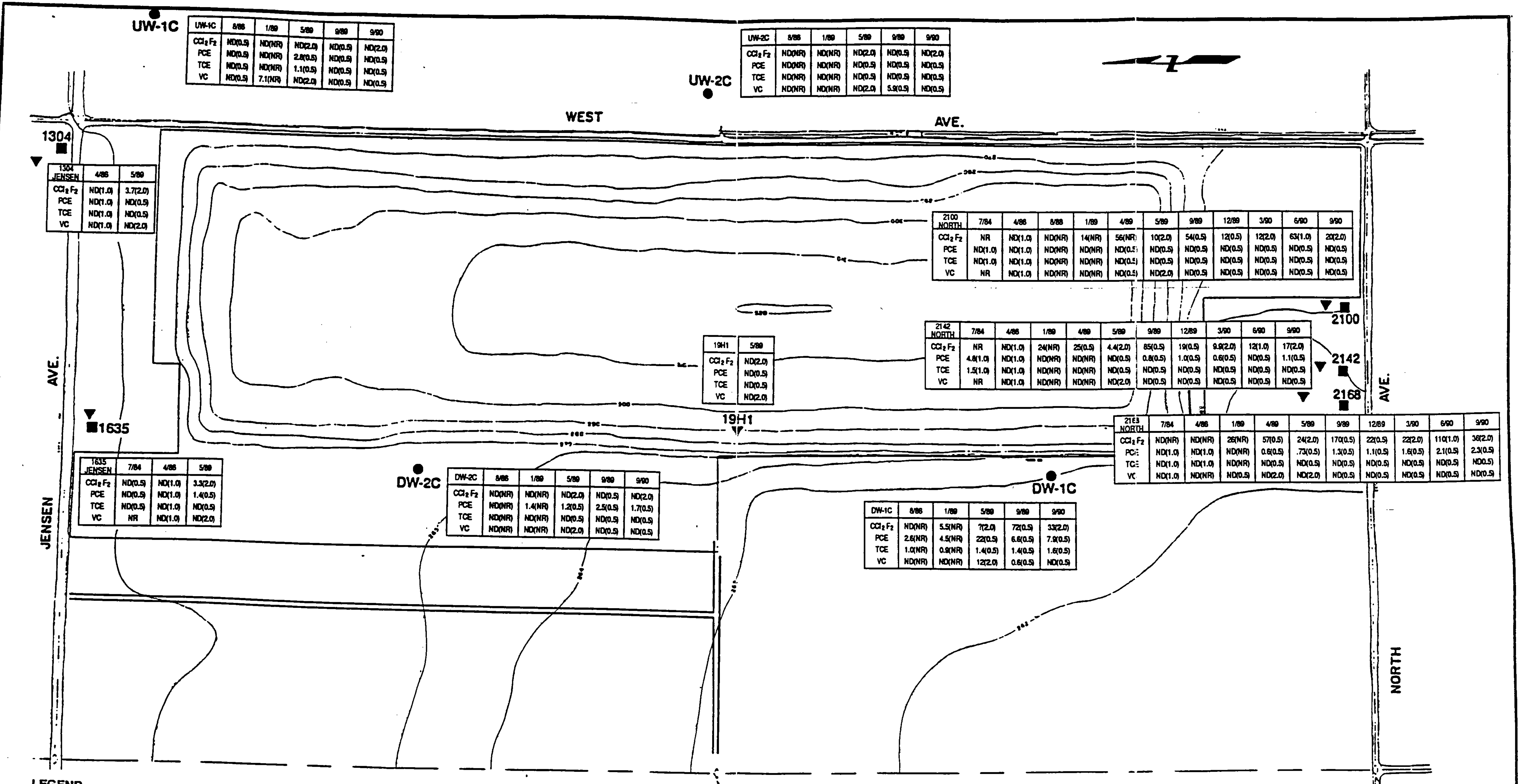
Reference: ESA. 1989

Figure 3-4

CITY OF FRESNO SANITARY LANDFILL

DATA SUMMARY OF INTERMEDIATE WELL LOCATIONS (70 To 110 Ft.)

Camp Dresser & McKee Inc.



UW-1C	8/86	1/89	5/89	9/89	9/90
CCl_2F_2	ND(0.5)	ND(NR)	ND(2.0)	ND(0.5)	ND(2.0)
PCE	ND(0.5)	ND(NR)	2.8(0.5)	ND(0.5)	ND(0.5)
TCE	ND(0.5)	ND(NR)	1.1(0.5)	ND(0.5)	ND(0.5)
VC	ND(0.5)	7.1(NR)	ND(2.0)	ND(0.5)	ND(0.5)

UW-2C	8/86	1/89	5/89	9/89	9/90
CCl_2F_2	ND(NR)	ND(NR)	ND(2.0)	ND(0.5)	ND(2.0)
PCE	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)
TCE	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)
VC	ND(NR)	ND(NR)	ND(2.0)	5.9(0.5)	ND(0.5)

1304 JENSEN	4/86	5/89
CCl_2F_2	ND(1.0)	3.7(2.0)
PCE	ND(1.0)	ND(0.5)
TCE	ND(1.0)	ND(0.5)
VC	ND(1.0)	ND(2.0)

2100 NORTH	7/84	4/86	8/88	1/89	4/89	5/89	9/89	12/89	3/90	6/90	9/90
CCl_2F_2	NR	ND(1.0)	ND(NR)	14(NR)	56(NR)	10(2.0)	54(0.5)	12(0.5)	12(2.0)	63(1.0)	20(2.0)
PCE	ND(1.0)	ND(1.0)	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)
TCE	ND(1.0)	ND(1.0)	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)
VC	NR	ND(1.0)	ND(NR)	ND(NR)	ND(0.5)	ND(2.0)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)

19H1	5/89
CCl_2F_2	ND(2.0)
PCE	ND(0.5)
TCE	ND(0.5)
VC	ND(2.0)

2142 NORTH	7/84	4/86	1/89	4/89	5/89	9/89	12/89	3/90	6/90	9/90
CCl_2F_2	NR	ND(1.0)	24(NR)	25(0.5)	4.4(2.0)	85(0.5)	19(0.5)	9.9(2.0)	12(1.0)	17(2.0)
PCE	4.8(1.0)	ND(1.0)	ND(NR)	ND(NR)	ND(0.5)	0.8(0.5)	1.0(0.5)	0.6(0.5)	ND(0.5)	1.1(0.5)
TCE	1.5(1.0)	ND(1.0)	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)
VC	NR	ND(1.0)	ND(NR)	ND(NR)	ND(2.0)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)

2168 NORTH	7/84	4/86	1/89	4/89	5/89	9/89	12/89	3/90	6/90	9/90
CCl_2F_2	ND(NR)	ND(NR)	26(NR)	57(0.5)	24(2.0)	170(0.5)	22(0.5)	22(2.0)	110(1.0)	36(2.0)
PCE	ND(1.0)	ND(1.0)	ND(NR)	0.6(0.5)	.73(0.5)	1.3(0.5)	1.1(0.5)	1.6(0.5)	2.1(0.5)	2.3(0.5)
TCE	ND(1.0)	ND(1.0)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND0.5)
VC	ND(1.0)	ND(NR)	ND(0.5)	ND(2.0)	ND(2.0)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)

1635 JENSEN	7/84	4/86	5/89
CCl_2F_2	ND(0.5)	ND(1.0)	3.3(2.0)
PCE	ND(0.5)	ND(1.0)	1.4(0.5)
TCE	ND(0.5)	ND(1.0)	ND(0.5)
VC	NR	ND(1.0)	ND(2.0)

DW-2C	8/86	1/89	5/89	9/89	9/90
CCl_2F_2	ND(NR)	ND(NR)	ND(2.0)	ND(0.5)	ND(2.0)
PCE	ND(NR)	1.4(NR)	1.2(0.5)	2.5(0.5)	1.7(0.5)
TCE	ND(NR)	ND(NR)	ND(0.5)	ND(0.5)	ND(0.5)
VC	ND(NR)	ND(NR)	ND(2.0)	ND(0.5)	ND(0.5)

DW-1C	8/86	1/89	5/89	9/89	9/90
CCl_2F_2	ND(NR)	5.5(NR)	?(2.0)	72(0.5)	33(2.0)
PCE	2.6(NR)	4.5(NR)	22(0.5)	6.6(0.5)	7.9(0.5)
TCE	1.0(NR)	0.9(NR)	1.4(0.5)	1.4(0.5)	1.6(0.5)
VC	ND(NR)	ND(NR)	12(2.0)	0.6(0.5)	ND(0.5)

LEGEND

CCl_2F_2	Dichlorodifluoromethane MCL = None
PCE	Tetrachloroethene MCL = 2ug/l
TCE	Trichloroethene MCL = 5ug/l
VC	Vinyl Chloride MCL = 0.5ug/l
ND	Not Detected at Indicated Detection Level
NR	Not Reported

NS	Not Sampled
( )	Method Detection Level
?	Undetermined Concentration
●	Groundwater Monitoring Well by ESA
▼	Private Well
■	Private Residence

Note: Concentration of Compounds Reported in ug/l (ppb)

0 400 800 ft.

Notes: Numerous methane monitoring wells exist within landfill boundary (not shown).

Base map and locations of existing wells from City of Fresno Department of Public Works June 1988. Original map scale is 1 in. = 200 ft.

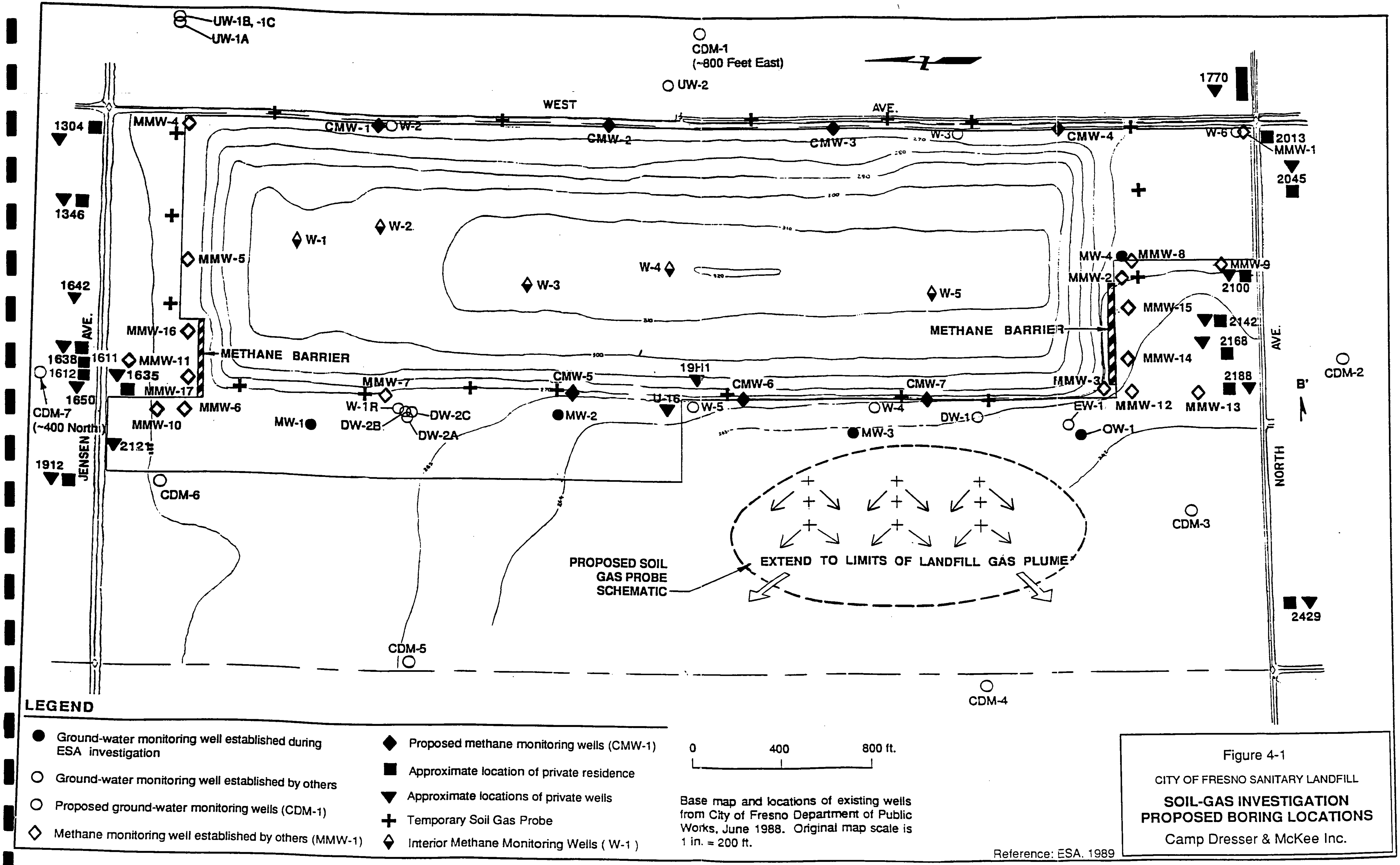
Reference: ESA. 1989

Figure 3-5

CITY OF FRESNO SANITARY LANDFILL

DATA SUMMARY OF DEEP WELL LOCATIONS (Greater Than 110 Ft.)

Camp Dresser & McKee Inc.



Base map and locations of existing wells from City of Fresno Department of Public Works, June 1988. Original map scale is 1 in. = 200 ft.

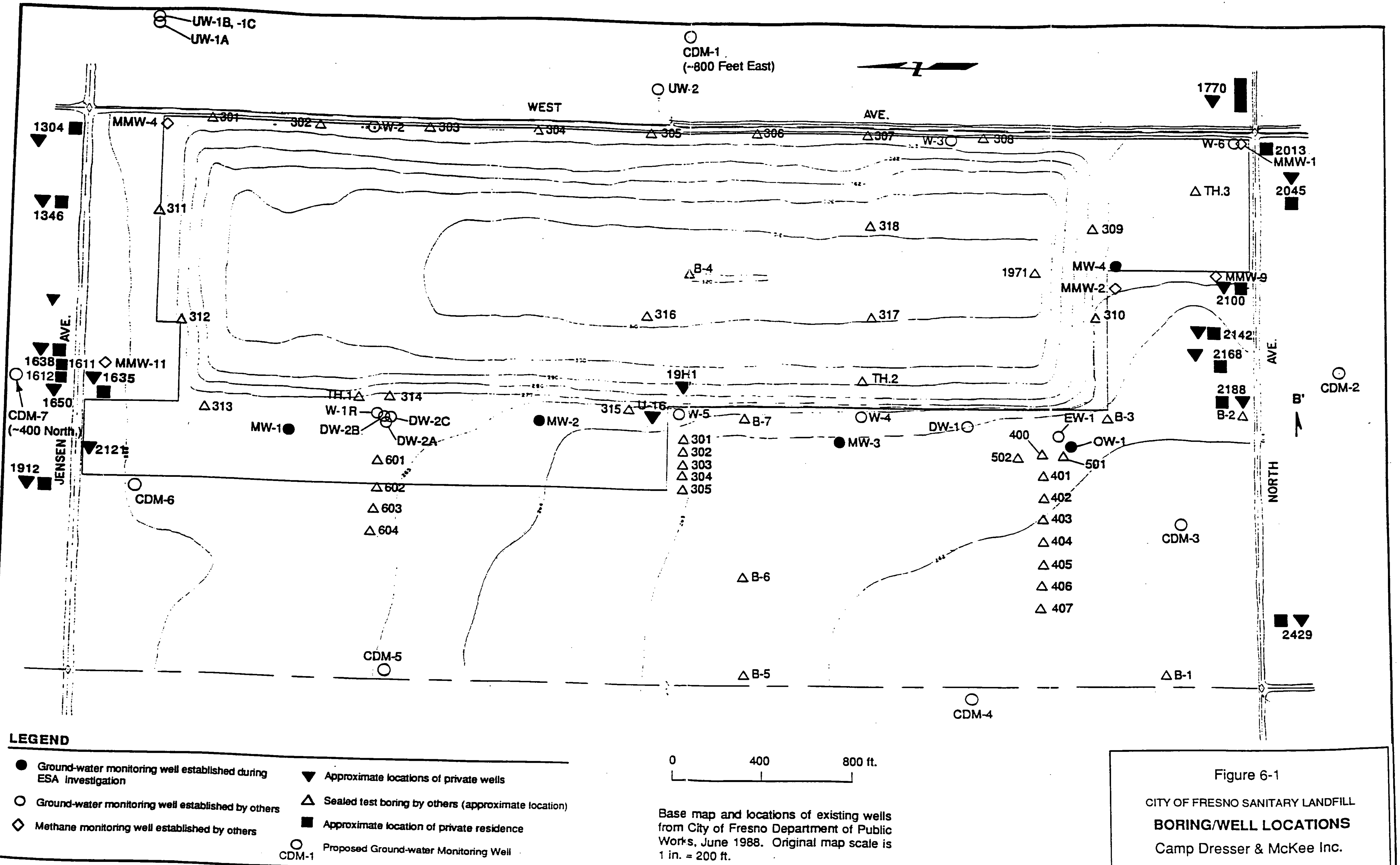
Reference: ESA, 1989

Figure 4-1

CITY OF FRESNO SANITARY LANDFILL

SOIL-GAS INVESTIGATION
PROPOSED BORING LOCATIONS

Camp Dresser & McKee Inc.



Base map and locations of existing wells from City of Fresno Department of Public Works, June 1988. Original map scale is 1 in. = 200 ft.

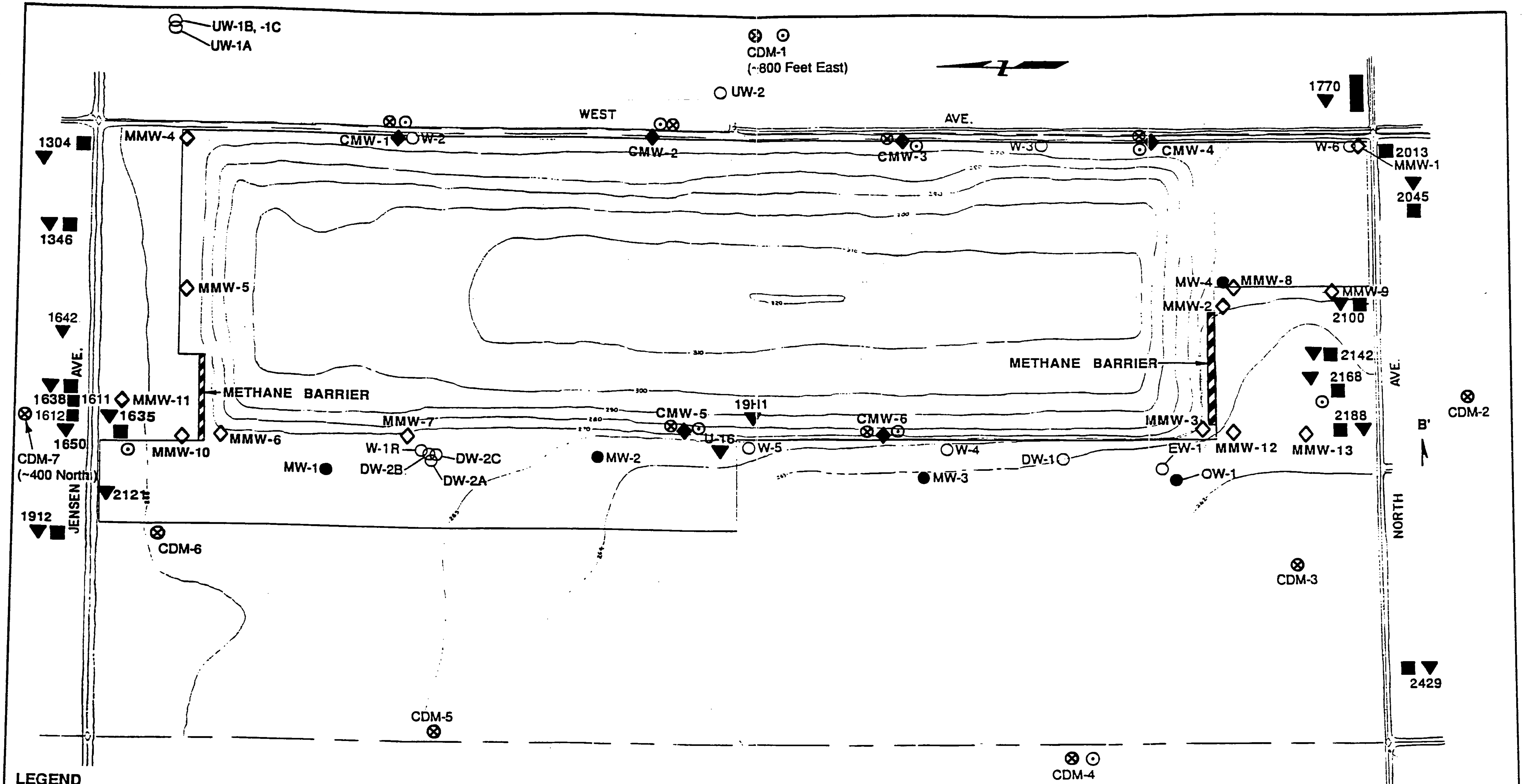
Reference: ESA, 1989

Figure 6-1

CITY OF FRESNO SANITARY LANDFILL

BORING/WELL LOCATIONS

Camp Dresser & McKee Inc.



LEGEND

- ● Ground-water monitoring well established during ESA investigation
- ○ Ground-water monitoring well established by others
- ⊗ Proposed Subsurface Sampling Location
- ◇ Methane monitoring well established by others (MMW-1)
- ◆ Proposed methane monitoring wells (CMW-1)
- ⊙ Proposed Surface Soil Sampling Location
- ■ Approximate location of private residence
- ▼ Approximate locations of private wells

0 400 800 ft.

Base map and locations of existing wells from City of Fresno Department of Public Works, June 1988. Original map scale is 1 in. = 200 ft.

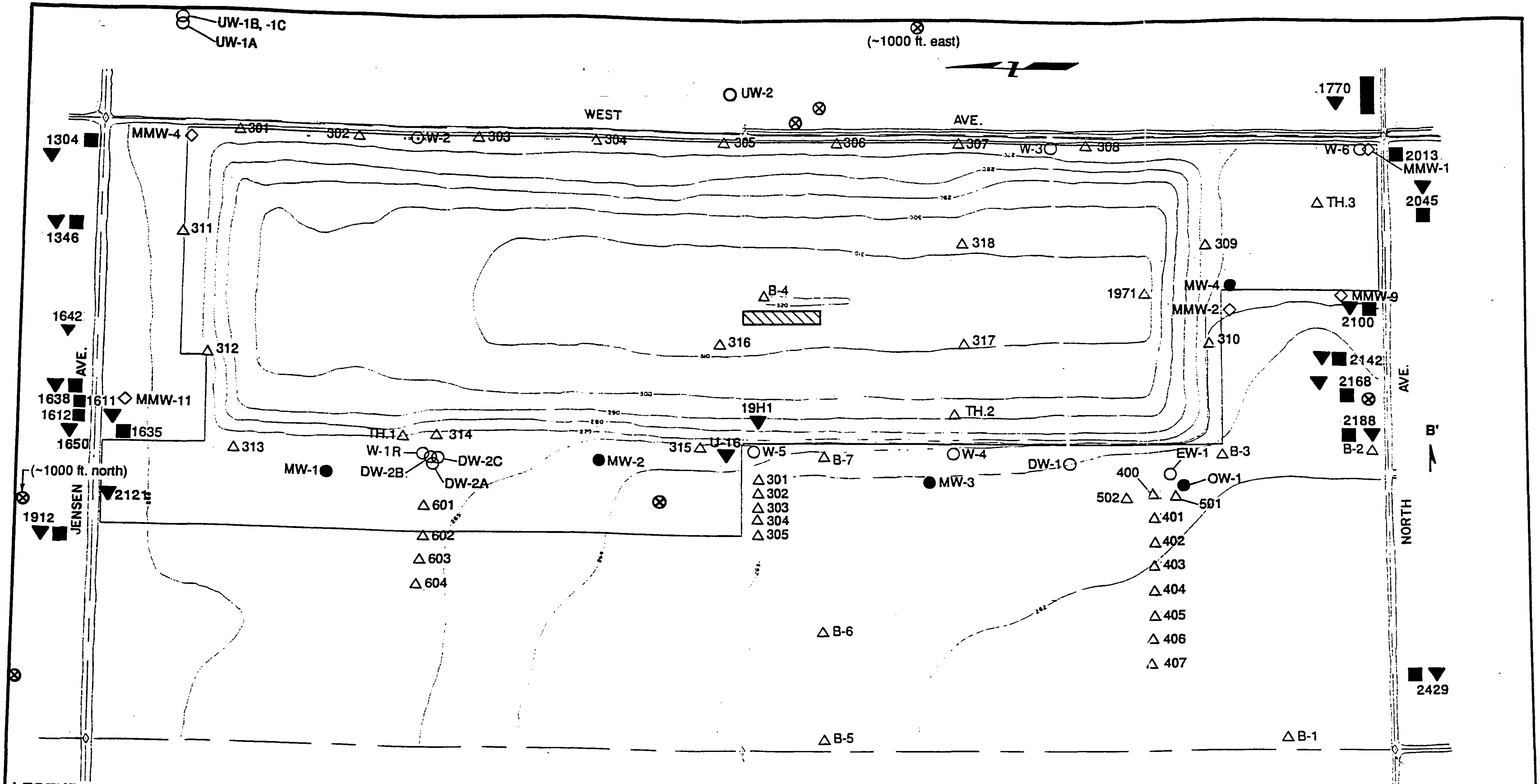
Reference: ESA, 1989

Figure 9-1

CITY OF FRESNO SANITARY LANDFILL

SURFACE AND SUBSURFACE PROPOSED SAMPLING LOCATIONS

Camp Dresser & McKee Inc.



LEGEND

- ● Ground-water monitoring well established during ESA investigation
- ○ Ground-water monitoring well established by others
- ◇ Methane monitoring well established by others
- ⊗ Proposed Ambient Air Sample Location
- ▼ Approximate locations of private wells
- △ Sealed test boring by others (approximate location)
- ■ Approximate location of private residence
- ▨ Proposed Weather Station Location

0 400 800 ft.

Base map and locations of existing wells from City of Fresno Department of Public Works, June 1988. Original map scale is 1 in. = 200 ft.

Reference: ESA. 1989

Figure 10-1

CITY OF FRESNO SANITARY LANDFILL

AMBIENT AIR - PROPOSED SAMPLE LOCATIONS

Camp Dresser & McKee Inc.

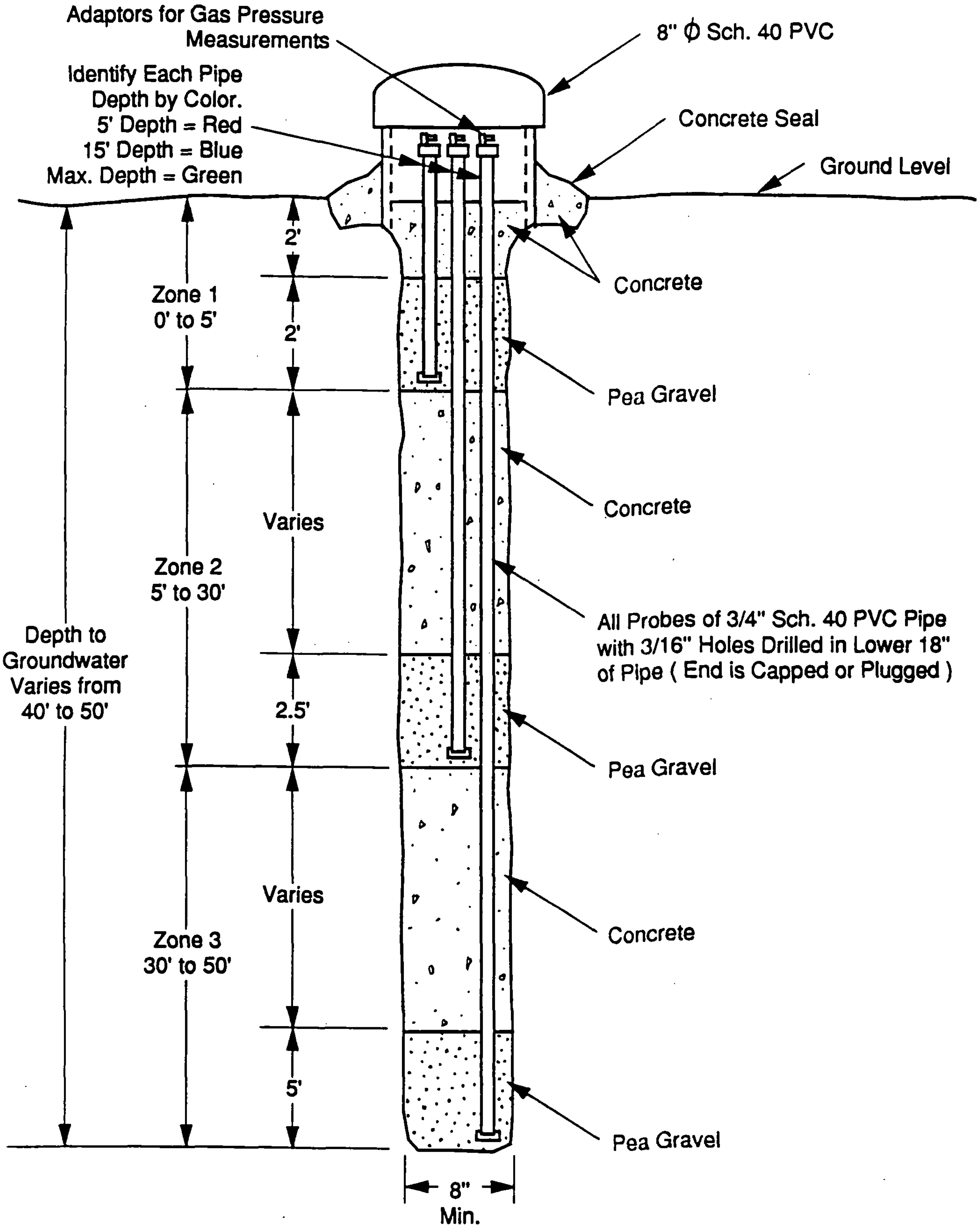


Figure 12-1

Existing Gas Monitoring Well Section

N.T.S.

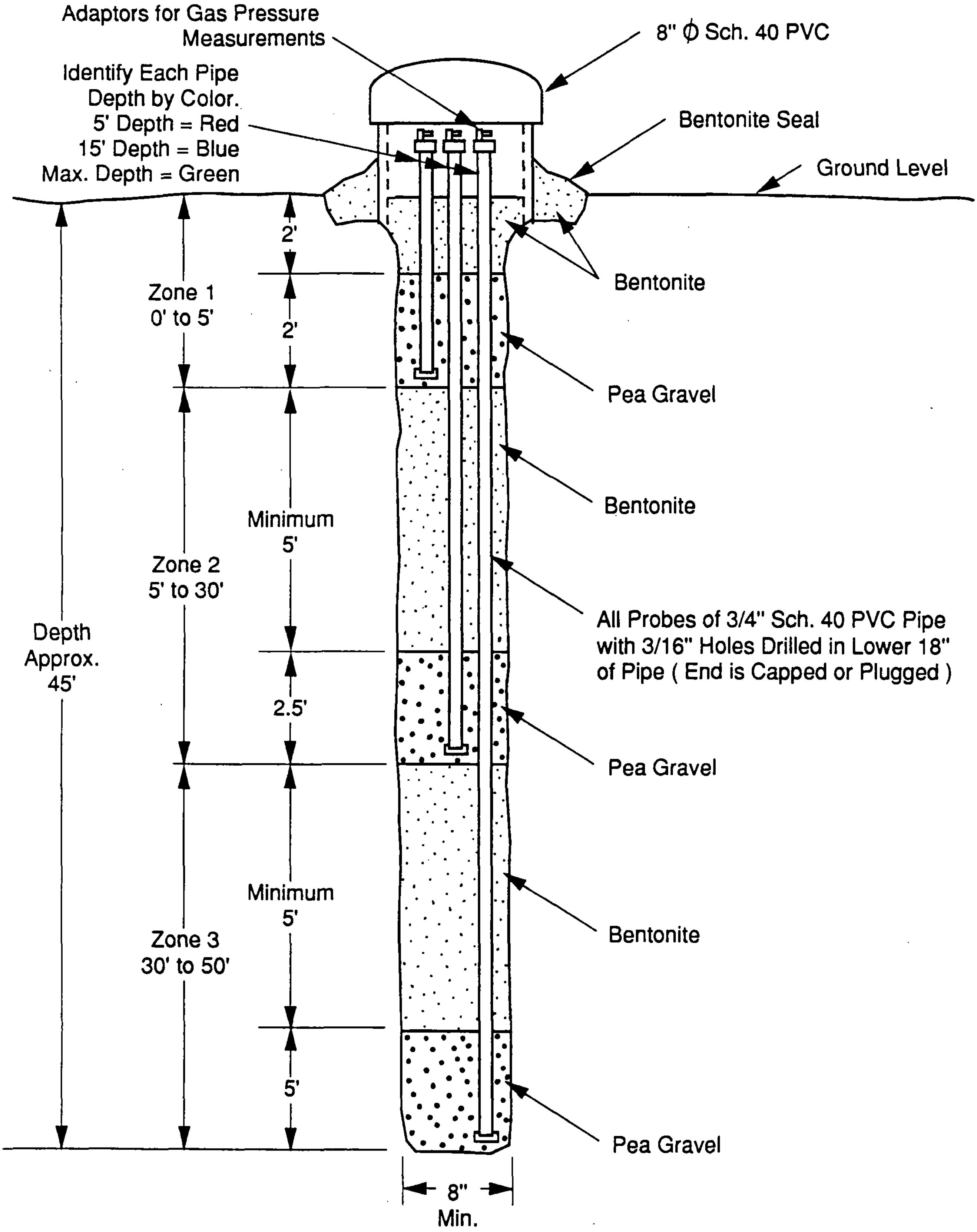


Figure 12-2

Proposed Gas Monitoring Well Section

N.T.S.

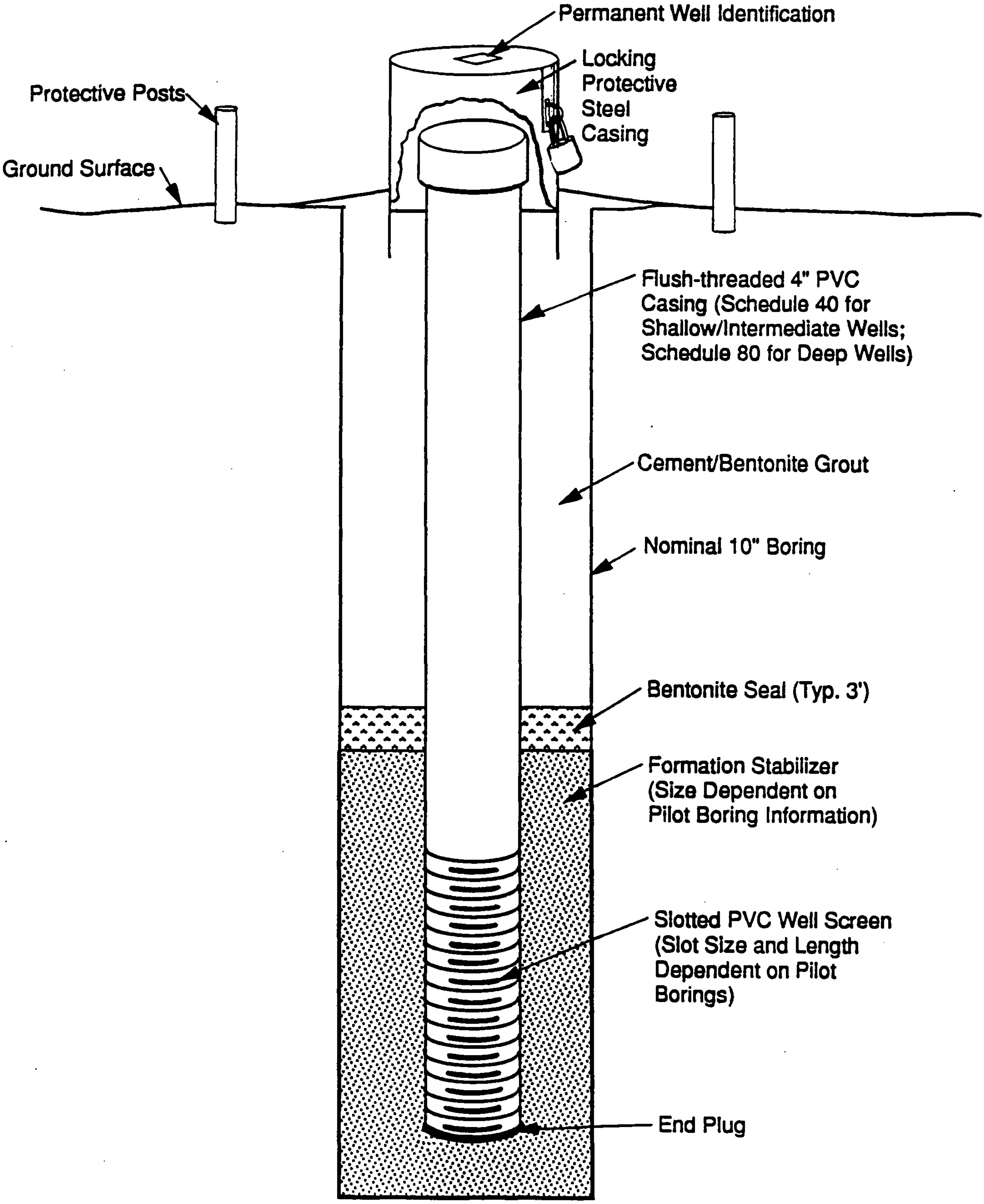


Figure 12-3

Typical Groundwater Monitoring Well Completion Diagram

N.T.S.

Section Four

4.0 SOIL GAS INVESTIGATION

A soil gas investigation is proposed for the Fresno Sanitary Landfill (FSL) RI/FS. This investigation will involve the installation of permanent soil gas monitoring wells and performance of an off-site soil gas survey. The purpose of this investigation is four-fold: 1) to determine the pathways of subsurface migration of landfill gas; 2) to define the extent of off-site landfill gas migration and consequent contaminant migration; 3) to quantify the concentrations of volatile organic compounds in the gas which have migrated off-site; and 4) to evaluate the possible impact of soil gas on groundwater quality through computer modeling. The first two objectives are established to guide the formulation of both on and off-site gas control remedial actions; the third and fourth investigations are performed to aid in the development of the risk assessment.

4.1 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and quantitative statements of the quality of data needed to support specific decisions or regulatory actions. DQOs for the soil gas investigation have been developed based on intended data uses as well as sampling and analytical capabilities. Specific data uses, PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters, analytical methods, and detection limits for soil gas sampling are discussed in this section.

4.1.1 Prioritized Data Uses and Decisions

Soil gas data collected from the FSL site will be used to determine the pathways of subsurface migrations of landfill gas, to define the extent of off-site landfill gas migration and consequent contaminant migration, and for modeling purposes. Level II quality data as defined by "Data Quality Objectives for Remedial Response Activities" (EPA 540/G-87/003A) will be obtained by the mobile laboratory. Level IV quality data is needed at a subset of sampling locations in order to identify and quantify contaminant migration, and will be obtained by a fixed-base laboratory. Both level II and IV data will be available for use by the remedial designers, risk assessors and modelers.

4.1.2 Quality Assurance Objectives

The quality assurance objectives for measurement data in terms of PARCC are discussed in Appendix A.

4.2 RATIONALE FOR SAMPLE LOCATIONS, NUMBER OF SAMPLES, AND ANALYSES

A system of seventeen multiple-depth gas monitoring wells, MMW 1-17, exist at the FSL site (Figure 4-1). Previous data indicates that landfill gas has migrated away from the trash prism. It is proposed that the existing gas monitoring network be expanded to include an additional seven permanent gas wells. Also proposed is an off-site soil gas survey using temporary probes to define the extent of gas migration. The following paragraphs describe the rationale for sample location, number, and analyses.

Seven additional gas monitoring wells (CMW 1-7) are proposed for this investigation. These wells shall consist of permanent installations constructed in accordance with State requirements for landfill gas control and monitoring at closed disposal sites (CAC Title 14, Chapter 3, Article 7.8). The seven additional wells are proposed at the locations depicted on Figure 4-1. Monitoring locations were selected to meet the requirement of CAC Title 14 that a maximum of 1000 feet exist between adjacent monitoring wells. The 13 gas monitoring wells selected for permanent perimeter monitoring (CMW-1,2,3,4,5,6, MMW-1,3,4,5,6,7,8) will be analyzed for methane. Seven of these wells (CMW-1, 3, 6, MMW-1, 5, 7, 8) will be analyzed for Calderon volatile organics in order to monitor the vertical distribution of volatile organics around the landfill perimeter. All wells are expected to be operational. MMW-15 and the shallow probe in MMW-14 are not currently operational, but sampling of these wells is not planned.

The well bore depth shall be approximately 45 feet. Three probes will be installed in each wellbore. The shallow probe will be placed approximately five feet below the ground surface in an attempt to monitor soil layers above any hardpan layer. The second probe will be installed at approximately 25 feet, which corresponds with the general maximum depth of refuse found by BSK when they drilled test holes through the landfill in 1984 (BSK, 1984). The third probe will be placed at a depth of approximately 45 feet. This is similar to the design of the seventeen existing wells. Details on the construction of the gas monitoring wells are described in Section 12.1.2.

The second portion of the soil gas investigation will be to track the off-site landfill gas plume through the use of a screening-level soil gas survey. Soil gas survey procedures involve driving a hollow probe approximately 15 feet into the soil or to the maximum depth possible for the van, whichever is greater, and collecting soil vapors for analysis of specific volatile compounds. If probe placement beneath the hardpan is not possible with a mobile hydraulic unit, alternative probe installation plans (such as using a backhoe) will be developed. Soil gas samples will be analyzed for methane and volatile organics.

The extent of existing gas migration off-site will be determined by initial sampling of temporary soil probes located at the perimeter of the landfill. Initial sampling points will be approximately 400 feet apart. Figure 4-1 shows the location of the initial soil gas sampling points. Approximately 20-25 soil gas samples will be collected at first, with more sampling points added away from the landfill perimeter at an approximate 100 foot spacing until the presence of landfill gas is no longer detected.

Points identified on Figure 4-1 are somewhat diagrammatic for purposes of illustration. The actual field locations will be strategically located based on field conditions. For example, sampling locations will take into consideration the presence of structures and agricultural systems such as pumps, ditches, and pipelines. The on-site technician will be responsible for analyzing the data from the initial soil gas survey and determining the location of the additional points. The objective is to define the lateral limits of the soil-gas plume.

Correlation of the permanent gas monitoring wells with the temporary soil gas probe monitoring will also be performed at methane monitoring wells MMW-1, MMW-2, MMW-4, MMW-5, MMW-6, MMW-7, and MMW-12, as depicted in Figure 3-1. Both the permanent and temporary probes will be analyzed for methane and vinyl chloride.

A technical memorandum will be prepared discussing the potential for expanding the soil gas investigation by performing additional gas sampling at multiple depths, down to the saturated zone. The memorandum will include a presentation of anticipated modeling activities and will be prepared prior to initiation of the field program calling for the installation of the seven additional gas monitoring wells. If additional sampling is determined to be required, it will be performed as part of the well installation effort. The technical memorandum will be submitted to the EPA within seven weeks of approval of the RI/FS SAP.

Soil Gas Sampling and Analysis Approach

The methods for analyses to be conducted include the following:

Location	Parameter	Method	Level
Perimeter Wells	Methane	OVA, HPK-2	II
	Calderon List & Freon 12	EPA TO-14	IV
Temporary Probes	Methane	TCD	II
	Calderon List & Freon 12	GC/FID and GC/ECD	II
	Calderon List & Freon 12	EPA TO-14	IV

In a 1987 study of 20 Class II landfills by the South Coast Air Quality Management District (Wood, 1987), methane was found to be a useful indicator of the presence of subsurface gas migration. The proposed approach, therefore, is to monitor for the presence of methane in all gas monitoring wells and temporary probes.

At the permanent gas wells, a combustible gas meter and an organic vapor analyzer (OVA) will be employed in conjunction with a vapor extraction pump to take direct methane readings of the permanent gas wells. Samples will also be collected in Summa canisters for EPA TO-14 analysis by the fixed-base laboratory of the 10 Calderon compounds.

All probes will be sampled and analyzed for both methane and vinyl chloride. The first set of probes placed at the landfill boundary will also be analyzed by the mobile laboratory for the ten Calderon compounds and Freon 12. Seven of these compounds which have been detected at the FSL site during previous groundwater or air investigations include vinyl chloride, benzene, methylene chloride, 1,2-DCA, TCA, TCE, and PCE.

The ten Calderon compounds and Freon 12 will continue to be monitored for as the mobile lab progresses away from the landfill in 100-foot increments. If a specific compound is not detected at two consecutive probe locations, analysis for this compound will be discontinued.

Since data from the soil probe survey will be used for risk assessment and modeling purposes, confirmation of the presence and concentrations of contaminants by a fixed-base laboratory is needed. A sample in a Summa canister will be taken at 5 percent of all probes monitored for methane and vinyl chloride. The sample will be analyzed for all ten Calderon compounds and Freon 12 by a fixed-base laboratory utilizing the TO-14 analysis. In addition, at 5% of the probe locations at which vinyl chloride is not detected, a Summa canister sample will be collected for vinyl chloride analysis by the fixed-base laboratory.

Correlation of the permanent gas monitoring wells with the temporary soil gas probe monitoring will also be performed. The van will draw an intermediate level probe sample from the permanent gas monitoring well after completing the gas sample withdrawal and analysis from a point in the soil adjacent to the well. Both the permanent and temporary probes will be analyzed for methane and vinyl chloride. This correlation will be performed for methane monitoring wells MMW-1, MMW-2, MMW-4, MMW-5, MMW-6, MMW-7, and MMW-12, as depicted in Figure 3-1.

Soil vapors collected in a Summa canister for Level IV analysis will be analyzed for EPA Method TO-14. For the soil gas survey vinyl chloride will be analyzed using EPA Modified 8010; methane will be analyzed using a thermal conductivity detector. A detection limit of 1 ppb is needed for vinyl chloride; 1 ppm is needed for methane. It should be noted that at this time there are no EPA Methods for conducting a temporary, screening-level soil gas survey. Analytical procedures utilized by the on-site mobile lab are described in Appendix F.

Sampling of the gas monitoring wells will indicate the general pathways of off-site migration around the landfill perimeter, as well as the vertical distribution of contaminants. Monitoring of the off-site probes will determine the lateral extent of gas migration. Samples taken from the temporary probes and analyzed for volatile organics by the GC in the van will support the development of the risk assessment. All soil gas samples will be utilized in the soil gas modeling effort.

Analytical and quality control procedures are discussed in Appendix B-2.

Section Five

5.0 LEACHATE INVESTIGATION

A leachate investigation is proposed for the FSL RI/FS. This investigation will initially involve conducting a water balance study for the site. A major part of the water balance study will be to determine if the existing buried irrigation pipeline is leaking. All available information will be gathered for the pipeline; if accurate flow information is not available, flow monitoring will be conducted, if possible, at the upstream and downstream ends of the pipeline to determine any losses. A video camera survey will be considered, if possible, to obtain a visual record of any breaks in the pipeline.

The water balance will also include a review of the existing HELP model data; the model will be rerun if necessary to obtain an accurate estimate of landfill infiltration. The ponded water which has been observed at the site will be included as an infiltration source; historical evidence and quantities of ponding will be investigated via historical aerial photographs and topographic maps. The evidence for fires occurring at the landfill in the past, which were extinguished using water, will also be investigated as a potential leachate-generating mechanism.

Drilling will be undertaken in the refuse area to investigate and characterize, to the extent possible, leachate in the refuse and the underlying vadose zone soils. A minimum of two borings within the landfill in the vicinity of the pipeline are planned.

5.1 DATA QUALITY OBJECTIVES

Data Quality Objectives (DOQs) are qualitative and quantitative statements of the quality of data needed to support specific decisions or regulatory actions. DOQs for the leachate investigation have been developed based on intended data uses as well as sampling and analytical capabilities. Specific data uses, PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters, analytical methods, and detection limits for leachate sampling are discussed in this section.

5.1.1 Prioritized Data Uses and Decisions

During the first phase of the investigation, which involves conducting a water balance study and reviewing the existing HELP-2 data, sample analysis is not required. The precision and accuracy of the flow monitoring equipment, and of the data used in HELP-2, will be considered during each step of the investigation.

A drilling program may be initiated to identify areas in and below the refuse fill where leachate has been generated. Leachate and soil data collected during the drilling program will be used for remedial design and modeling purposes. Collection of Level IV quality data, as defined by "Data Quality Objectives for Remedial Response Activities" (EPA 540/G-87/003A), is planned.

5.1.2 Quality Assurance Objectives

The quality assurance objectives for measurement data in terms of PARCC are discussed in Appendix A.

5.2 RATIONALE FOR SAMPLE LOCATIONS, NUMBER OF SAMPLES, AND ANALYSES

As described previously in the RI/FS Work Plan, a limited drilling program will be undertaken in those areas where leachate appears likely. A minimum of two borings within the landfill in the vicinity of the pipeline are planned. In addition, these two borings will be utilized to address the State requirements under Title 23, Chapter 15, to perform vadose zone monitoring. Drilling will be performed as discussed in Section 12.2.1. If free leachate is encountered during drilling and can be sampled, it will be characterized by analyzing for leachate parameters as suggested in EPA's landfill guidance, Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill sites (EPA 15401 P-91/001), as well as for volatile organics.

After noting the depth of refuse, the borings will be continued into the underlying vadose zone soils. Samples will be collected of the underlying soils to determine if leachate has migrated below the refuse and if NAPLs are present. Leachate and soil samples will be analyzed for the following parameters:

Matrix	Parameter	Method
Leachate	Volatile Organics	EPA 8240
	Metals	EPA 6010,7061,7471,7741
	Phosphorus, Nitrate	EPA 300
	Nitrite, Sulfate	EPA 300
	Chloride	EPA 300
	TDS	EPA 160.1
	TSS	EPA 160.2
	Ammonia-Nitrogen	Std. Methods 4500-NH_3B&E
	COD	EPA 410.1 & 410.2
	Oil and Grease	EPA 413.2
	Hardness	EPA 130.2
	Sulfide	EPA 376.1
	BOD	EPA 405.1
Soil	Volatile Organics	EPA 8240
	BNAs	EPA 8270
	Pesticides/PCBs	EPA 8080
	Herbicides	EPA 8150
	Dioxin	EPA 8280
	Metals	EPA 6010,7061,7471, 7741
	Soil Moisture	ASTM D2216-80
	Soil Porosity	ASTM D2116 and 854
	TOC	Modified ASTM D4129/D5136
	pH	EPA 9045

In addition, pH of any leachate samples will be tested in the field. The specific compounds required for each of these analytical methods are outlined in Appendix B-1. Analytical methods specified for groundwater will also be used for leachate.

The number of sampling locations will be determined from the results of the first phase of the leachate investigation. The objective at the first phase is to identify areas of the landfill with a high probability of leachate generation. These could include, but are not limited to, regions where surface water runoff has historically ponded, locations adjacent to the buried irrigation supply line running along the Annadale Avenue alignment, and areas of past underground fires extinguished through the injection of quantities of water.

Boreholes will be advanced through the landfill and logged for evidence of free leachate. If leachate is encountered during drilling, it will be sampled through the hollow-stem auger as described in Section 12.2.1.

At a minimum, 5 soil samples will be collected and analyzed from each boring. This includes one sample at the top of the saturated zone since this is where LNAPLs would be likely to accumulate, and one sample at the first fine-grained unit encountered, since this is where DNAPLs might accumulate. Continuous sampling techniques will be used to ensure adequate quantity of material for the analytical tests.

If during this task, or any other aspect of the Remedial Investigation, the data is interpreted to suggest the existence of contaminants in a free phase or NAPL form, further investigation may entail drilling and sampling, independent of this leachate investigation activity.

Section Six

6.0 HYDROGEOLOGIC INVESTIGATION

A hydrogeologic study will be conducted as part of the RI/FS, which will involve the determination of subsurface stratigraphy using drilling and downhole geophysical techniques, and the installation of additional groundwater monitoring wells. The objectives of the investigation are to (1) continue to develop a hydrogeologic model of the site, building on information collected by previous investigators, (2) to identify to the extent possible the vertical and lateral extent of off-site contaminant migration in groundwater, and (3) to determine the effect of the nearby irrigation wells, particularly U-16, on the groundwater regime. The installation of additional wells will provide a means of defining the extent of the groundwater plume through water quality sampling (Section 6.0).

6.1 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and quantitative statements of the quality of data needed to support specific decisions or regulatory actions. DQOs for the groundwater investigation have been developed based on intended data uses as well as sampling and analytical capabilities. Specific data uses, PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters, analytical methods, and detection limits for the groundwater investigation are discussed in this section.

6.1.1 Prioritized Data Uses and Decisions

Data collected for the hydrogeologic task will be used to select monitoring well completion intervals; to refine the understanding of site hydrogeology (the hydrogeologic model); to determine pathways of contaminant migration in groundwater; and to better understand the physiochemical characteristics of the site water-bearing zones. Geologic data including lithologic descriptions of borings and downhole geophysical logs are by definition field screening-level data, collected by on-site observation or portable instruments. As such, Level II quality data, as defined by "Data Quality Objectives for Remedial Response Activities" (EPA 540/G-87/003A) are acceptable. However, samples of subsurface soils collected for analysis of Total Organic Carbon (TOC), grain-size analysis, and volatile organics may be used to support the Feasibility Study regarding groundwater treatment design, or the risk assessment. Level IV quality will be maintained for these data.

Analytical methods, discussed in Section 9.0, were selected based on their ability to provide appropriate quantitation. The specific compounds and detection limits required for each of these analytical methods are discussed in Appendix B-1.

6.1.2 Quality Assurance Objectives

The quality assurance objectives for soil samples collected during the hydrogeologic investigation, in terms of precision, accuracy, completeness, representativeness, and comparability, are discussed in Appendix A.

6.2 RATIONALE FOR SAMPLE LOCATIONS, NUMBER OF SAMPLES, AND ANALYSES

As described previously in the RI/FS Work Plan, the hydrogeologic investigation will be a focused program to supplement and expand on existing information that has been developed at the site by previous investigators. Several previous investigators have conducted studies and installed monitoring wells (Figure 3-2) in an effort to determine the site hydrogeology. The near surface (< 500 feet) geology has been generally characterized as consisting of interbedded clays, silts, sands, sandy clays, and sandy silts. The existing data do not appear to indicate any well-developed, continuous aquifers or aquitards at discrete depths. It appears, based on the water level data collected since 1987, that the site hydrogeology is comprised of a single aquifer system, at least to the depths investigated to date (approximately 170 feet). Previous site investigators have identified three general hydrostratigraphic units: shallow, intermediate, and deep. These units do not appear to necessarily correspond to specific aquifer zones or permeable sand units, but were apparently selected for well completion intervals in order to vertically characterize what appears to be a single interconnected aquifer system.

In order to accomplish the objectives of the hydrogeologic task, a program of drilling, downhole geophysical logging, and well installation will be conducted. The locations of borings and wells are shown on Figure 6-1. Pilot borings will be drilled using mud rotary techniques; monitor wells will be installed using an air rotary casing driver rig. At each selected location, a small-diameter pilot boring will be advanced to a total depth of about 250 feet using mud rotary drilling, and will be lithologically logged by the field geologist. The purpose of the pilot boring will be to characterize the subsurface stratigraphy, and allow selection of well completion intervals and proper well screen size. Lithologic information including grain size, texture, color, USCS soil classification, and drilling characteristics will be recorded in the field log book.

Downhole geophysical logging will then be conducted by a qualified contractor. Spontaneous potential, resistivity, and gamma logs will be run in each pilot hole. These logs will assist in establishing the stratigraphy at the new locations, and will allow correlation with existing gamma logs and descriptions. This approach will provide a means of geologic correlation across the site, in order to recognize potential migration pathways for groundwater. At the conclusion of logging, the pilot hole will be immediately grouted from the bottom of the hole to the surface using a tremie system; holes will not be allowed to remain open overnight. Details of grouting are discussed in Section 12.0.

The proposed well locations have been chosen to define the lateral and vertical boundaries of the contaminant plume, either downgradient of areas of known contamination, or further upgradient of the landfill. Each location has been numbered starting at the upgradient or east side of the landfill; the rationale for each location follows. The need for remote upgradient or background wells at varying depths at Location CDM-1 is evident since organic compounds have been detected at each of the existing upgradient locations (UW-1 and

UW-2), east of the FSL. Groundwater flow appears to be to the west. The transport mechanism to explain the presence of organics at upgradient wells will be investigated during the RI, but may be due to partitioning from landfill gas. It is anticipated that a 3-well cluster will be installed at CDM-1 about 1200 feet east of West Avenue, or beyond the influence of migrating landfill gas. The exact location will be dependent on the results of the soil gas survey. The three wells will be installed at varying depths, roughly corresponding to the shallow, intermediate and deep zones of the previous investigators; actual completion depths will be dependent on the location of permeable aquifer material as shown by the geophysical log and lithologic description of the pilot boring. Each well will be installed in a separate boring, not in a single boring as was done in the past. This will eliminate the potential for cross-contamination between wells sharing a common borehole. The background wells will characterize the groundwater away from the influence of the landfill.

Location CDM-2 is proposed to define the lateral and vertical extent of the plume south of the landfill boundary, based on the detected dichlorofluoromethane in the residences along North Avenue. A 3 well cluster is proposed for this location, again to correspond to the general completion intervals identified by others. The actual completion depths will depend on the results of the geophysical logging in the pilot hole at that location. Location CDM-3 is downgradient of wells MW-4, OW-1 and EW-1, with detected organics. Two wells are proposed at this location, to characterize the shallow and intermediate zones. The completion zones will be dependent on the geophysical log at this location.

Location CDM-4 will be a far downgradient monitor location outside the limit of the plume. The results of the soil gas survey will be reviewed to assist in locating these wells beyond the plume boundary. Three wells are anticipated, including a deep well to define the vertical extent of contamination. Location CDM-5 has been located in the same manner as CDM-4, downgradient of observed organics in MW-1 and W-1R.

Location CDM-6 is proposed to define the northwestern extent of the plume. One shallow well is anticipated at this location. Finally, Location CDM-7 will be placed downgradient of observed, although very low, levels of organics in residential wells found north of the landfill. Two wells are anticipated at this location, which will function as a far offsite monitor beyond the plume. As above, completion intervals will be dependent on the results of the geophysical logging.

Proposed locations may change, depending on whether access agreements with landowners can be obtained from the City. Details of well installation and handling of drilling/ development wastes will be presented in Section 11.0.

At each pilot hole location, in situ core samples of the subsurface material will be obtained at selected depths dependent on field conditions. These samples will be analyzed for grain size, total organic carbon (TOC), and volatile organics using EPA Method 8240. The purpose of these analyses is to characterize the aquifer material and achieve an understanding of contaminant transport by groundwater by comparing the aquifer material results with groundwater contamination levels. Approximately 2 samples per boring are anticipated. Depth of sampling will be dependent on the identification of permeable aquifer material.

Contingent on the well owner's cooperation, a monitoring test will be conducted which will determine the well flow rate while measuring water level changes in selected site wells, for a period of at least 24 hours. The test will be conducted after the agricultural season is complete, to avoid impacting the owner's irrigation schedule. Also, during all water quality sampling episodes, notation will be made as to whether the U-16 pump is on or off. If possible, pending the cooperation of the owner, an on-off meter will be installed (hard-wired) into the pump controller to record on-off cycles on a weekly basis during sampling.

The sampling results for rounds while pumping is occurring will be compared to rounds when the pump is off to determine the potential impacts on water quality results. The results of this comparison and the results of the monitoring test will be prepared in a technical memorandum to EPA, along with any recommendations for control responses, if necessary.

Analytical and quality control procedures are discussed in Appendix B-1.

Section Seven

7.0 GROUNDWATER INVESTIGATION

The groundwater investigation will involve sampling of existing and newly-installed site monitoring wells, to monitor the extent of organic chemicals in groundwater and to provide data for the health risk assessment and feasibility study. This expanded RI sampling program will continue for a minimum of one year, including two annual sampling episodes. In addition, an effort will be made to determine the historical pumping practices of all irrigation wells within 1 mile of the site in order to determine their influence on the groundwater gradient. The data quality objectives, sampling rationale, and analytical methods for the groundwater investigation are discussed in this section. Field procedures are discussed in Section 12.4.

7.1 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and quantitative statements of the quality of data needed to support specific decisions or regulatory actions. DQOs for the groundwater investigation have been developed based on intended data uses as well as sampling and analytical capabilities. Specific data uses, PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters, analytical methods, and detection limits for the groundwater investigation are discussed in this section.

7.1.1 Prioritized Data Uses and Decisions

Data collected during the groundwater investigation will be used for risk assessment; to evaluate the potential health threat to residents; to identify the nature and extent of groundwater contamination; and to assist in development of remedial alternatives. Level IV quality data, as defined by "Data Quality Objectives for Remedial Response Activities" (EPA 540/G-87/003A) is therefore needed for all on-site well data.

The analyses to be conducted on groundwater samples will include the volatile organic compounds, BNAs, pesticides/PCBs, herbicides, dioxin, and total metals. Additional chemical parameters will be analyzed for as necessary to fully investigate the potential range of chemicals present including free phase chemicals (light or dense NAPLs).

Analytical methods, discussed in Section 7.2, were selected based on their ability to provide quantitation or detection limits below the relevant federal and state action limits. Potential ARARs for FSL are discussed in the CDM Fresno Sanitary Landfill RI/FS Work Plan.

The specific compounds and detection limits required for each of these analytical methods are included in Appendix B-1.

7.1.2 Quality Assurance Objectives

The quality assurance objectives for measurement data in terms of precision, accuracy, completeness, representativeness, and comparability are discussed in Appendix A.

7.2 RATIONALE FOR SAMPLE LOCATIONS, NUMBER OF SAMPLES, AND ANALYSES

Twenty-six existing and seventeen new on-site wells will be sampled as part of the groundwater investigation. As discussed in Section 2.3, many of the existing wells have previously been sampled for volatile organic compounds (VOCs), pesticides, metals, and water quality parameters. A review of these data indicates that VOCs, namely TCE, PCE, VC and dichlorodifluoromethane, were consistently detected throughout the reported sampling events. PCE was detected at levels between 100 and 150 μg/l at 3 wells; VC was detected at levels between 50 and 100 μg/L at 6 wells.

The objective of the groundwater investigation is to collect data for the development of a risk assessment database, for the delineation of the extent of groundwater contamination, and for the evaluation of feasible remedies for water treatment. These RI goals will be accomplished through annual sampling of forty-three on-site wells, and quarterly sampling of 14 on-site wells for one year, beginning in September 1991. Quarterly sampling will occur during March, June, September and December; annual sampling will occur during September. This RI sampling substitutes for the current Waste Discharge Requirements; at the end of the 1 year period, the City's sampling program will resume until site closure, when new post-closure monitoring requirements will take effect.

In addition to annual sampling of the 43 on-site wells, quarterly sampling of 16 on-site wells is planned. These well locations have been chosen in order to closely monitor the lateral and vertical boundaries of the contaminant plume. Specifically, on the eastern landfill perimeter UW-2A, 2B, 2C, and W-3 will monitor the vertical extent of contamination. W-3 has been chosen because it has relatively low pH and high TDS values. CDM-1A, 1B, and 1C will monitor the upgradient or background conditions. On the western landfill perimeter DW-1A, 1B, 1C, W-5, and MW-1 will monitor the vertical extent of contamination. MW-1 has a relatively high vinyl chloride value; W-5 is located near the irrigation pipeline, which is a possible soil gas migration pathway. CDM-4A, 4B, 4C, and 6A will monitor the lateral plume boundary. The on-site wells selected for quarterly sampling are listed in Table 12.4.

The locations of the wells are shown in Figure 6-1. Actual sampling procedures and pertinent completion data for each well, except U-16, are presented in Section 12.0. Well U-16 is a privately owned irrigation well. It is not known whether completion data is available, or whether access is obtainable. All samples will be analyzed for the following:

Parameter	Method
Volatile Organics	EPA 8240, 8010/8020
BNAs	EPA 8270
Pesticides/PCBs	EPA 8080
Herbicides	EPA 8150
Dioxin	EPA 8280
Metals	EPA 6010, 7061, 7471, 7741

Parameter	Method
Chloride	EPA 300
Nitrate	EPA 300
Sulfate	EPA 300
Alkalinity	Standard Method 403
TDS	EPA 160.1
TKN	Standard Method 4500-NH_3E and Norg B
Organic-N	Standard Method 4500-Norg B and NH_3B & E
Ammonia-N	Standard Method 4500-NH_3B & E
COD	EPA 410.1 and 410.2
Sulfide	EPA 376.1
Hardness	EPA 130.2

In addition, pH, temperature, conductivity and turbidity will be measured in the field. The specific compounds and detection limits required for each of these analytical methods are outlined in Appendix B-1.

Background concentrations of indicator parameters and waste constituents will be determined as described by Title 23, California Code of Regulations, Chapter 15, revised Article 5 (1991). Since organic compounds have been detected at existing upgradient locations (UW-1 and UW-2), the 3-well cluster to be installed at CDM-1 is the only location available for background determination. Collection of a minimum of one sample from CDM-1A, 1B, and 1C every two months is planned in order to statistically characterize the individual shallow, intermediate, and deep aquifer intervals.

The statistical procedure proposed to evaluate the background data distribution is the tolerance interval as described in "Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities - Interim Final Guidance" (EPA/530-SW-89-026). A one-sided tolerance, with 95% coverage of the population, and 95% confidence will be used. The purpose of the tolerance interval approach is to define a concentration range from background well data, within which a large proportion of the monitoring observations should fall. These concentration ranges will be used by the California Regional Water Quality Control Board to establish site-specific water quality protection standards.

After one year, background data will be inspected for outliers and normal distribution. If necessary, outliers will be eliminated from the background database. If a normal distribution of data is not found, either the tolerance interval will be constructed assuming a different distribution, on a more suitable statistical procedure will be used. Non-detect data, and seasonality of data will be handled as described in the EPA guidance referenced above.

EPA Methods 8010/8020 have been selected for analysis of VOCs for all on-site wells because they provide quantitation limits below state and federal action limits (e.g., MCL for vinyl chloride is 0.5 ppb). Because all site contaminants may not have been identified, GC/MS sampling by EPA Method 8240 will be conducted on 10 percent of the samples (5 wells) during the first round of sampling. GC/MS has a capability for identifying unknown compounds that is far superior to the GC 8010/8020 method; GC/MS alone, however would not provide adequate quantitation limits. GC/MS analysis will be performed at the following locations: DW-1B, DW-1C, OW-1, CDM-1B, and DW-2A. The downgradient wells DW-1B, DW-1C, and OW-1 are selected for GC/MS analysis because "unidentified peaks" have been previously detected during 601 analysis. CDM-1B and DW-2A are upgradient and downgradient locations also chosen for GC/MS analysis. In the event that GC/MS analysis reveals the presence of compounds not detected by 8010/8020, the locations and numbers of samples analyzed by 8240 will be reevaluated.

For consistency with past analyses, for adequate characterization of groundwater quality, and for possible use as indicator parameters, all groundwater samples will be analyzed for the water quality parameters listed above.

Since dioxin is relatively immobile and insoluble in water, it is not a common groundwater contaminant. During the first round of sampling, analysis for polychlorinated dibenzo-p-dioxin and polychlorinated dibenzofuran homologs by EPA Method 8280 is planned for 10 percent of the samples (5 wells). Five wells that have previously been found to contain VOCs have been chosen: DW-1B, W-3, W1R, MW-1, and W-2. If no dioxin is found in the initial sampling, it will be dropped from the parameter list.

All analytical and quality control procedures are discussed in Appendix B-1.

Section Eight

8.0 RESIDENTIAL WELL SAMPLING

Residential well sampling is described in this section. Ongoing quarterly sampling of five residential wells has been carried out by the City since mid-1989. A total of 14 nearby residential wells have been sampled by previous investigators. The objective of this task is to continue the ongoing residential well monitoring in order to fully investigate the potential range of contaminants present. This expanded sampling program will continue for a minimum of one year, including two annual sampling episodes. The data will be input to the risk assessment, and will also be used in the feasibility study.

8.1 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are qualitative and quantitative statements of the quality of data needed to support specific decisions or regulatory actions. DQOs for residential well sampling have been developed based on intended data uses as well as sampling and analytical capabilities. Specific data uses, PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters, analytical methods, and detection limits for residential well sampling are discussed in this section.

8.1.1 Prioritized Data Uses and Decisions

Data collected at residential wells will be used to evaluate the potential health threat to residents; to identify the nature and extent of groundwater contamination; and to assist in development of remedial alternatives. Level IV quality data, as defined by "Data Quality Objectives for Remedial Response Activities" (EPA 540/G-87/003A) is therefore needed for all residential well data. The analyses to be conducted on residential well samples will include volatile organic compounds, BNAs, pesticides/PCBs, herbicides, dioxin, and total metals.

Analytical methods, discussed in Section 8.2, were selected based on their ability to provide quantitation or detection limits below the relevant federal and state action limits. Potential ARARs for FSL are discussed in the CDM Fresno Sanitary Landfill Work Plan.

The specific compounds and detection limits required for each of these analytical methods are included in Appendix B-1.

8.1.2 Quality Assurance Objectives

The quality assurance objectives for measurement data in terms of precision, accuracy, completeness, representativeness, and comparability are discussed in Appendix A.

8.2 RATIONALE FOR SAMPLE LOCATIONS, NUMBER OF SAMPLES, AND ANALYSES

Fourteen residential wells and one on-site City well have been identified in the vicinity of the FSL (see Figure 6-1). As part of previous investigations, each of the 14 residential wells has been sampled for analysis of volatile organic compounds; 5 of these wells have been sampled quarterly by the City for the analysis of volatile organic compounds. In addition, most of the residential wells have been sampled for pesticides, metals, and water quality parameters. A review of the data indicates that concentration levels for pesticides and the majority of VOCs were below the detection limit. PCE was detected at levels above the detection limits but below federal and state action limits at numerous wells; PCE was detected at levels slightly above the action limit in 2 wells (2168 and 2429 North Avenue).

A list of the well owners contacted prior to previous sampling efforts is included in Table 12-8. Water level and well depth information gathered from previous reports is presented in Table 12-9. The vertical extent of gravel pack around the outside of the well casing is unknown for all 14 wells. Previous reports have indicated, however, that it was not uncommon years ago for wells to have extensive gravel pack intervals which sometimes extended up to the ground surface.

The objective of the residential well sampling program is to collect data for the development of a risk assessment database, for the delineation of groundwater contamination, and for the evaluation of feasible remedies. These goals will be accomplished through annual sampling of 14 residential, 1 on-site City well (19-H1), and quarterly sampling by the City of five residential wells. In addition, two irrigation water samples will be collected: one from the canal upstream of the site, and one from the pipeline that has passed through the landfill. To be consistent with the Waste Discharge Requirements for FSL, quarterly sampling will occur during March, June, September and December; annual sampling will occur during September.

Quarterly monitoring locations have been chosen in order to closely monitor the presence and lateral migration of the contaminant plume. Specifically 2142, 2168 and 2429 North and 1635 Jensen have been chosen because they are the 4 residential locations at which PCE has been detected. In addition, 2100 and 2188 North were chosen because dichlorodifluoromethane has been detected at these locations.

Parameter	Method
Volatile Organics	EPA 8240 EPA 8010/8020
BNAs	EPA 8270
Pesticides/PCBs	EPA 8080
Herbicides	EPA 8150
Dioxin	EPA 8280
Metals (total)	EPA 6010, 7061, 7471, 7741
Chloride	EPA 300
Nitrate	EPA 300
Sulfate	EPA 300
Alkalinity	Std. Method 403
TDS	EPA 160.1
TKN	Std. Method 4500 NH_3E and Norg B
Organic-N	Std. Method 4500 Norg B & NH_3B & E

Parameter	Method
Ammonia-N	Std. Method 4500 NH_3B & E
COD	EPA 410.1 & 410.2
Sulfide	EPA 376.1
Hardness	EPA 130.2

In addition, pH, temperature, and turbidity will be measured in the field.

The specific compounds and detection limits required for each of these analytical methods are outlined in Appendix B-1. The wells selected for quarterly and annual sampling are listed in Table 12-5, and illustrated in Figure 6-1. Actual sampling procedures and pertinent completion data for each well are presented in Section 12.

EPA Methods 8010/8020 have been selected for analysis of VOCs for all residential wells because they provide quantitation limits below state and federal action limits (e.g., MCL for vinyl chloride is 0.5 ppb). GC/MS analysis by EPA Method 8240 will also be conducted on 10% of the samples (2 wells) during the first round of sampling in order to more thoroughly characterize the nature of contamination in the groundwater. Residential wells 2168 and 2429 North have been selected for GC/MS analysis since these are the two residential wells at which PCE was detected at levels above the action limit. In the event that GC/MS analysis reveals the presence of compounds not detected by 8010/8020, the location and percentage of samples analyzed by 8240 will be re-evaluated. Also, 8240 analysis will be performed on all samples in which "unidentified peaks" were detected in the 8010/8020 analysis.

For consistency with past analyses, for adequate characterization of groundwater quality, and for possible use as indicator parameters, all groundwater samples will be analyzed for the groundwater quality parameters listed above.

Since dioxin is relatively immobile and insoluble in water,it is not a common groundwater contaminant. During the first round of sampling analysis, EPA Method 8280 for polychlorinated bibenzofuran homologs is planned for 10% of the residential well samples (2 wells). Private wells at 2168 and 2429 North Avenue have been selected for dioxin analysis since previous data indicates they have higher levels of contamination than the other residential wells. In the event that any residential or on-site wells reveals the presence of dioxin homologs, the percentage of samples, location, and analytical method for dioxin will be re-evaluated.

The discussion of analytical and quality control methods for residential well sampling is identical to the on-site groundwater sampling procedures, and is included in Appendix B-1.

Section Nine

9.0 SURFACE AND SUBSURFACE SOIL INVESTIGATION

A surface and subsurface soil investigation will be performed as part of the FSL remedial investigation. The following sections describe data quality objectives and sampling rationale.

9.1 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are qualitative and quantitative statements of the quality of data needed to support specific decisions or regulatory actions. DQOs for the soil investigation have been developed based on intended data uses as well as sampling and analytical capabilities, specific data uses, PARCC (precision, accuracy, representative, completeness, and comparability) parameters, analytical methods, and detection limits. DQOs for surface and subsurface soil are discussed in this section.

9.1.1 Prioritized Data Uses and Decisions

Soil samples will be collected during the hydrogeologic and soil gas investigations. Surface soil data will be used to determine if an exposure pathway exists for ingestion or dermal contact due to soils contaminated by the landfill. Surface soil data will also be used to determine background concentrations. Subsurface soil data will be used to characterize the vertical extent of contaminated soil at the landfill perimeter, and the geochemical characteristics of the upgradient and downgradient aquifer material. This information will assist in development of remedial alternatives for the treatment of groundwater.

Analytical Level IV data as defined by "Data Quality Objectives for Remedial Response Activities" (EPA 540.G-87/003A) are needed for the investigation. Surface soil samples and subsurface soil samples collected during the soil gas investigation will be analyzed for volatile organics, BNAs, pesticides/PCBs, herbicides, dioxin, and metals. Subsurface samples collected during the hydrogeologic investigation will be analyzed for volatile organics, in addition to grain size and TOC.

The specific compounds and detection limits required for each of these analytical methods are outlined in Appendix B-1.

9.1.2 Quality Assurance Objectives

The quality assurance objectives for measurement data in terms of precision, accuracy, completeness, representativeness, and comparability are discussed in Appendix A.

9.2 RATIONALE FOR SAMPLE LOCATIONS, NUMBER OF SAMPLES, AND ANALYSES

Figure 9-1 shows proposed soil sampling locations for the FSL soil investigation. Both surface and subsurface soil samples will be collected. An approximate total of 30 soil samples are proposed consisting of 10 surface samples and 63 subsurface samples. Soil samples will be collected during the soil gas (Section 4.0) and hydrogeologic (Section 6.0) investigations. The following paragraphs describe the rationale for sample location, number, and analyses.

A total of 11 surface soil samples will be collected for risk assessment purposes and to determine background. Figure 9-1 shows the location of the sampling points. Surface samples will be collected along the perimeter of the landfill at proposed soil gas monitoring locations CMW-1 through CMW-7. Upgradient and downgradient sample locations are also proposed; these are identified on Figure 9-1, near proposed CDM monitoring well locations CDM-1 and CDM-4. Finally two surface samples are proposed near private residences at 2168 North Avenue, located south of the FSL, and 1635 Jensen Avenue, located north of the FSL.

A total of 63 subsurface soil sample locations are proposed under this investigation. The sample locations correspond with CDM monitoring wells CDM-1 through CDM-7 (Figure 9-1). Approximately two subsurface soil samples will be collected from seven pilot borings proposed in the hydrogeologic investigation. Samples will be selected from permeable zones which appear to be preferential flow paths for groundwater. The sampling is described in Section 6.0.

Subsurface soil samples will also be collected during the installation of permanent soil gas wells. The locations of these sampling points are shown on Figure 9-1 and correspond to proposed CDM gas monitoring wells CMW-1 through CMW-7. Subsurface samples will be collected at 5-foot intervals down to 45 feet. The 5-foot depth corresponds with the level at which a clay hardpan has been observed around the site. It is anticipated that the hardpan impedes transport of material downward. Shallow subsurface samples from the 2- to 5-foot interval will be analyzed under a 5-day turnaround time. The deeper subsurface samples will be retained by the laboratory. The decision to perform the planned analyses will be based on analytical results of the shallow subsurface samples.

The analyses to be conducted for the soil investigation include the following:

Location	Parameter	Method
Surface Soil/ Subsurface Soil Soil Gas Investigation	Volatile Organics	EPA 8240
	BNAs	EPA 8270
	Pesticides/PCBs	EPA 8080
	Herbicides	EPA 8150
	Dioxin	EPA 8280
	Metals	EPA 6010, 7061, 7471, 7741
Subsurface Soil Hydrogeological Investigation	Grain Size	ASTM C136
	Total Organic Carbon	Modified ASTM D-4129 & D-5136
	Volatile Organics	EPA 8240

The purpose of the analyses is to characterize the extent of soil contamination at the perimeter of the site due to the landfill and to determine contaminants of concern for the risk assessment. Subsurface samples to be collected under the hydrogeologic investigation will be analyzed for volatile organics, total organic carbon (TOC), and grain size. These analytes will assist in determining the characteristics of aquifer material. It is anticipated that landfill gas is the mechanism for contaminant migration; therefore, analyses for other organics and metals are not being performed. The grain size results will also assist in selecting appropriate screen slot size for monitoring wells.

The analytical and quality control procedures for grain size, TOC volatile organics, BNAs, pesticides/PCBs, herbicides, dioxin and metals are presented in Appendix B-1.

Section Ten

10.0 AMBIENT AIR SAMPLING

There is a potential at the FSL site that landfill gas may be emanating from the landfill surface into the ambient air, which could pose a potential health risk to nearby residents. The inclusion of this task in the RI will provide data on ambient air at the landfill so that a risk assessment can be completed for the inhalation pathway.

10.1 DATA QUALITY OBJECTIVES

Data quality are qualitative and quantitative statements of the quality of data needed to support specific decisions or regulatory actions. DQOs for ambient air sampling have been developed based on intended uses as well as sampling and analytical capabilities. Specific data uses, PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters, analytical methods, and detection limits for ambient air sampling are discussed in this section.

10.1.1 Prioritized Data Uses and Decisions

Data collected for the ambient air investigation will be used to evaluate the potential health threat to residents. Data gathered under this task will meet the objectives of the risk assessment source modeling to be performed by EPA's contractor. Level IV quality data, as defined by "Data Quality Objectives for Remedial Response Activities" (EPA 540/C-87/003A) is therefore needed for ambient air analysis.

10.1.2 Quality Assurance Objectives

The quality assurance objectives for measurement data in terms of precision, accuracy, completeness, representativeness, and comparability are discussed in Appendix A.

10.2 RATIONALE FOR SAMPLE LOCATION, NUMBER OF SAMPLES, AND ANALYSES

The proposed air sampling program consists of ambient air sampling and installation of a weather station to monitor and record precipitation, wind speed and direction (including sigma theta). The rationale for sample location, number of samples, and analyses is described in the following paragraphs.

It is proposed that six air sampling locations be established, one for each side of the landfill. Figure 10-1 shows the proposed locations for air sampling. Previous weather monitoring data indicate a prevailing wind direction from the west-northwest with wind shifts to the southeast approximately 6% of the time. The background location is 1,000 feet upwind, and also provides downwind coverage if the wind switches to out of the southeast. The location north of the site is proposed to maximize the chance of detecting emissions if the wind shifts to out of the southeast. Three downwind locations, one on the fence line, one 150 feet from the site, and one 1,000 feet from the site are proposed to obtain data in downwind concentrations and in accordance with EPA guidance for siting air samplers near roads and structures. The sixth sampling location is near the residences on the southside of the landfill. These locations are somewhat diagrammatic and may be changed based on weather data from the met station.

It is proposed that the weather station be located in the center of the landfill. At this location wind speed and direction can be recorded and related specifically to the landfill.

At a minimum, 24-hour composite samples will be collected at each location over two separate 24-hour periods. During this time the meteorological station will be operating continuously, recording wind speed and direction. Each 24-hour air sample will be collected with a Summa canister with a critical orifice to control the sampling rate. Sample collection and standard operating procedures for the Summa canister and weather station are described in Section 12.7. If diurnal wind conditions exist, the time period over which the samples are collected will be re-evaluated.

In addition to Summa canister samples, adsorbent tubes will be used to collect 24-hour samples at four downwind landfill air sampling locations. The purpose for utilizing the adsorbent tubes is to correlate the results with the canister sampling as required by EPA. The procedure for collecting adsorbent tube samples is described in Section 12.7.1.

The analyses to be conducted on ambient air samples will include the following:

Parameter	Method
Calderon Compounds	EPA TO-14 and EPA TO-2

Specifically, ambient air samples will be analyzed for vinyl chloride; benzene; methylene chloride; chloroform; 1,2-dichloroethane; 1,1,1-trichloroethane; carbon tetrachloride; trichloroethylene; tetrachloroethylene; 1,2-dibromoethane. Vinyl chloride and benzene pose the highest risk, due to their ambient air standard, for the inhalation pathway. Therefore, these two compounds will have the greatest impact on development of the risk assessment. The eight additional compounds requested for analysis have been identified in the Calderon legislation (CA HSC Section 41805.5). These compounds have been identified due to their presence in landfill gas and their potential toxicity.

Analytical and quality control procedures for analysis of air samples are included in Appendix B-2.

Section Eleven

11.0 RI DERIVED WASTES

This section describes the approach to disposition of waste materials that will be generated during the RI investigation. The procedures for handling and disposing of RI derived wastes are described in detail for each task in Section 12.0. To summarize, all drill cuttings and excess soil sample material will be contained onsite, on the upper surface of the landfill. A shallow depression will be created using the onsite earthmoving equipment and lined with plastic sheeting, to contain the soils produced during the hydrogeology and surface/subsurface soil investigations. Waters produced during well development and purged from the wells during sampling will be contained temporarily in a portable poly tank and/or transferred directly to a vacuum tanker truck, for disposal at the Fresno sewage treatment plant located 3 miles west of the site. Purge water is routinely disposed of by the City at the sewage treatment plant. Levels of contamination in the purge water are expected to be relatively low, and will not exceed the permit limits of the treatment plant. No wastes will be produced during the residential well sampling tank. Wastes such as discarded protective clothing, used respirator cartridges, and other materials related to personnel protection will be contained in plastic and clearly labeled; ordinary paper/putrescible trash will be contained in separate plastic garbage bags, and bags will be disposed of in the City's municipal trash system. Waters generated by decontamination procedures at the decon station will be contained and pumped into a portable poly tank, then transferred to a vacuum truck for disposal at the Fresno sewage treatment plant. Any collected or excess solvent material used in equipment decontamination will be contained and stored in a 55-gallon drum, clearly labeled, for disposal as hazardous waste.

11.1 DATA QUALITY OBJECTIVES

Since samples of derived waste will not be required, this section is not applicable.

11.2 RATIONALE FOR SAMPLE LOCATION, NUMBER OF SAMPLES, AND ANALYTICAL PROCEDURES

Not applicable.

Section Twelve

12.0 FIELD METHODS AND PROCEDURES

This section presents the methods and procedures that will be used to collect samples and conduct measurements in the field. Included in this section are methods for:

- Soil gas testing.
- Soil borings.
    - hydro borings
    - subsurface borings - gas
    - subsurface borings - leachate
- Soil gas monitoring probe installation.
- Leachate and vadose zone soil sample collection.
- Groundwater monitoring well installation.
- Water level measurements.
- Water sample collection.
- Soil sample collection.
- Air sample collection.
- Sample identification.
- Sample containers, preservation, and shipping.
- Sample report forms and chain-of-custody records.
- On-site laboratory analytical procedures.
- Quality assurance/control samples.
- Documentation.
- Disposal of contaminated materials.

- Equipment decontamination.

This section is accompanied by a series of appendices that provide further detail for field procedures. The contents of the appendices are listed below:

Volume II

Appendix A - Quality Assurance Goals

Appendix B - Analytical and Quality Control Procedures

Appendix B1- Groundwater, Soil and Leachate

Appendix B2- Soil, Gas and Ambient Air

Appendix C - Field Forms

- Field Equipment Log
- Unified Soil Classification System
- Sample Boring Log
- Boring Log
- Sample Monitoring Well Construction Log - Standard Flush Mount
- Monitoring Well Construction Log - Standard Flush Mount
- Well Development Log
- Sample Label Example
- Chain of Custody Record
- Custody Seal
- Field Change Request Form

Appendix D - Standard Operating Procedures

- Investigation-Derived Waste
- Environmental Sample Shipping
- Weather Station
- Summa Canister
- Soil Gas Probe Monitoring

Appendix E - Calibration and Operating Procedures

- Calibration for the HNu PI 101
- YSI Model 33 Conductivity Meter

- Orion SA 250 pH meter
- Bacharach HPK Combustible Gas & Oxygen Indicator
- Foxboro Century 128 OVA Flame Ionization Detector

Appendix F - Laboratory Quality Assurance Manuals

- Agriculture & Priority Pollutant Laboratories (APPL)
- Coast-to-Coast Analytical Services
- Tracer Research

12.1 SOIL GAS INVESTIGATION

A soil gas investigation will be conducted on the FSL site. The following is a summary of procedures for soil gas sampling. A qualified subcontractor will perform the soil gas investigation, including placement of probes and analysis of soil vapor. The subcontractor's equipment consists of a field van equipped with a gas chromatograph powered by gasoline--powered generators. A hydraulic drive mechanism is used to drive and withdraw the sampling probes.

12.1.1 Summary of Field Procedures and Sample Collection for Soil Gas Survey

Prior to the placement of the soil gas probe at each investigation point, all equipment which will come in contact with the soil will be decontaminated following the general procedures in Section 12.8. Probes consist of 7- to 10-foot lengths of 3/4-inch diameter hollow steel pipe fitted with detachable drive points.

The soil gas probe is placed in the hydraulic drive mechanism and then pushed in the ground approximately 15 feet deep; lengths of pipe are added as necessary. The probe is then withdrawn several inches to remove the open end of the probe from the drive point and expose the probe to the soil gas. If probe placement beneath the hardpan is not possible with the hydraulic drive, a small drilling rig will be used to advance a small-diameter boring through the hardpan to allow sampling.

A reducer and a length of teflon tubing is attached to the soil gas probe and a vacuum pump is used to purge 5-10 probe volumes. Based on the relatively granular soil in the vicinity of the landfill, it is anticipated that the probe evacuation time will be approximately 30 seconds. It is estimated that an evacuation pressure of approximately one to three inches of mercury will be required. The vacuum pump is capable of pulling up to 25 inches of mercury.

While the vacuum pump is running, a syringe and needle are inserted through the tubing and down into the probe. The syringe is purged with soil gas; then, without removing the syringe and needle from the adaptor, a 2-10 ml soil gas sample is collected. Once the sample is collected, the syringe and needle are removed and the needle is capped. The sample of soil gas is then analyzed for methane, the ten Calderon compounds, and Freon 12. Seven of the Calderon compounds which have been detected at the FSL site during previous groundwater or air investigations include vinyl chloride, benzene, methylene chloride, 1,2-DCA, TCA, TCE, and PCE.

The ten Calderon compounds and Freon 12 will continue to be monitored for as the mobile lab progresses away from the landfill in 100-foot increments. If a specific compound is not detected at two consecutive probe locations, analysis for this compound will be discontinued.

A sample in a Summa canister will be taken at 5 percent of all probes monitored for methane and vinyl chloride. Summa canister samples will be collected by inserting a stainless steel T-joint in the sample extraction line. A teflon tube will connect the canister to the T-joint. The vacuum inside the canister will draw in the sample. It will take 1-2 minutes for the canister to fill. An external pressure gauge will be used to measure the pressure of the canister contents before and after sample collection. The sample will be analyzed for all ten Calderon compounds and Freon 12 by a fixed-base laboratory utilizing the TO-14 analysis. In addition, at 5% of the probe locations at which vinyl chloride is not detected, a Summa canister sample will be collected for vinyl chloride analysis by the fixed-base laboratory.

In order to correlate soil gas probe data with permanent soil gas well data, temporary probe locations adjacent to MMW-1, MMW-2, MMW-4, MMW-5, MMW-6, MMW-7, and MMW-12 are planned. The soil gas sampling van will also draw an intermediate level probe sample from each of these wells. Both the permanent and temporary samples will be analyzed for methane and vinyl chloride.

Additional procedures for obtaining canister samples are described in Section 12.7, Ambient Air Sampling. Table 12-1 includes the analytical methods, sample containers, and sample collection points.

12.1.2 Summary of Field Procedures and Sample Collection for Permanent Soil Gas Wells

Soil gas well borings will be installed with a hollow stem auger rig in accordance with the drilling methods for a hollow stem auger as described in "A Compendium of Superfund Field Operation Methods" EPA/540/P-87/001, Section 8.1.6.13, Hollow Stem Augers. Drilling and installation of the gas monitoring wells will be performed by a qualified subcontractor. The following is a summary of methods and procedures to be used:

Soil Gas Borings

- An experienced contractor with knowledge of the local geologic conditions will be selected. The hollow stem auger system will be a Central Mine Equipment (CME)-75 or equivalent capable of reaching the required depths.

- The rig and the hollow stem augers will be decontaminated following the procedures in Section 12.8 prior to drilling the first boring and after each boring is completed. The washdown will be performed at the on-site decontamination facility.

- The hollow stem auger will either be a hydraulically or mechanically powered drill rig which simultaneously rotates and axially advances a hollow stem auger column. Each of the joints between auger sections will be properly connected.

Table 12–1
Summary of Analysis for Permanent Soil Gas Well Samples

page 1 of 2

ANALYTICAL METHOD		Calderon VOCs TO14 and Freon 12
PRESERVATIVES		none
ANALYTICAL HOLDING TIME		<30 days
SAMPLE NUMBER	SAMPLING SCHEDULE	6 liter SUMMA Cannister
CMW1–SG–001	Day 1	1
CMW1–SG–002	Day 1	1
CMW1–SG–003	Day 1	1
CMW3–SG–004	Day 1	1
CMW3–SG–005	Day 1	1
CMW3–SG–006	Day 1	1
CMW6–SG–007	Day 1	1
CMW6–SG–008	Day 1	1
CMW6–SG–009	Day 1	1
CMW6–SG–030 (duplicate of CMW6–SG–007)		1
MMW1–SG–010	Day 1	1
MMW1–SG–011	Day 1	1
MMW1–SG–012Q	Day 1	1
MMW1–SG–031 (duplicate of MMW1–SG–011	Day 1	1
TOTAL		14

Table 12-1
Summary of Analysis for Permanent Soil Gas Well Samples

ANALYTICAL METHOD		Calderon VOCs TO14 and Freon 12
PRESERVATIVES		none
ANALYTICAL HOLDING TIME		<30 days
SAMPLE NUMBER	SAMPLING SCHEDULE	6 liter SUMMA Cannister
MMW5-SG-013	Day 1	1
MMW5-SG-014	Day 1	1
MMW5-SG-015	Day 1	1
MMW7-SG-016	Day 1	1
MMW7-SG-017	Day 1	1
MMW7-SG-018Q	Day 1	1
MMW8-SG-019	Day 1	1
MMW8-SG-020	Day 1	1
MMW8-SG-021	Day 1	1
MMW8-SG-032 (duplicate of MMW8-SG-021)	Day 1	1
CMW7-SG-035 (blank)	Day 1	1
CMW7-SG-036 (blank)	Day 1	1
TOTAL		12

Q = Laboratory QC sample will be located downwind of the landfill.

- Samples from the soil material will be collected from each boring using a continuous coring device. A CME continuous core sampler consisting of 5-foot long split sampling tube with basket retainer and shoe will be employed. The continuous core sampler is advanced at the same time as the drill hole, collecting a relatively undisturbed sample. One twelve-inch (12") brass sleeve will be placed inside the continuous sampler so that an analytical sample can be obtained from each 5-foot interval drilled. The material not captured by the brass sleeve in each boring will be logged by the on-site geologist. Geologic observations will be recorded on the Boring Log. The Unified Soil Classification System (USCS) will be used to describe lithologies, and symbols will be consistent with those in Appendix B.

- After the continuous coring device is removed from the hole, it will be opened, exposing the brass sleeve and the soil material. The depth interval for the sleeve will be marked in the logbook, and the sleeve labeled using an indelible pen. Intervals which exhibit anomalous HNu readings (when compared to other intervals in the same hole) will have analytical preference. One sleeved sample will be selected for analysis from each boring. The selected sleeve will be immediately capped by first covering the exposed ends with aluminum foil, then capping the ends with plastic caps. The caps will then be taped in place.

  Samples for shipment will be prepared following procedures in Section 12.11.

- Selected samples will be analyzed for volatiles, metals, BNAs, pesticides/PCBs, herbicides, and dioxin. Section 12.6 describes the analytical requirements.

- In addition to completing the Boring Log for each boring, the on-site geologist will maintain a Field Logbook. The Site Logbook maintained by the field supervisor, will document the following: day, date, time entered site, temperature, weather conditions, names, and titles of personnel present; names and titles of any visitors on site; arrival time of driller and other subcontractors, feet drilled, materials used, references to the Boring Logs, decontamination iterations; any potential problem areas or incidents, and how those may impact the project; any telephone calls made and how those affected the decision-making process.

Permanent Soil Gas Well Installation and Monitoring

Seven permanent gas monitoring wells will be installed at the FSL site. In each boring, three probes will be installed at depths of approximately 5 feet, 25 feet, and 45 feet, respectively. Soil gas probes consist of 1/4" polyethylene tubing connecting the ground surface to gravel packs at specific depths. Soil gas probes will be installed in Schedule 40 PVC casing. A stopcock is located at the end of each probe. Figure 12-2 depicts the construction details of the proposed soil gas monitoring wells.

All of the 14 gas monitoring wells selected for permanent perimeter monitoring (CMW-1, 2, 3, 4, 5, 6, 7, MMW-1, 3, 4, 5, 6, 7, 8) will be analyzed for methane. The soil gas monitoring wells are monitored directly for methane utilizing the Bacharach HPK-2 combustible gas and oxygen indicator. The HPK-2 is capable of measuring methane at the percent levels. These levels are anticipated in the wells at the perimeter of the landfill. Summa canister samples will be collected for analysis of the Calderon compounds at seven of the gas monitoring wells (CMW-1, 3, 6, MMW-1, 5, 7, and 8) from all depths. The Calderon samples will be used to characterize the vertical distribution of landfill gases along all sides of the landfill. Correlation of the permanent gas monitoring wells with the temporary soil gas probe monitoring will be performed. The soil gas sampling van will draw an intermediate level probe sample from the permanent gas monitoring well after completing the gas sample withdrawal and analysis from a point in the soil adjacent to the well. Both the permanent and temporary probes will be analyzed for methane and vinyl chloride. This correlation will be performed for methane monitoring wells MMW-1, MMW-2, MMW-4, MMW-5, MMW-6, MMW-7, and MMW-12, as depicted in Figure 3-1.

Methane Measurement

Turn the HPK combustible gas indicator to ON. Perform the HPK startup procedures. Attach the probe to the stopcock with a length of 1/4" Tygon^R tubing. The pump should almost stop. If it does not, there is a leak in the sample line. Locate and repair the leak before proceeding.

Open the stopcock, watch closely for water in the sampling line. Turn the HPK off quickly if water enters the liquid trap. Read the combustible and oxygen meters when the needle on the oxygen meter reaches its low point. Close the stopcock. Disconnect the Tygon^{R} tubing at the stopcock. Let the HPK vent with the pump running until the oxygen meter reads 21 percent again. If direct measurement of the gas well with the HPK does not indicate the presence of methane, the Summa canister collected at that location will be analyzed for methane by the fixed-based laboratory.

Summa Canister Collection

Table 12-1 illustrates the permanent soil gas well locations at which Summa canisters will be collected. The procedures for collecting these samples are described below:

- Connect vacuum gauge to sample canister, open valve, check and record initial vacuum, close valve, remove vacuum gauge.
- Each well will be fitted with a cap with a 1/4 in. o.d. Swagelok brass tubing adaptor. A teflon tube will be used to connect a vacuum pump, calibrated with a rotometer, to the well. At least 2 well volumes will be purged prior to sample collection.
- Teflon tubes will be provided by the laboratory, and will be changed between wells.
- The teflon tube will be detached from the pump, and attached to the canister for sample collection.
- After sample collection, close the valve, disconnect the tubing, record the final vacuum, and attach a label to the sample canister with pertinent sample information.

12.1.3 Disposal of Contaminated Material

Drill cuttings will be generated during the drilling of borings for permanent gas wells. These cuttings will be transported to the upper surface of the landfill. At this location, a depression will be constructed for disposal of contaminated material. At a maximum, the depression will be 3 feet deep and 100 feet by 100 feet in area. A liner of plastic will be placed within the depression prior to any disposal of soil material.

12.2 LEACHATE INVESTIGATION

Drilling will be undertaken in the refuse area to investigate and characterize, to the extent possible, leachate in the refuse and the underlying vadose zone soils. A minimum of 2 borings within the landfill in the vicinity of the pipeline are planned.

12.2.1 Summary of Field Procedures and Sample Collection for Leachate and Vadose Zone Soils

Leachate Sampling

The leachate exploration borings will be advanced through the trash prism in the areas that appear to have a potential for free leachate, in order to sample and characterize the leachate. In addition, the borings will allow characterization of the unsaturated zone soils beneath the refuse, to determine if leachate migration is occurring and to determine if permanent, post-closure vadose zone monitoring is possible.

- An experienced contractor will be selected. The drilling technique selected will be capable of reaching the required depths. The drilling technique will be specified in a letter to EPA within 7 weeks of SAP approval.
- The rig will be decontaminated following the procedures in Section 12.8 prior to drilling the first boring and after each boring is completed. The washdown will be performed at the on-site decontamination facility.

- The drill will be advanced through the refuse using appropriate health and safety precautions. The borings will be logged for evidence of moisture and free fluid.

- If saturated conditions are encountered, the driller will be instructed to allow the liquid to enter the drill casing, and a sample of the liquid will be obtained if possible using a clean and decontaminated Teflon bailer. Table 12-2 shows the analyses which will be requested for leachate, if it is encountered. The pH, conductivity, and temperature of the leachate will be determined in the field.

- The appropriate sample containers will be filled from the bailer. Samples for shipment will be prepared following the procedures in Sections 12.10 and 12.11.

- If significant quantities of leachate are encountered, as determined by the project manager, a leachate monitoring well will be installed, following the procedures outlined in Section 12.3.1 (after the vadose zone monitoring is completed as described below). A completed log and record of leachate occurrence and leachate well installation will be maintained by the on-site geologist.

- The boring will be advanced below the base of the refuse into the underlying soil. Depth of drilling will be determined based on the first fine-grained geologic unit below the water table. The depth of refuse will be noted in the field logbook and on the Boring Log. The rig will be set up for continuous coring, and continuous five-foot soil cores will be obtained. Table 12-3 shows the soil analyses that will be requested. Three (3) twelve-inch (12") brass sleeves will be placed inside the continuous sampler so that the appropriate analytical samples can be obtained from the five-foot interval. Geologic observations will be noted by examining the material not captured in the sleeves, and will be recorded on the Boring Log. The Unified Soil Classification System (USCS) will be used to describe lithologies, and symbols will be consistent with those in Appendix B.

- After the continuous coring device is removed and opened, the depth interval for the sleeves will be marked in the logbook, and the sleeves labeled using an indelible pen. Sleeves will be immediately capped by first covering the exposed ends with aluminum foil, then capping with plastic end caps. The caps will then be taped in place. Samples for shipment will be prepared following procedures in Sections 12.10 and 12.11.

Table 12–2
Summary of Analyses for Leachate Samples

ANALYTICAL METHOD		VOC 8240	Soil Moisture Metals 6010/7061/ 7471/7741	Phosphorus, Nitrate Nitrite, Sulfate Chloride (300) TDS/TSS 160.1/160.2	Ammonia–N COD 410.1/410.2 Oil&Grease 413.2	Hardness 130.2	Sulfide 376.1	BOD 405.1	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl* Chill to 4 C	Chill to 4 C	Chill to 4 C	H2SO4 to pH<2*	HNO3 to pH<2*	Zinc Acetate and NaOH to pH<9*	Chill to 4 C	
ANALYTICAL HOLDING TIME		<14 days	<6 months (28 days for Hg)	<7 days for TDS	<28 days	<6 months	<7 days	<48 hours	
SAMPLE NUMBER	SAMPLING SCHEDULE	2 x 120 ml glass vial	1 x 8 oz jar	1 x 8 oz jar	1 x 8 oz jar	1 x 8 oz jar	1 x 8 oz jar	1 x 16 oz jar	
2416–LE–L1–001	Day 1	2	1	1	1	1	1	1	8
2416–LE–L2–001Q	Day 1	2	1	1	1	1	1	1	8
2416–LE–L3–001	Day 1	2	1	1	1	1	1	1	8
2416–LE–L10–001 (duplicate of	Day 1	2	1	1	1	1	1	1	8
2416–LE–L3–001)	Day 1	2	1	1	1	1	1	1	8
TOTALS		10	5	5	5	5	5	5	40

* = Preservation may not be used, depending of pH of leachate samples
Q = Laboratory QC Sample
LE = Leachate Sample

Table 12-3
Summary of Analyses for Subsurface Soil Samples (Leachate Investigation)

ANALYTICAL METHOD		VOC 8240	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	TOC D4129/D5136 Metals 6010/7061/ 7471/7741	pH 9045 ASTM D2216-80 Porosity; Moist. ASTM D2116, 854	Bottles per Location
PRESERVATIVES		Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<14 days	<14 days	<14 days	<6 months (28 days for Hg)	<14 days	
SAMPLE NUMBER	SAMPLING SCHEDULE	brass sleeve	brass sleeve	brass sleeve	brass sleeve	brass sleeve	brass sleeve	brass sleeve	
2416-SB-L1-001	Day 1	1	1	1	1	1	1	1	7
2416-SB-L1-002	Day 1	1	1	1	1	1	1	1	7
2416-SB-L1-003	Day 1	1	1	1	1	1	1	1	7
2416-SB-L1-004Q	Day 1	1	1	1	1	1	1	1	7
2416-SB-L1-005	Day 1	1	1	1	1	1	1	1	7
2416-SB-L2-001	Day 1	1	1	1	1	1	1	1	7
2416-SB-L2-002	Day 1	1	1	1	1	1	1	1	7
2416-SB-L2-003	Day 1	1	1	1	1	1	1	1	7
2416-SB-L2-004	Day 1	1	1	1	1	1	1	1	7
2416-SB-L2-005	Day 1	1	1	1	1	1	1	1	7
2416-SB-L3-001 (duplicate of 2416-SB-L2-005)	Day 1	1	1	1	1	1	1	1	7
TOTALS		11	11	11	11	11	11	11	77

Q = Laboratory QC Sample
SB = Subsurface Soil Sample

- It is anticipated that the first fine-grained geologic unit below the water table will be approximately 50 to 70 feet below the base of the refuse allowing five sampled intervals of soils in each boring (one sample every 10 feet). One sample will be taken at the top of the saturated zone, since this is where LNAPLs would be likely to accumulate, and one sample will be taken at the first fine-grained unit encountered, since this is where DNAPLs might accumulate. Actual sample depths will be based on field conditions.
- If a leachate well is not installed, each boring will be grouted immediately after sampling to the surface, to prevent cross-contamination.

12.2.2 Disposal of Contaminated Material

Drill cuttings will be generated during drilling. These cuttings will be transported to the upper surface of the landfill. At this location, a depression will be constructed for disposal of soil material. At a maximum, the depression will be 3 feet deep and 100 feet by 100 feet in area. A plastic liner will be placed within the depression prior to any disposal of soil material.

12.3 HYDROGEOLOGIC INVESTIGATION

A hydrogeologic investigation will be performed on the FSL site. The following paragraphs describe the method and procedures to be used.

12.3.1 Summary of Field Procedures and Sample Collection Methods

Two types of drill rigs will be used in the hydrogeologic investigation. These include a mud rotary rig and air rotary casing hammer rig. A mud rotary rig will be used to drill pilot boreholes for downhole geophysical surveys. Based on the geophysical characteristics of the pilot borings, the completion intervals of the monitoring wells will be determined. The borings drilled with the mud rotary drilling method will be drilled as described in "A Compendium of Superfund Field Operations Methods" EPA/540/P-87/001, Section

8.1.6.1.7, Mud and Water Rotary Drilling. Mud rotary drilling is required in order to run geophysical logs, to adequately characterize the subsurface. The following is a summary of the methods and procedures to be used:

- A drilling contractor shall be selected with experience in the local area, if possible. The rigs shall be of a design adequate to reach the depths anticipated. Two contractors may be required to supply both mud rotary and air rig equipment.
- The mud rotary rig and all drill pipe will be decontaminated prior to drilling the first hole and between holes. A decontamination facility will be established on the site to allow rig washdown and drill pipe decontamination between borings. Decontamination procedures are discussed in Section 12.8.1.
- Only pure bentonite mud will be used during drilling. No drilling additives or synthetic polymers will be used. During drilling, mud will be contained in a portable mud tank and recirculated. When drilling is complete, mud will be pumped into a dump truck or other properly designed vehicle and hauled to the upper surface of the landfill and placed in the lined depression, discussed in Section 12.1.3. Disposal of drilling spoils are also discussed in Section 12.2.2.
- Each boring will be logged by examining the cuttings brought to the surface by the circulating mud. Geologic observations will be recorded on the Boring Log; a sample form is included in Appendix C. The USCS will be used to describe lithologies, and symbols will be consistent with those in Appendix C. Borings will be advanced to approximately 250 feet below ground surface.
- Downhole geophysics will be run in each boring by a qualified geophysical contractor. Spontaneous potential, resistivity, and gamma ray logs will be requested. Logs will be run at a scale of 1-inch to 20 feet, at an appropriate sensitivity to clearly show formational contacts. Field prints and reproducible mylars or computer disc copies will be obtained from the contractor.
- Subsurface samples of aquifer material will be collected at selected depths from the pilot borings. In zones of suspected permeable aquifer material, the driller will collect a split-spoon sample using the drill string to drive and retrieve the sampler. Brass sleeves will be placed inside the sampler. Samples will be collected for volatile organics, total organic carbon (TOC), and particle size distribution. Sample preservation and handling are discussed in Section 12.10. The particle size distribution data will be used to determine screen slot size and filter pack material size. Screen slot size will be

equivalent to the sieve size that retains 90 percent of the formation material (Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Well, EPA 600/4-89/034).

- At the completion of geophysical logging and sampling, the pilot borings will be grouted to the surface as quickly as possible. No pilot borings will remain open overnight, to minimize any intercommunication. Grout specifications will be the same as those in the following monitoring well installation section.
- In addition to completing the Boring Log for each boring, the on-site geologist will maintain a Field Logbook. The Site Logbook will be maintained by the field supervisor.

The boreholes for monitoring well installation will be drilled using an air rotary drill rig. The boreholes will be drilled in accordance with procedures described in "A Compendium of Superfund Field Operations Methods" EPA/540/P-87/001, Section 8.1.6.1.8, Air Rotary Method. Monitor well depths will be determined based on the geophysical logs obtained from the pilot borings.

The air rotary casing driver combination is particularly efficient where drilling through unconsolidated materials. In areas of heaving or running sands, unstable zones are supported by the outer casing. Reliable lithologic samples are collected from the interval that is being drilled because the overlying formation is cased off. The casing also minimizes the potential for inter-aquifer cross-contamination. The following is a summary of the methods and procedures to be used:

- A drill rig and contractor shall be selected with experience in the local area, if possible. The rig shall be of a design adequate to reach the depths anticipated.
- The rig and all drill pipe will be decontaminated prior to drilling the first hole and between holes. A decontamination facility will be established to allowing washdown and drill pipe decontamination between borings. Decontamination procedures are discussed in Section 12.8.1.
- No drilling additives will be used.

During drilling, cuttings will be contained in a portable tank or drums. When drilling is complete, the containers will be placed into a truck and transported to the landfill as discussed in Section 12.1.3.

- Geologic observations will be recorded on the Boring Log; a sample form is included in Appendix C. The USCS will be used to describe lithologies, and symbols will be consistent with those in Appendix C.
- In addition to completing the Boring Log for each boring,the on-site geologist will maintain a Field Logbook. The Site Logbook will be maintained by the field supervisor.

Monitoring Well Installation

After drilling of the boreholes, monitoring wells will be installed. The following is a description of installation procedures.

- All casing material will be decontaminated by the driller prior to use. Casing will be steam cleaned and allowed to air dry.
- Casing for shallow and intermediate depth wells will be 4-inch, Schedule 40 PVC (per ASTM D1875) with flush-threaded joints (Figure 12-2). Screen will be continuous machine-slotted PVC. Deep wells will be completed with 4-inch Schedule 80 PVC. The general locations and planned depths are described in Section 6.0. The completion intervals will be selected in the field based on the results of the geophysical logs.
- Two-foot sections of blank riser and screen will be retained for evidence of material used. The samples will be wrapped in aluminum foil and retained for the length of the project.
- Centralizers will be fabricated from aluminum straps and clamped to the casing above and at the base of the screen to ensure plumbness and alignment of the casing. Additional centralizers will be attached to the blank casing in 50-foot increments.
- After the well screen and casing are installed through the drill casing, the annulus around the well screens will be filled with a formation stabilizer consisting of inert Monterey silica sand or equivalent that is well rounded and

sorted, with the sand size based on a sieve analyses performed in the field, and/or a review of the soil grain size analyses conducted on samples collected from the pilot borings. Appendix C contains the procedure for sieve analysis. A sample of the formation stabilizer will be retained for evidence of materials used. The formation stabilizer will be placed in the annulus and brought up five feet above the top of the screen, in order to maintain an adequate barrier to prevent grout contamination of the screened interval. The filter pack will be added in measured increments and during placement the casing will be raised in increments less than the height the material will attain as it fills the entire annulus. During placement and raising the casing, the top of the filter pack will be sounded to ensure that it does not bridge in the casing and that it is at the appropriate height as determined from the calculated volume.

- An annular seal will be placed above the sand pack, consisting of three feet of pure bentonite, which will be hydrated according to manufacturer instructions, followed by a grout mixture of cement and bentonite to the ground surface. During material installation, the drill casing will be continuously withdrawn. The cement/bentonite grout will be emplaced using a tremie system. The cement/bentonite grout will be mixed according to the following ratios: 7.0 gallons potable water, 94 pounds of Type I/II Portland Cement, and 3-4 pounds pure bentonite additive, yielding 1.55 cubic feet per sack of cement. Samples of the bentonite pellets, cement, bentonite used in the grout mixture, and water used in the grout will be retained as evidence of materials used in well construction. Two pounds of the dry material, prior to mixing, and one liter of water will be retained.

- The screen lengths will be dependent on the thickness of the permeable zones encountered. Screen length will not exceed 20 feet, to minimize dilution of water quality samples. If thicker aquifer materials are encountered, additional wells may be required.

- The surface completion will consist of a steel protective casing set 3 to 4 feet above the ground surface. Three posts, 3 to 4 feet in height, will be cemented into the ground around each monitoring well. The posts will prevent damage to the well from vehicular traffic. Each well will be locked with a padlock to prevent unauthorized access. All of the locking devices will be keyed alike.

- A concrete apron will be constructed around the protective casing, and will be sloped away from the well to drain. The well number will be inscribed in the concrete apron with a scribing tool. A metal plate will be affixed to the inside of the protective casing, containing the following information permanently inscribed: (1) well number, (2) date installed, (3) completed depth, and (4) screen interval.

Well Development

Following well installation, the completed wells will be developed to promote aquifer flow into the well. The following general procedures will be followed:

- Wells will be developed using a combination of surge block, bailing, or submersible pump methods. Development water will be contained in a vacuum truck or portable tank.

- Wells will be developed until a water sample tests less than 5 Nephelometric Turbidity Units (NTU) of turbidity (described below) and is relatively free of suspended material, or until the well has been purged for a total of 4 hours. At least three casing volumes of water will be removed. The bailer, surge block, and/or submersible pump will be decontaminated at the central decontamination facility prior to and following each use.

- The development water will be monitored periodically for temperature and conductivity with a YSI Model 33 S-C-T meter and for pH with an Orion SA 250 pH meter (calibration and operating procedures are included in Appendix C). Measurements will be recorded in the field logbook. Stability of these parameters within 10% is an indicator of the completion of development. The rate of water level recovery will be monitored immediately following well development using a freshly decontaminated water level probe, and the measurements recorded on the appropriate form in Appendix C. Quality control procedures for monitoring instruments as described in Appendix E and in the manufactures' SOPs will be followed and recorded in the logbook.

- After development, all wells will be equipped with dedicated bladder pumps and inflatable packer assemblies similar to those in existing wells to facilitate well sampling. Pumps and packers will be obtained from QED Environmental Systems or equivalent.

- All well construction and development information will be recorded in the field logbook. Monitoring well construction log forms will be completed and will be referenced in the field logbook. A sample monitoring well construction form is included in Appendix C. Well development data will be recorded in the field logbook. All development water will be containerized and disposed of following procedures discussed in the following section.

12.3.2 Disposal of Contaminated Material

Drill cuttings generated during the drilling of pilot and monitor well borings will be disposed of as discussed in Section 12.1.3. Development water generated from the new monitoring wells will be pumped into a vacuum truck and disposed of in the Fresno sanitary treatment plant which is located 3 miles west of the site.

12.4 GROUNDWATER INVESTIGATION

Forty-three on-site wells will be sampled as part of the groundwater investigation. Installation of new monitoring wells is discussed above and in Section 6. The annual and quarterly sampling schedule for these wells is outlined on Table 12-4. Well construction details for existing wells are included in Table 12-5. Table 12-6 includes the analytical methods, sample containers, and sample collection points for annual sampling. The following is a summary of the field procedures for groundwater sampling.

12.4.1 Summary of Field Procedures and Sample Collection for the Groundwater Investigation

The twenty-six existing and seventeen new on-site monitoring wells will be equipped with operable dedicated bladder pumps. Well construction details for existing wells are listed in Table 12-5.

- A decontamination, sample preparation, and support area will be set up at the wellhead. All equipment and instruments that will be placed into the well casing or come in contact with water samples will be decontaminated. Decontamination procedures are described in Section 12.8.1. All decontamination procedures will be recorded in the field logbook.

TABLE 12-4
ON-SITE GROUNDWATER SAMPLING SCHEDULE

One-Time Sampling During RI	Subsequent Quarterly Sampling	Yearly Sampling (Every 4th Quarter)
UW-1A	UW-2A	UW-1A
UW-1B	UW-2B	UW-1B
UW-1C	UW-2C	UW-1C
W-2	CDM-1A	W-2
UW-2A	CDM-1B	UW-2A
UW-2B	CDM-1C	UW-2B
UW-2C	DW-1A	UW-2C
CDM-1A	DW-1B	CDM-1A
CDM-1B	DW-1C	CDM-1B
CDM-1C	CDM-4A	CDM-1C
W-3	CDM-4B	W-3
W-6	CDM-4C	W-6
MW-4	CDM-6A	MW-4
CDM-2A	MW-1	CDM-2A
CDM-2B	W-3	CDM-2B
CDM-2C	W-5	CDM-2C
CDM-3A		CDM-3A
CDM-3B		CDM-3B
OW-1		OW-1
EW-1		EW-1
DW-1A		DW-1A
DW-1B		DW-1B
DW-1C		DW-1C
CDM-4A		CDM-4A
CDM-4B		CDM-4B
CDM-4C		CDM-4C
W-4		W-4
MW-3		MW-3
W-5		W-5
19-H1		19-H1
MW-2		MW-2
CDM-5A		CDM-5A
CDM-5B		CDM-5B
CDM-5C		CDM-5C
DW-2A		DW-2A
DW-2B		DW-2B
DW-2C		DW-2C
W-1R		W-1R
MW-1		MW-1
CDM-6A		CDM-6A
U-16		U-16
CDM-7A		CDM-7A
CDM-7C		CDM-7-C

TABLE 12-5

ELEVATION AND COMPLETION DATA FOR EXISTING ON-SITE MONITORING WELLS FRESNO SANITARY LANDFILL

Well	Elevation At Well Datum (ft)	Total 2" PVC Casing Length (ft)[3]	Top of Pump (ft)[3]	Top of Packer (ft)[3]	Depth of Screened Interval (ft)	Elevation of Water Surface (ft above MSL)
W-1R	267.90[1]**	72.92	67.00	-	50-60	210.85
W-2	266.40[1]	69.50	64.00	-	50-60	210.62
W-3	266.40[1]	71.83	66.00	-	50-60	211.65
W-4	264.00[1]	68.87	63.00	-	50-60	208.21
W-5	266.50[1]	69.09	65.00	-	50-60	208.64
W-6	Not Surveyed	69.23	65.00	-	50-60	-
MW-1	267.38**	71.17	66.00	-	59-61	211.08
MW-2	266.22**	71.50	66.00	-	59-69	211.32
MW-3	264.47	65.40	59.00	-	53-63	210.38
MW-4	266.54**	67.60	62.00	-	55-65	211.58
UW-1A	266.54	70.45	56.15	-	50-60	211.38
UW-1B	265.48	95.38	87.00	-	100-110	212.05
UW-1C	265.41	147.67	137.75	133.00	150-160	211.92
UW-2A	265.42	57.30	51.40	-	50-60	210.55
UW-2B	265.38	85.71	75.83	-	100-110	211.21
UW-2C	265.42	149.10	138.71	134.00	150-160	211.10
DW-1A	262.23	56.19	?	Not Measured	50-60	—
DW-1B	262.07	108.60	96.75	94.00	100-110	209.57
DW-1C	260.95	158.25	151.83	133.00	150-160	209.63
DW-2A	265.95	70.33	?	-	50-60	209.73[2]
DW-2B	264.99	110.22	99.33	95.00	100-110	209.54
DW-2C	266.34	169.37	155.65	144.00	150-160	210.87
OW-1	263.92	102.80	92.00	81.00	82.5-102.5	209.96
EW-1	264.52	?	?	?	50-100	210.52

* Water level measurements taken on: 5/11 - 5/18/89

**Portion of 2-inch PVC stick up cut to accommodate new pump

[1] From measurement by Mitchel/Anderson 7/29/88

[2] Water level measurement taken on 6/5/89

[3] From top of 2" PVC casing

Table 12–6
Summary of Analyses for Groundwater Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4 C	2 drops 1:1 HCl Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO3 to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
UW1A–GW–001*	Day 1	–	3	2	2	2	–	1	10
UW1B–GW–001	Day 1	–	3	2	2	2	–	1	10
UW1C–GW–001	Day 1	–	3	2	2	2	–	1	10
W2–GW–001Q	Day 1	–	3	4	4	4	4	2	21
UW2A–GW–001*	Day 2	–	3	2	2	2	–	1	10
UW2B–GW–001	Day 2	–	3	2	2	2	–	1	10
UW2C–GW–001	Day 2	–	3	2	2	2	–	1	10
TOTALS		0	21	16	16	16	4	8	81

Q = laboratory QC sample
* = well dry during 9/90 sampling

Table 12–6
Summary of Analyses for
Groundwater Well Samples

ANALYTICAL METHOD		Chloride, Nitrate, Sulfate (300) Alkalinity (Std M 403) TDS (160.1)	TKN Organic–N Ammonia–N COD(410.1 & 410.2)	Sulfide (376.1)	Hardness (130.2)	Bottles per Location
PRESERVATIVES		Chill to 4 C	H2SO4 to pH<2	Zinc Acetate and NaOH to pH>9	HNO3 to pH<2	
ANALYTICAL HOLDING TIME		<7 days for TDS	<28 days	<7 days	<6 months	
SAMPLE NUMBER	SAMPLING SCHEDULE	1x500 ml polyethylene bottle	3 x 40 ml glass vial	1x500 ml polyethylene bottle	1x500 ml polyethylene bottle	
UW1A–GW–001*	Day 1	1	1	1	1	4
UW1B–GW–001	Day 1	1	1	1	1	4
UW1C–GW–001	Day 1	1	1	1	1	4
W2–GW–001Q	Day 1	2	2	2	2	8
UW2A–GW–001*	Day 2	1	1	1	1	4
UW2B–GW–001	Day 2	1	1	1	1	4
UW2C–GW–001	Day 2	1	1	1	1	4
TOTALS		8	8	8	8	32

Q = laboratory QC sample
* = well dry during 9/90 sampling

Table 12-6
Summary of Analyses for Groundwater Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4 C	2 drops 1:1 HCl Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO3 to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
CDM1A-GW-001	Day 3	–	3	2	2	2	–	1	10
CDM1B-GW-001	Day 3	3	3	2	2	2	–	1	13
CDM1C-GW-001	Day 3	–	3	2	2	2	–	1	10
W3-GW-001	Day 3	–	3	2	2	2	2	1	12
CDM20-GW-001 (duplicate of W3-GW-001)	Day 3	–	3	2	2	2	–	2	11
W6-GW-001	Day 4	–	3	2	2	2	–	1	10
MW4-GW-001	Day 4	–	3	2	2	2	–	1	10
CDM2A-GW-001	Day 4	–	3	2	2	2	–	1	10
CDM2B-GW-001	Day 4	–	3	2	2	2	–	1	10
CDM2C-GW-001	Day 4	–	3	2	2	2	–	1	10
TOTALS		3	30	20	20	20	2	11	106

Q = laboratory QC sample
* = well dry during 9/90 sampling

Table 12–6
Summary of Analyses for Groundwater Well Samples

ANALYTICAL METHOD		Chloride, Nitrate, Sulfate (300) Alkalinity (Std M 403) TDS (160.1)	TKN Organic–N Ammonia–N COD(410.1 & 410.2)	Sulfide (376.1)	Hardness (130.2)	Bottles per Location
PRESERVATIVES		Chill to 4 C	H2SO4 to pH<2	Zinc Acetate and NaOH to pH>9	HNO3 to pH<2	
ANALYTICAL HOLDING TIME		<7 days for TDS	<28 days	<7 days	<6 months	
SAMPLE NUMBER	SAMPLING SCHEDULE	1x500 ml polyethylene bottle	3 x 40 ml glass vial	1x500 ml polyethylene bottle	1x500 ml poly bottle	
CDM1A–GW–001	Day 3	1	1	1	1	4
CDM1B–GW–001	Day 3	1	1	1	1	4
CDM1C–GW–001	Day 3	1	1	1	1	4
W3–GW–001	Day 3	1	1	1	1	4
CDM20–GW–001 (duplicate of W3–GW–001)	Day 3	1	1	1	1	4
W6–GW–001	Day 4	1	1	1	1	4
MW4–GW–001	Day 4	1	1	1	1	4
CDM2A–GW–001	Day 4	1	1	1	1	4
CDM2B–GW–001	Day 4	1	1	1	1	4
CDM2C–GW–001	Day 4	1	1	1	1	4
TOTALS		10	10	10	10	40

Q = laboratory QC sample
* = well dry during 9/90 sampling

Table 12-6
Summary of Analyses for Groundwater Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4 C	2 drops 1:1 HCl Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO3 to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
CDM3A-GW-001	Day 5	–	3	2	2	2	–	1	10
CDM3B-GW-001	Day 5	–	3	2	2	2	–	1	10
OW1-GW-001Q	Day 5	3	3	4	4	4	–	2	20
EW1-GW-001**	Day 5	–	3	2	2	2	–	1	10
DW1A-GW-001*	Day 6	–	3	2	2	2	–	1	10
DW1B-GW-001	Day 6	3	3	2	2	2	2	1	15
CDM21--GW-00 (duplicate of DW1B-GW-001)	Day 6	3	3	2	2	2	2	1	15
DW1C-GW-001	Day 6	3	3	2	2	2	–	1	13
TOTALS		12	24	18	18	18	4	9	103

Q = laboratory QC sample
* = well dry during 9/90 sampling
** = pump broken 9/90

Table 12-6
Summary of Analyses for Groundwater Well Samples

ANALYTICAL METHOD		Chloride, Nitrate, Sulfate (300) Alkalinity (Std M 403) TDS (160.1)	TKN Organic-N Ammonia-N COD(410.1 & 410.2)	Sulfide (376.1)	Hardness (130.2)	Bottles per Location
PRESERVATIVES		Chill to 4 C	H2SO4 to pH<2	Zinc Acetate and NaOH to pH>9	HNO3 to pH<2	
ANALYTICAL HOLDING TIME		<7 days for TDS	<28 days	<7 days	<6 months	
SAMPLE NUMBER	SAMPLING SCHEDULE	1x500 ml polyethylene bottle	3 x 40 ml glass vial	1x500 ml polyethylene bottle	1x500 ml poly bottle	
CDM3A-GW-001	Day 5	1	1	1	1	4
CDM3B-GW-001	Day 5	1	1	1	1	4
OW1-GW-001Q	Day 5	2	2	2	2	8
EW1-GW-001**	Day 5	1	1	1	1	4
DW1A-GW-001*	Day 6	1	1	1	1	4
DW1B-GW-001	Day 6	1	1	1	1	4
CDM21--GW-00 (duplicate of DW1B-GW-001)	Day 6	1	1	1	1	4
DW1C-GW-001	Day 6	1	1	1	1	4
TOTALS		9	9	9	9	36

Q = laboratory QC sample
* = well dry during 9/90 sampling

Table 12-6
Summary of Analyses for Groundwater Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4 C	2 drops 1:1 HCl Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO3 to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
CDM4A-GW-001	Day 7	–	3	2	2	2	–	1	10
CDM4B-GW-001	Day 7	–	3	2	2	2	–	1	10
CDM4C-GW-001	Day 7	–	3	2	2	2	–	1	10
W4-GW-001*	Day 7	–	3	2	2	2	–	1	10
MW3-GW-001*	Day 8	–	3	2	2	2	–	1	10
W5-GW-001*	Day 8	–	3	2	2	2	–	1	10
19H1-GW-001	Day 8	–	3	2	2	2	–	1	10
MW2-GW-001	Day 8	–	3	2	2	2	–	1	10
TOTALS		0	24	16	16	16	0	8	80

* = well dry during 9/90 sampling

Table 12-6
Summary of Analyses for Groundwater Well Samples

ANALYTICAL METHOD		Chloride, Nitrate, Sulfate (300) Alkalinity (Std M 403) TDS (160.1)	TKN Organic-N Ammonia-N COD (410.1 & 410.2)	Sulfide (376.1)	Hardness (130.2)	Bottles per Location
PRESERVATIVES		Chill to 4 C	H2SO4 to pH<2	Zinc Acetate and NaOH to pH>9	HNO3 to pH<2	
ANALYTICAL HOLDING TIME		<7 days for TDS	<28 days	<7 days	<6 months	
SAMPLE NUMBER	SAMPLING SCHEDULE	1x500 ml polyethylene bottle	3 x 40 ml glass vial	1x500 ml polyethylene bottle	1x500 ml poly bottle	
CDM4A-GW-001	Day 7	1	1	1	1	4
CDM4B-GW-001	Day 7	1	1	1	1	4
CDM4C-GW-001	Day 7	1	1	1	1	4
W4-GW-001*	Day 7	1	1	1	1	4
MW3-GW-001*	Day 8	1	1	1	1	4
W5-GW-001*	Day 8	1	1	1	1	4
19H1-GW-001	Day 8	1	1	1	1	4
MW2-GW-001	Day 8	1	1	1	1	4
TOTALS		8	8	8	8	32

Q = laboratory QC sample
* = well dry during 9/90 sampling

Table 12-6
Summary of Analyses for Groundwater Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4 C	2 drops 1:1 HCl Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO3 to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
CDM5A-GW-001	Day 9	–	3	2	2	2	–	1	10
CDM5B-GW-001	Day 9	–	3	2	2	2	–	1	10
CDM5C-GW-001	Day 9	–	3	2	2	2	–	1	10
DW2A-GW-001Q	Day 9	3	3	4	4	4	–	2	20
DW2B-GW-001	Day 10	–	3	2	2	2	–	1	10
DW2C-GW-001	Day 10	–	3	2	2	2	–	1	10
W1R-GW-001	Day 10	–	3	2	2	2	2	1	12
MW1-GW-001	Day 10	–	3	2	2	2	2	1	12
CD22-GW-001 (duplicate of MW1-GW-001)	Day 10	–	3	2	2	2	2	1	12
U16-GW-001	Day 10	–	3	2	2	2	–	1	10
TOTALS		3	27	20	20	20	6	10	106

Table 12-6
Summary of Analyses for Groundwater Well Samples

ANALYTICAL METHOD		Chloride, Nitrate, Sulfate (300) Alkalinity (Std M 403) TDS (160.1)	TKN Organic-N Ammonia-N COD(410.1 & 410.2)	Sulfide (376.1)	Hardness (130.2)	Bottles per Location
PRESERVATIVES		Chill to 4 C	H2SO4 to pH<2	Zinc Acetate and NaOH to pH>9	HNO3 to pH<2	
ANALYTICAL HOLDING TIME		<7 days for TDS	<28 days	<7 days	<6 months	
SAMPLE NUMBER	SAMPLING SCHEDULE	1x500 ml polyethylene bottle	3 x 40 ml glass vial	1x500 ml polyethylene bottle	1x500 ml poly bottle	
CDM5A-GW-001	Day 9	1	1	1	1	4
CDM5B-GW-001	Day 9	1	1	1	1	4
CDM5C-GW-001	Day 9	1	1	1	1	4
DW2A-GW-001Q	Day 9	2	2	2	2	8
DW2B-GW-001	Day 10	1	1	1	1	4
DW2C-GW-001	Day 10	1	1	1	1	4
W1R-GW-001	Day 10	1	1	1	1	4
MW1-GW-001	Day 10	1	1	1	1	4
CD22-GW-001 (duplicate of MW1-GW-001)	Day 10	1	1	1	1	4
U16-GW-001	Day 10	1	1	1	1	8
TOTALS		10	10	10	10	40

Table 12-6
Summary of Analyses for Groundwater Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4 C	2 drops 1:1 HCl Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO3 to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
CDM6A-GW-001	Day 11	–	3	2	2	2	–	1	10
CDM7A-GW-001	Day 11	–	3	2	2	2	–	1	10
CDM7C-GW-001	Day 11	–	3	2	2	2	–	1	10
CDM8-GW-001 (blank)	Day 1	3	3	2	2	2	–	1	13
CDM9-GW-001 (blank)	Day 2	–	3	2	2	2	2 *	1	12
CDM10-GW-001 (blank)	Day 3	–	3	2	2	2	–	1	10
CDM11-GW-001 (blank)	Day 4	–	3	2	2	2	–	1	10
CDM12-GW-001 (blank)	Day 5	–	3	2	2	2	–	1	10
TOTALS		3	24	16	16	16	2	8	85

* = Dioxin blanks to be held by lab for possible future analysis

Table 12-6
Summary of Analyses for Groundwater Well Samples

ANALYTICAL METHOD		Chloride, Nitrate, Sulfate (300) Alkalinity (Std M 403) TDS (160.1)	TKN Organic-N Ammonia-N COD(410.1 & 410.2)	Sulfide (376.1)	Hardness (130.2)	Bottles per Location
PRESERVATIVES		Chill to 4 C	H2SO4 to pH<2	Zinc Acetate and NaOH to pH>9	HNO3 to pH<2	
ANALYTICAL HOLDING TIME		<7 days for TDS	<28 days	<7 days	<6 months	
SAMPLE NUMBER	SAMPLING SCHEDULE	1x500 ml polyethylene bottle	3 x 40 ml glass vial	1x500 ml polyethylene bottle	1x500 ml poly bottle	
CDM6A-GW-001	Day 11	1	1	1	1	4
CDM7A-GW-001	Day 11	1	1	1	1	4
CDM7C-GW-001	Day 11	1	1	1	1	4
CDM8-GW-001 (blank)	Day 1	1	1	1	1	4
CDM9-GW-001 (blank)	Day 2	1	1	1	1	4
CDM10-GW-001 (blank)	Day 3	1	1	1	1	4
CDM11-GW-001 (blank)	Day 4	1	1	1	1	4
CDM12-GW-001 (blank)	Day 5	1	1	1	1	4
TOTALS		8	8	8	8	32

Table 12–6
Summary of Analyses for Groundwater Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4 C	2 drops 1:1 HCl Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO3 to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
CDM13–GW–001 (blank)	Day 6	–	3	2	2	2	–	1	10
CDM14–GW–001 (blank)	Day 7	–	3	2	2	2	–	1	10
CDM15–GW–001 (blank)	Day 8	–	3	2	2	2	–	1	10
CDM16–GW–001 (blank)	Day 9	–	3	2	2	2	–	1	10
CDM17–GW–001 (blank)	Day 10	–	3	2	2	2	–	1	10
CDM18–GW–001 (blank)	Day 11	–	3	2	2	2	–	1	10
TOTALS		0	18	12	12	12	0	6	60

Table 12–6
Summary of Analyses for Groundwater Well Samples

ANALYTICAL METHOD		Chloride, Nitrate, Sulfate (300) Alkalinity (Std M 403) TDS (160.1)	TKN Organic–N Ammonia–N COD(410.1 & 410.2)	Sulfide (376.1)	Hardness (130.2)	Bottles per Location
PRESERVATIVES		Chill to 4 C	H2SO4 to pH<2	Zinc Acetate and NaOH to pH>9	HNO3 to pH<2	
ANALYTICAL HOLDING TIME		<7 days for TDS	<28 days	<7 days	<6 months	
SAMPLE NUMBER	SAMPLING SCHEDULE	1x500 ml polyethylene bottle	3 x 40 ml glass vial	1x500 ml polyethylene bottle	1x500 ml poly bottle	
CDM13–GW–001 (blank)	Day 6	1	1	1	1	4
CDM14–GW–001 (blank)	Day 7	1	1	1	1	4
CDM15–GW–001 (blank)	Day 8	1	1	1	1	4
CDM16–GW–001 (blank)	Day 9	1	1	1	1	4
CDM17–GW–001 (blank)	Day 10	1	1	1	1	4
CDM18–GW–001 (blank)	Day 11	1	1	1	1	4
TOTALS		6	6	6	6	24

- The depth to water will be measured using the water level indicator device. Water levels will be measured to an accuracy of 0.01 feet. The probe will be decontaminated before and after each use. The water level will be recorded in the field logbook. Depth to water will be recorded as measured from the top of the well casing.

- Calculate the volume of water in casing storage within the packed-off interval. The casing storage volume is calculated using the formula: (3.14) x (well radius in feet)^2 x (length of water column) x (7.48 gallons/cubic foot), to determine one casing volume in gallons.

- A minimum of 3 casing volumes of water will be purged, with exceptions made for wells with low recharge rates. Low recharge wells are defined as wells that cannot recharge 80% of the original volume within 8 hours. Low recharge wells will not be drawn down more than 50% of the original volume during purging.

- Temperature, pH, and conductivity will be monitored during the purging to ensure that they have stabilized within 10% before sampling. These water quality measurements will be made once at the beginning of each purge volume. A model 33 YSI conductivity meter will be used to measure conductivity and temperature. The pH will be determined through the use of a portable Orion SA250 pH meter. Turbidity will be measured once prior to sampling using a portable turbidity meter.

- Information concerning well purging shall be recorded in the logbook. The disposal of purge water is discussed in Section 12.4.2.

- Fill up the VOA vials first. Check for air bubbles in the VOA vial by turning it upside-down and tapping the side of the bottle. If bubbles are present, discard the sample and refill the bottle after first adding acid.

- QA samples will be prepared at the frequency discussed in Section 12.12. All samples will be logged in the field logbook. The groundwater sampling form will be prepared and the form will be referenced in the field logbook. Included will be the well number, identifier, analyte(s), date, time, and collector's signatures.

- Samples will be labeled and packed for shipment, following procedures in Section 12.11. Chain-of-custody records and any other necessary shipping documentation will be prepared.

12.4.2 Disposal of Contaminated Material

Purge water will be pumped from each well directly into a 100-gallon polyethylene tank for temporary on-site storage. The water will be transported to the Fresno Sanitary Treatment Plant for final disposal.

12.5 RESIDENTIAL WELL SAMPLING

Fourteen residential wells and one City well in the vicinity of the Fresno Sanitary Landfill will be sampled as part of the residential well sampling program. The annual and quarterly sampling schedule for these wells is outlined on Table 12-7. The following is a summary of the field procedures for residential well sampling.

12.5.1 Summary of Field Procedures and Sample Collection for Residential Well Sampling

Since the 14 residential wells are operating domestic wells, samples will be obtained either from the well head or a location before the holding tank, or from the faucet tap. While sampling from the well head is preferred, it is expected that most of the well heads will be sealed. If samples are collected from the faucet tap, all filters will be removed prior to sampling. At the on-site City well (19H1), the sample will be collected from a faucet at the wellhead. Two irrigation water samples will be collected: one from the canal upstream from the landfill; one from the pipeline that has passed through the trash prism. Access points for sampling will be determined in the field. The rationale for residential well sampling locations has been discussed in Section 7.0. Residential well owners are listed in Table 12-8. Table 12-9 lists elevation data for residential wells. Table 12-10 lists the analytical methods, sample containers, and sample collection points for residential well samples.

TABLE 12-7
RESIDENTIAL WELL SAMPLING SCHEDULE

One-Time Sampling During RI	Subsequent Quarterly Sampling	Yearly Sampling (Every 4th Quarter)
2045 North	2142 North	2045 North
2100 North	2168 North	2100 North
2142 North	2188 North	2142 North
2168 North	2429 North	2168 North
2188 North	1635 Jensen	2188 North
1912 Jensen		1912 Jensen
1635 Jensen		1635 Jensen
1642 Jensen		1642 Jensen
1346 Jensen		1346 Jensen
1304 Jensen		1304 Jensen
2429 North		2429 North
1650 Jensen		1650 Jensen
2121 Jensen		2121 Jensen
19H1		

TABLE 12-8

LIST OF WELL OWNERS IN THE IMMEDIATE VICINITY OF THE FRESNO LANDFILL*

Mr. Richard Salinas
1770 West North Avenue
Fresno, CA 93706

Bobby and Mary Mink
2045 West North Avenue
Fresno, CA 93706

Mr. Dorsey Brown
2100 West North Avenue
Fresno, CA 93706

Mr. Walter Kraft
2142 West North Avenue
Fresno, CA 93706

Mr. John Trujillo
P. O. Box 725
Mendota, CA 93640
(for 2168 West North Avenue)

Concha Trujillo
2188 West North Avenue
Fresno, CA 93706

Mr. Cecil Nuckels
2429 West North Avenue
Fresno, CA 93706

Mr. Augustine Gaona
1304 West Jensen Avenue
Fresno, CA 93706

Mr. Mitchel Batrich
1346 West Jensen Avenue
Fresno, CA 93706

**Barbara Paolini and
Jan Victoria Angel
300 Fairview Avenue
Seattle, WA 98109
(for 1635 West Jensen Avenue)

**1638 and 1646 West Jensen:
unknown owners; houses vacant

Mr. Marvin Wines
1650 West Jensen Avenue
Fresno, CA 93706

Mike and Jeanine Chiarito
1912 Jensen Avenue
Fresno, CA 93706

*Earth Science Associates 9/25/89
**Owners not residing at these addresses

TABLE 12-9

ELEVATION DATA FOR RESIDENTIAL WELLS IN THE IMMEDIATE VICINITY OF THE FRESNO SANITARY LANDFILL*

Well	Elevation at Well Datum (ft)	Distance From Well Datum To Grade (ft)	Approximate Elevation At Grade (ft above MSL)	Static Water Depth** (ft)	Elevation of Water Surface (ft above MSL)	Total Well Depth (ft)
1770 North	(1)	?	265.70	(2)	(2)	90+
2045 North	(1)	-0.75	(1)	53.28	(2)	(2)
2100 North	264.60	-0.50	264.10	52.95	211.15	197
2142 North	263.32	-0.42	262.90	52.48	210.42	-144
2168 North	263.57	-0.47	263.10	52.53	210.57	-133
2188 North	262.51	-0.21	262.30	52.09	210.21	-102?
2429 North	(1)	?	(1)	(2)	(2)	(2)
1304 Jensen	(1)	?	(1)	(2)	(2)	150?
1346 Jensen	(1)	?	(1)	(2)	(2)	-100
1642/38 Jensen	(1)	-0.60	(1)	53.71	(2)	100±
1635 Jensen Domestic	268.12	-2.02	266.10	(2)	(2)	200±
1650 Jensen	(1)	?	(1)	(2)	(2)	(2)
1912 Jensen	(1)	-0.75	(1)	57.86	(2)	-98
2121 Jensen	?	?	?	?	?	?
19H1	290.67	-1.67	289.00	(2)	(2)	255

(1) Not surveyed

(2) Unable to measure or determine.

*Earth Science Associates 9/25/89.

**Water level measurements taken on 5/89.

Table 12-10
Summary of Analyses for Residential Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4 C	2 drops 1:1 HCl Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO3 to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
1770N-GW-001	Day 1	–	3	2	2	2	–	1	10
2045N-GW-001	Day 1	–	3	2	2	2	–	1	10
2100N-GW-001	Day 1	–	3	2	2	2	–	1	10
2142N-GW-001	Day 1	–	3	2	2	2	–	1	10
2168N-GW-001Q	Day 1	3	3	4	4	4	4	2	24
2600N-GW-001 (duplicate of 2168N-GW-001)	Day 1	3	3	2	2	2	2	1	15
2188N-GW-001	Day 1	–	3	2	2	2	–	1	10
2429N-GW-001	Day 1	3	3	2	2	2	2	1	15
2500N-GW-001 (blank)	Day 1	3	3	2	2	2	2 *	1	15
TOTALS		12	27	20	20	20	10	10	119

Q = laboratory QC sample
* = Dioxin blanks to be held by lab for possible future analysis

Table 12–10
Summary of Analyses for Groundwater Well Samples

ANALYTICAL METHOD		Chloride, Nitrate, Sulfate (300) Alkalinity (Std M 403) TDS (160.1)	TKN Organic–N Ammonia–N COD(410.1 & 410.2)	Sulfide (376.1)	Hardness (130.2)	Bottles per Location
PRESERVATIVES		Chill to 4 C	H2SO4 to pH<2	Zinc Acetate and NaOH to pH>9	HNO3 to pH<2	
ANALYTICAL HOLDING TIME		<7 days for TDS	<28 days	<7 days	<6 months	
SAMPLE NUMBER	SAMPLING SCHEDULE	1x500 ml polyethylene bottle	3 x 40 ml glass vial	1x500 ml polyethylene bottle	1x500 ml poly bottle	
1770N–GW–001	Day 1	1	1	1	1	4
2045N–GW–001	Day 1	1	1	1	1	4
2100N–GW–001	Day 1	1	1	1	1	4
2142N–GW–001	Day 1	1	1	1	1	4
2168N–GW–001Q	Day 1	1	1	1	1	4
2600N–GW–001 (duplicate of 2168N–GW–001)	Day 1	1	1	1	1	4
2188N–GW–001	Day 1	1	1	1	1	4
2429N–GW–001	Day 1	1	1	1	1	4
2500N–GW–001 (blank)	Day 1	1	1	1	1	4
TOTAL		9	9	9	9	36

Table 12-10
Summary of Analyses for Residential Well Samples

ANALYTICAL METHOD		VOC 8240	VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Total Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		2 drops 1:1 HCl Chill to 4°C	2 drops 1:1 HCl Chill to 4°C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	HNO3 to pH < 2	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<7 days before extraction	<7 days before extraction	<7 days before extraction	<30 days before extraction	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING SCHEDULE	3 x 40 ml glass vial	3 x 40 ml glass vial	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	2 x 1 liter amber glass bottle	1 x 1 liter polyethylene bottle	
1304J-GW-001	Day 2	–	3	2	2	2	–	1	10
1346J-GW-001	Day 2	–	3	2	2	2	–	1	10
1635J-GW-001	Day 2	–	3	2	2	2	–	1	10
2620J-GW-001 (duplicate of 1635J-GW-001)	Day 2	–	3	2	2	2	–	1	10
1642J-GW-001	Day 2	–	3	2	2	2	–	1	10
1650J-GW-001	Day 2	–	3	2	2	2	–	1	10
1912J-GW-001	Day 2	–	3	2	2	2	–	1	10
2121J-GW-001	Day 2	–	3	2	2	2	–	1	10
2520J-GW-001 (blank)	Day 2	–	3	2	2	2	–	1	10
IRR1-GW-001	Day 2	–	3	2	2	2	–	1	10
IRR2-GW-001	Day 2	–	3	2	2	2	–	1	10
TOTALS		0	33	22	22	22	0	11	110

Table 12-10
Summary of Analyses for Groundwater Well Samples

ANALYTICAL METHOD		Chloride, Nitrate, Sulfate (300) Alkalinity (Std M 403) TDS (160.1)	TKN Organic-N Ammonia-N COD(410.1 & 410.2)	Sulfide (376.1)	Hardness (130.2)	Bottles per Location
PRESERVATIVES		Chill to 4 C	H2SO4 to pH<2	Zinc Acetate and NaOH to pH>9	HNO3 to pH<2	
ANALYTICAL HOLDING TIME		<7 days for TDS	<28 days	<7 days	<6 months	
SAMPLE NUMBER	SAMPLING SCHEDULE	1x500 ml polyethylene bottle	3 x 40 ml glass vial	1x500 ml polyethylene bottle	1x500 ml poly bottle	
1304J-GW-001	Day 2	1	1	1	1	4
1346J-GW-001	Day 2	1	1	1	1	4
1635J-GW-001	Day 2	1	1	1	1	4
2620J-GW-001 (duplicate of 1635J-GW-001)	Day 2	1	1	1	1	4
1642J-GW-001	Day 2	1	1	1	1	4
1650J-GW-001	Day 2	1	1	1	1	4
1912J-GW-001	Day 2	1	1	1	1	4
2121J-GW-001	Day 2	1	1	1	1	4
2520J-GW-001 (blank)	Day 2	1	1	1	1	4
IRR1-GW-001	Day 2	1	1	1	1	4
IRR2-GW-001	Day 2	1	1	1	1	4
TOTALS		11	11	11	11	44

If the residential well sampling is conducted by the City of Fresno, CDM staff will ensure that comparable sampling procedures are used for all groundwater sampling wells. Ideally, one lab will be used for all analyses. If not, CDM will ensure that identical analytical and QC procedures are used by both labs.

Summary of Field Procedures

1. The volume of holding tanks, if any, used by households to store well water will be estimated.

2. Based on flow estimates measured by timing flow into a calibrated bucket, the purge volume of the holding tanks will be calculated and evacuated prior to sampling. After the holding tank volume has been evacuated, water will be allowed to run for an additional fifteen minutes.

3. If no holding tanks are present, water from the tap will be run for 15 minutes prior to sampling, and field parameters will be monitored to ensure that they have stabilized.

4. Measure the conductivity, temperature, and pH of the groundwater periodically in a separate container. Record all field measurements in the field notebook. A Yellow Springs Instruments (YSI) conductivity (SCT) meter and an Orion pH probe will be used for these measurements. All manufacturers calibration and maintenance procedures will be followed. At least four measurements will be collected during the 15 minute purge. The conductivity and pH measurements should stabilize within 10% prior to sample collection. Prior to sampling, turbidity will be measured using a portable turbidity meter.

5. Calculate the flow rate using a calibrated bucket and record the total volume purged.

6. Collect a water sample from the tap, filling the sample containers directly.

7. Fill VOA containers completely, checking inverted bottle to ensure that bubbles are absent. VOA vials will be preserved with two drops 1:1 HC1 placed in the vial prior to sample collection. Leave 10% ullage in extractable containers and mark volume level on extractable container. Fill the polyethylene metals container and preserve to $pH < 2$ with HNO_3. Bottle types, preservation and holding times are shown in Table 12-10 and discussed in Section 12.9 and 12.10.

8. Place all samples on ice immediately after collection. Record preservative on sample label.

9. Prepare the necessary quality assurance samples (Section 12.12).

10. Log all samples in the field notebook. Include well number, sample number, date, time, samplers, bottle type, and lot number(s), and preservatives used, if any.

11. Label all samples containers with date, time, sample number, requested analysis, and preservatives used.

12. Pack the samples as required (Section 12.11) and complete necessary chain-of-custody forms.

13. Ship samples as specified in Section 12.11.

12.5.2 Disposal of Contaminated Material

Tap water purged from the residential well lines and holding tanks will be allowed to discharge directly into the drains. Purge water from the City well (19H1) will be pumped directly into the landfill water truck. Since contamination has never been detected in 19H1, the water will be sprayed directly onto the landfill as part of their daily dust control operations.

12.6 SURFACE AND SUBSURFACE SOIL INVESTIGATION

Surface and subsurface soils will be sampled during the hydrogeologic and soil gas investigation. This section describes the field procedures and sample collection methods. The analytical methods, sample containers, and number of samples for surface and subsurface soil collection are outlined in Tables 12-11, 12-12, and 12-13.

Table 12-11
Summary of Analyses for Surface Soil Samples (Soil Gas Investigation)

ANALYTICAL METHOD		VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Metals 6010/7000/ 7471/7741	Bottles per Location
PRESERVATIVES		Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<14 days	<14 days	<14 days	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING LOCATION	2 x 120 ml glass vial	1 x 8 oz jar	1 x 8 oz jar	1 x 8 oz jar	1 x 4 oz jar	1 x 8 oz jar	
2416-SS-A1-001	CMW-1	2	1	1	1	1	1	7
2416-SS-A2-001	CMW-2	2	1	1	1	1	1	7
2416-SS-A3-001	CMW-3	2	1	1	1	1	1	7
2416-SS-A4-001	CMW-4	2	1	1	1	1	1	7
2416-SS-A5-001	CMW-5	2	1	1	1	1	1	7
2416-SS-A6-001	CMW-6	2	1	1	1	1	1	7
2416-SS-A7-001	CMW-7	2	1	1	1	1	1	7
2416-SS-A8-001	2168 NORTH	2	1	1	1	1	1	7
2416-SS-A9-001	1635JENSEN	2	1	1	1	1	1	7
2416-SS-A10-001	upgradient	2	1	1	1	1	1	7
2416-SS-A11-001	downgradient	2	1	1	1	1	1	7
2416-SS-A10-001 duplicate		2	1	1	1	1	1	7
TOTALS		24	12	12	12	12	12	84

Q = Laboratory QC Sample
SS = Surface Soil Sample

Table 12-12
Summary of Analyses for Subsurface Soil Samples (Hydrogeologic Investigation)

ANALYTICAL METHOD		VOC 8010/8020	Grain-size ASTM C136	TOC ASTM D4129/D5136	Bottles per Location
PRESERVATIVES		Chill to 4 C	None	Chill to 4 C	
ANALYTICAL HOLDING TIME		<14 days	<30 days	<28 days	
SAMPLE NUMBER	SAMPLING LOCATION	brass sleeve	1 x 1000 gm ziploc baggie	brass sleeve	
2416-SB-B1-001	CDM-1	1	1	1	3
2416-SB-B1-002		1	1	1	3
2416-SB-B2-001	CDM-2	1	1	1	3
2416-SB-B2-002		1	1	1	3
2416-SB-B3-001	CDM-3	1	1	1	3
2416-SB-B3-002		1	1	1	3
2416-SB-B4-001	CDM-4	1	1	1	3
2416-SB-B4-002		1	1	1	3
2416-SB-B5-001	CDM-5	1	1	1	3
2416-SB-B5-002		1	1	1	3
2416-SB-B6-001	CDM-6	1	1	1	3
2416-SB-B6-002		1	1	1	3
2416-SB-B7-001	CDM-7	1	1	1	3
2416-SB-B7-002		1	1	1	3
2416-SB-B8-001 duplicate		1	1	1	3
2416-SB-B9-001 duplicate		1	1	1	3
TOTALS		16	16	16	48

SB = Subsurface Soil Sample
Q = Laboratory QC Sample

Table 12–13
Summary of Analyses for Subsurface Soil Samples (Soil Gas Investigation)

ANALYTICAL METHOD		VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<14 days	<14 days	<14 days	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING LOCATION	brass sleeve	brass sleeve	brass sleeve	brass sleeve	brass sleeve	brass sleeve	
2416–SB–B20–001	CMW–1*	1	1	1	1	1	1	6
2416–SB–B20–002	CMW–1#	1	1	1	1	1	1	6
2416–SB–B20–003	CMW–1#	1	1	1	1	1	1	6
2416–SB–B20–004	CMW–1#	1	1	1	1	1	1	6
2416–SB–B20–005	CMW–1#	1	1	1	1	1	1	6
2416–SB–B20–006	CMW–1#	1	1	1	1	1	1	6
2416–SB–B20–007	CMW–1#	1	1	1	1	1	1	6
2416–SB–B21–001Q	CMW–2*	1	1	1	1	1	1	6
2416–SB–B21–002	CMW–2#	1	1	1	1	1	1	6
2416–SB–B21–003	CMW–2#	1	1	1	1	1	1	6
2416–SB–B21–004	CMW–2#	1	1	1	1	1	1	6
2416–SB–B21–005	CMW–2#	1	1	1	1	1	1	6
2416–SB–B21–006	CMW–2#	1	1	1	1	1	1	6
TOTALS		13	13	13	13	13	13	78

Q = Laboratory QC Sample; SB = Subsurface Soil Sample
* = 5–DAY TURNAROUND REQUIRED # = Hold for future analysis

Table 12–13
Summary of Analyses for Subsurface Soil Samples (Soil Gas Investigation)

ANALYTICAL METHOD		VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<14 days	<14 days	<14 days	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING LOCATION	brass sleeve	brass sleeve	brass sleeve	brass sleeve	brass sleeve	brass sleeve	
2416–SB–B21–007	CMW–2#	1	1	1	1	1	1	6
2416–SB–B22–001	CMW–3*	1	1	1	1	1	1	6
2416–SB–B22–002	CMW–3#	1	1	1	1	1	1	6
2416–SB–B22–003	CMW–3#	1	1	1	1	1	1	6
2416–SB–B22–004	CMW–3#	1	1	1	1	1	1	6
2416–SB–B22–005	CMW–3#	1	1	1	1	1	1	6
2416–SB–B22–006	CMW–3#	1	1	1	1	1	1	6
2416–SB–B22–007	CMW–3#	1	1	1	1	1	1	6
2416–SB–B23–001	CMW–4*	1	1	1	1	1	1	6
2416–SB–B23–002	CMW–4#	1	1	1	1	1	1	6
2416–SB–B23–003	CMW–4#	1	1	1	1	1	1	6
2416–SB–B23–004	CMW–4#	1	1	1	1	1	1	6
2416–SB–B23–005	CMW–4#	1	1	1	1	1	1	6
TOTALS		13	13	13	13	13	13	78

Q = Laboratory QC Sample; SB = Subsurface Soil Sample

* = 5–DAY TURNAROUND REQUIRED # = Hold for future analysis

Table 12–13
Summary of Analyses for Subsurface Soil Samples
(Soil Gas Investigation)

ANALYTICAL METHOD		VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<14 days	<14 days	<14 days	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING LOCATION	brass sleeve	brass sleeve	brass sleeve	brass sleeve	brass sleeve	brass sleeve	
2416–SB–B23–006	CMW–4#	1	1	1	1	1	1	6
2416–SB–B23–007	CMW–4#	1	1	1	1	1	1	6
2416–SB–B24–001	CMW–5*	1	1	1	1	1	1	6
2416–SB–B24–002	CMW–5#	1	1	1	1	1	1	6
2416–SB–B24–003	CMW–5#	1	1	1	1	1	1	6
2416–SB–B24–004	CMW–5#	1	1	1	1	1	1	6
2416–SB–B24–005	CMW–5#	1	1	1	1	1	1	6
2416–SB–B24–006	CMW–5#	1	1	1	1	1	1	6
2416–SB–B24–007	CMW–5#	1	1	1	1	1	1	6
2416–SB–B25–001	CMW–6*	1	1	1	1	1	1	6
2416–SB–B25–002	CMW–6#	1	1	1	1	1	1	6
2416–SB–B25–003	CMW–6#	1	1	1	1	1	1	6
2416–SB–B25–004	CMW–6#	1	1	1	1	1	1	6
TOTALS		13	13	13	13	13	13	78

Q = Laboratory QC Sample; SB = Subsurface Soil Sample
* = 5–DAY TURNAROUND REQUIRED # = Hold for future analysis

Table 12–13
Summary of Analyses for Subsurface Soil Samples
(Soil Gas Investigation)

ANALYTICAL METHOD		VOC 8010/8020	BNA 8270	Pest/PCB 8080	Herbicides 8150	Dioxin 8280	Metals 6010/7061 7471/7741	Bottles per Location
PRESERVATIVES		Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	Chill to 4 C	
ANALYTICAL HOLDING TIME		<14 days	<14 days	<14 days	<14 days	<14 days	<6 months (28 days for Hg)	
SAMPLE NUMBER	SAMPLING LOCATION	brass sleeve	brass sleeve	brass sleeve	brass sleeve	brass sleeve	brass sleeve	
2416–SB–B25–005	CMW–6#	1	1	1	1	1	1	6
2416–SB–B25–006	CMW–6#	1	1	1	1	1	1	6
2416–SB–B25–007	CMW–6#	1	1	1	1	1	1	6
2416–SB–B26–001	CMW–7*	1	1	1	1	1	1	6
2416–SB–B26–002	CMW–7#	1	1	1	1	1	1	6
2416–SB–B26–003	CMW–7#	1	1	1	1	1	1	6
2416–SB–B26–004	CMW–7#	1	1	1	1	1	1	6
2416–SB–B26–005	CMW–7#	1	1	1	1	1	1	6
2416–SB–B26–006	CMW–7#	1	1	1	1	1	1	6
2416–SB–B26–007	CMW–7#	1	1	1	1	1	1	6
2416–SB–B30–	duplicate of	1	1	1	1	1	1	6
2416–SB–B30–	duplicate of	1	1	1	1	1	1	6
2416–SB–B30–	duplicate of	1	1	1	1	1	1	6
2416–SB–B30–	duplicate of	1	1	1	1	1	1	6
2416–SB–B30–	duplicate of	1	1	1	1	1	1	6
2416–SB–B30–	duplicate of	1	1	1	1	1	1	6
TOTALS		16	16	16	16	16	16	96

Q = Laboratory QC Sample; SB = Subsurface Soil Sample

* = 5–DAY TURNAROUND REQUIRED # = Hold for future analysis

12.6.1 Field Procedures and Sample Collection Method

Surface Soils

- Prepare sampling location by removing any dead vegetation, such as leaves from ground surface.
- Using a clean trowel remove 0-6 inches in depth of the surface soil and place in a clean sampling jar.
- Prepare sample jar as described in Section 12.9, 12.10, 12.11, and 12.12.

Subsurface Soils

Approximately 14 soil borings will be drilled for both the soil gas well installation and the hydrogeologic investigation, with subsurface soil samples collected to verify and define off-site contamination. All soil samples are to be collected in accordance with procedures in a "Compendium of Superfund Field Operation Methods" EPA/540/P-87/001, Section 8.1.6.2, Sampling Techniques. Subsurface soil sampling has been described previously in Section 12.3.1.

12.6.2 Disposal of Contaminated Material

Any material generated during the sampling of subsurface soil will be handled as described in Section 12.1.3.

12.7 AMBIENT AIR SAMPLING

Ambient air samples will be collected in the FSL field program. Samples will be collected with Summa canisters. The field procedures and sample collection methods are described in the following sections. Table 12-14 outlines the analytical method, sample container, and number of samples for ambient air sampling.

Table 12–14
Phase I
Landfill Ambient Air Program
Summary of Analysis for Ambient Air Samples

ANALYTICAL METHOD		Calderon VOCs TO14	Calderon VOCs TO2
PRESERVATIVES		none	none
ANALYTICAL HOLDING TIME		<30 days	<30 days
SAMPLE NUMBER	SAMPLING SCHEDULE	15 liter SUMMA Cannister	adsorbent tube
2416–AIR–001	Day 1	1	
2416–AIR–041			1
2416–AIR–002	Day 1	1	
2416–AIR–042			1
2416–AIR–003	Day 1	1	
2416–AIR–043			1
2416–AIR–004	Day 1	1	
2416–AIR–044			1
2416–AIR–005	Day 1	1	
2416–AIR–045			1
2416–AIR–006Q	Day 1	1	
2416–AIR–046Q			1
2416–AIR–007 (duplicate of 2416–AIR–006)	Day 1	1	
2416–AIR–047 (duplicate of 2416–AIR–046)			1
2416–AIR–008 (nitrogen blank)	Day 1	1	
2416–AIR–048 (field blank)	Day 1		1
2416–AIR–009	Day 2	1	
2416–AIR–010	Day 2	1	
2416–AIR–011	Day 2	1	
2416–AIR–012	Day 2	1	
2416–AIR–013	Day 2	1	
2416–AIR–014	Day 2	1	
2416–AIR–015 (nitrogen blank)	Day 2	1	
TOTAL		15	8

Q = Laboratory QC sample will be located downwind of the landfill

12.7.1 Summary of Field Procedures and Sample Collection Methods

One week prior to sample collection, the temporary on-site meteorological station will be activated. The weather station is required to record wind speed and direction and any precipitation during the 24-hour sampling period. The met station will be placed in the center of the landfill at a height of 3 meters. Continuous measurements will be recorded on an strip chart. Wind direction will be recorded by a PSD grade sensor with a threshold speed of 1 mile/hour.

24-hour, time-integrated ambient air samples will be collected using 15-liter Summa canisters. Criteria for acceptable air data will be if the wind direction is within 45° of the assumed prevailing wind, and that wind direction remains in that range for 18-hours out of a 24-hour sampling period. No sampling will be attempted when average wind speeds exceed 10 mph and wind gusts exceed 25 mph. Sampling will not occur during a rainfall. The locations for the ambient samples are shown on Figure 10-1. The procedure for collecting air samples is described below:

- Laboratory will provide canisters with critical orifice valves, which allow slow sampling rates over a 24-hour period.
- Connect vacuum gauge to sample canister, open valve, check and record initial vacuum, close valve, remove vacuum gauge.
- Attach a length of teflon tubing, of appropriate length, to the sample canister.
- Connect or position the opposite end of the tubing in such a way so as to access the sampling point.
- Open the valve following laboratory instructions, to initiate integrated sampling.
- Summa canisters will be secured to a metal stake with a lock and chain. A chain of custody seal will be placed on the Summa canister valve as an indicator of tampering.

- After 24 hours, close the valve, record the final pressure with an external pressure gauge, disconnect the tubing, and attach a label to the sample canister with pertinent sample information.

At a minimum, one collocated sample will be collected at the upgradient location on day 1, and at the downgradient location on day 2. If any of these samples are not valid, an additional day of sampling may be required.

Canisters and critical orifice valves are decontaminated by the laboratory. The canister is decontaminated by repeatedly heating, then flushing with nitrogen. The critical orifice valve is decontaminated in a high temperature oven.

In addition to Summa canister samples, adsorbent tubes will be used to collect 24-hour samples at four downwind landfill air sampling locations. The purpose for utilizing the adsorbent tubes is to correlate the results with the canister sampling as required by EPA. Due to the adsorption/desorption inefficiency of the tubes, however, it is anticipated that the adsorption tubes results will not be identical to the canister results. The procedure for collecting adsorbent tube samples is described below.

- Laboratory will provide adsorbent tubes and mass flow control meters with flow rates in the range of 5-100 ml/minute. All mass flow meters will be calibrated at the rate to be used for sampling prior to use.
- For a 24-hour sampling period, a flow rate of 10 ml/min. would result in a 14-liter sample. The laboratory has recommended an approximate 10 liter sample size.
- To collect an air sample, the cartridges are removed from the sealed container just prior to sample collection.
- The exit (unmarked) end of the cartridge is connected to the sampling apparatus. Two tubes will be attached in series so that the second can be analyzed for breakthrough, if necessary. The endcap is left on the sample inlet and the entire system is leak checked by activating the sampling pump and observing that no flow is obtained over a 1-minute period. The sampling pump is then shut off.

- The endcap is removed from the cartridge, a particulate filter and holder are placed on the inlet end of the cartridge, and the sampling pump is started. The following parameters are recorded on an appropriate data sheet: date, sampling location, time, ambient temperature, barometric pressure, relative humidity, flow rate, rotameter reading (if applicable), cartridge number, and pump.

- The samples are collected for the desired time, periodically recording the variables listed above. At the end of the sampling period the flow rate is checked. If the flows at the beginning and end of the sampling period differ by more than 10%, the cartridge should be marked as suspect.

- The cartridges are removed (one at a time), the endcaps are replaced, and the cartridges are placed into the original container. The friction top can is sealed and packaged for immediate shipment to the analytical laboratory.

12.7.2 Disposal of Contaminated Material

No contaminated material is expected to be produced during the ambient air field sampling program.

12.8 RI-DERIVED WASTE AND DECONTAMINATION

The field procedures dealing with RI derived waste are discussed in Section 12.1.3, 12.2.2, 12.3.2, 12.4.2, 12.5.2, 12.6.2, and 12.7.2. All RI derived waste will be handled in accordance with the Standard Operating Procedures for Investigation - Derived Waste, which is presented in Appendix C.

12.8.1 Equipment Decontamination

All reusable field equipment used to collect, handle, or measure samples will be decontaminated before coming into contact with any sample. The decontamination procedure will match the degree of contamination on the sampling tool. For example, steam cleaning will be necessary to remove dirt from auger flights, to prepare well screen and casing for installation into the borehole, and to clean brass sleeves for soil sample collection. Brushes and soap will be required to remove dirt from split spoon samplers. Sampling equipment that has come into contact with oil and grease will have to be cleaned with hexane to remove the oily material.

A centrally located decontamination station will be established for steam cleaning of drilling equipment. This decontamination system will include a pad on which the drill rigs and other large drilling equipment, such as auger flights, can be steam cleaned. The drilling rigs and other drilling equipment will be steam cleaned between each hole. The pad will be constructed so that it drains into a sump. Steam cleaning water collected in the sump will be collected by a vacuum truck contractor and disposed of at the Fresno Sanitary Treatment Plant.

All equipment decontamination episodes will be recorded in the field logbook. The general decontamination procedures are as follows:

- A sufficient supply of tap water will be obtained from the City of Fresno water supply system.
- Augers, well casing, and well screen will be steam cleaned to remove all visible dirt.
- Copious amounts of water with a phosphate-free detergent will be used to wash and brush all dirt from the sampling item, including the steam cleaned items.
- Sampling items will be rinsed thoroughly with tap water, checked for any residual dirt, and rewashed if necessary.
- The item will be rinsed with solvent to remove residual organics. Solvents will be pesticide grade or better.
- The item will be rinsed twice with tap water.
- The item will then be rinsed with deionized water (ASTM Type II).

- The item will be completely air dried prior to use. Items will be covered if not immediately used. Large items will be placed on a clean sheet of plastic.
- Items not used immediately will be either wrapped in aluminum foil (small items) or in sheet plastic (larger items) to prevent cross-contamination.

12.9 SAMPLE CONTAINERS

All samples will be placed into containers provided by the laboratory. Groundwater samples will be collected in the following containers:

- For VOCs, three 40-ml glass vials with Teflon-lined silicon septa and black phenolic caps.
- For each BNA, pesticide, PCB, herbicide, and dioxin sample, 2-1 liter amber glass bottles.
- For metals, 1-1 liter polyethylene bottle.

Surface soil samples will be collected in the following containers:

- For VOCs, 2-120 ml glass vials with Teflon-lined silicon septa and black phenolic caps.
- For each BNA, pesticide, PCB, herbicide, and metal sample, 1-8 ounce jar.
- For dioxin, 1-4 ounce jar.
- For grain-size analysis, 1-1,000 gram ziploc baggie.

Subsurface soil samples will be collected in brass sleeves, with the exception of grain-size analysis samples which will be collected in ziploc baggies.

12.10 SAMPLE PRESERVATION AND HOLDING TIMES

All samples for both on-site and fixed-base laboratory analyses (except grain-size) will be chilled to 4 degrees Centigrade in the field, during shipment, and in the laboratory. The sample containers will be placed in chilled coolers immediately following collection and kept cool with ice prior to and during shipment. Groundwater samples for volatiles analysis will be preserved with two drops 1:1 HCL in each 40 ml vial. Groundwater samples for metals analysis will be preserved by bringing the sample to a pH less than 2 using nitric acid. No preservatives are added to the soil samples. Preservatives will be recorded on the container label and in the field logbook.

Analytical holding times for the groundwater samples are 14 days for VOCs; 7 days before extraction for BNAs, pesticides, PCBs, and herbicides; 30 days before extraction for dioxin; 6 months for metals (28 days for mercury). Analytical holding times for soil samples are 14 days for VOCs, BNAs, pesticides, PCBs, herbicides, and dioxin; 6 months for metals (28 days for mercury). There is no method specified holding time for particle size.

12.11 SAMPLE SHIPMENT

All samples collected at Fresno Sanitary Landfill are considered environmental samples; they are not known to contain hazardous levels of contaminants and may be shipped to the laboratory accordingly.

Each of the sample bottles will be sealed and labeled as follows: bottle labels will contain all required information including sample number, time, and date of collection, analysis requested, sampler's name and preservatives used, if any. Sealed bottles will be placed inside polyethylene ziploc bags. The bagged bottles will be packed in large coolers, padded with an absorbent material, such as vermiculite, and chilled with ice contained in ziploc bags. All sample documents will be affixed to the underside of each cooler lid. See Appendix B for environmental sample packaging procedures.

The coolers will be labeled for shipment according to EPA and Department of Transportation procedures. No precautionary notices are required on the package exterior. Shipments to the laboratory will be handled by an overnight carrier such as Federal Express. Other "cargo only" aircraft may be used but samples will not be transported by any carrier that also carries passengers. Samples may be transported by CDM personnel in private vehicles.

Samples with restrictive holding times will be shipped within 24 hours following collection, usually on the same day for volatiles analysis. Samples collected late in the day will be shipped the following day. Advance coordination will be required for any shipments on Friday (which will arrive at the lab on Saturday). Samples without holding times will be held until the next critical shipment is ready in order to reduce shipping and handling costs.

The following information shall be included on sample labels:

- Site name.
- Field identification of sample station number.
- Date and time collected.
- Whether the sample is preserved or unpreserved and preservative use, if any, and the type of preservative used.
- Types of analysis to be conducted.

12.11.1 Sample Identification

Samples will be identified through the use of a cooling system to identify sample locations and sample replicates. This coding system will ensure that samples are uniquely identified, and provide a tracking procedure to facilitate data validation and retrieval. The following information will be included on each sample label:

- Sample number.

- Date and time of the sample collection.
- Designation of the sample as a grab or composite.
- Whether the sample is preserved or not, and the preservative used.
- Type(s) of analysis.
- Samplers name.

Sample labels will be waterproof, written with indelible ink, and secured to the sample container with clear acetate tape.

It should be noted that only the double volume quality control samples will be labeled with their QC classification. All other QC samples will only be logged in the field notebooks and FPC's copy of the chain-of-custody form, not on the sample labels or the laboratory's chain-of-custody forms. This will ensure that the laboratory does not know which of the samples are blanks or duplicates.

The groundwater well samples will be numbered according to the following system:

UWIA-GW-001

UWIA - Identification of the well.
GW - Identification of the media: groundwater.
001 - Identification of the sample event at the well
Q - QA/QC sample

The residential well samples will be numbered according to the following system:

1770N-GW-001

1770N - Identification of the residential well, QA/QC duplicate, and rinsate blank.
GW - Identification of the media: groundwater.
001 - Identification of the sampling event at the residential well

The surface soil samples will be numbered according to the following system:

2416-SS-S1-001

2416 -	CDM job number
SS -	Identification of the media: surface soil
S1 -	Identification of the sampling location
001 -	Identification of the sampling event at the sampling location
Q -	QA/QC sample

The subsurface soil samples will be numbered according to the following system:

2416-SB-T1-001

2416 -	CDM job number
SB -	Identification of the media: subsurface soil
T1 -	Identification of the sampling location
001 -	Identification of the sampling event at the sampling location

The leachate samples will be numbered according to the following system:

2416-LE-L1-001

2416 -	CDM job number
LE -	Identification of the media: leachate
L1-	Identification of the sampling location
001 -	Identification of the sampling event at the sampling location
Q -	QA/QC sample

12.11.2 Sample Report Forms and Chain-of-Custody Records

Chain-of-custody procedures will be used to document the handling and processing of all samples from the time of collection until they are destroyed. Each shipment of samples will be accompanied by a CDM chain-of-custody record which documents all aspects concerning the time of collection, method of shipment, analysis requested, etc., for each sample. This written record may become important if the results of any analysis are used in litigation. A sample chain-of-custody record is included in Appendix C. The following is a summary of chain-of-custody procedures:

- The following information will be supplied on the chain-of-custody form:
  - Project name.
  - Signature of sampler.
  - Sampling station number or sample number date and time of collection, grab, or composite sample designation and a brief description of the type of sample.
- Individuals receiving the samples shall sign, date, and note the time that they received the samples on the form matrix.
- Chain-of-custody records initiated in the field shall be placed in a plastic cover and taped to the inside of the shipping container used for sample transport from the field to the laboratory.
- Custody seals shall be used when samples are shipped to the laboratory.
- When samples are relinquished to a shipping company for transport, the tracking number for the shipping bill/receipt shall be recorded on the chain-of-custody form.
- Collection of soil gas vapors and the analysis of these vapors with the on-site QC are addressed in the Supplemental SCP QAPP for the Central Base Area.

12.12 QUALITY CONTROL SAMPLES

Duplicate, blank, and lab QC samples will be prepared in accordance with the procedures in the QAPP and will be used as a check of laboratory and field sampling procedures.

12.12.1 Duplicates

Duplicates of field samples will be collected at a frequency of 10 percent at sampling points which are known or suspected to be contaminated. Duplicates will be collected, numbered, packaged, and sealed in the same manner as the other samples. The samples will not be identified as duplicates on the sample labels so that the identify of the sample as a duplicate will be unknown to the laboratory personnel performing the analyses. The samples will be recorded as a duplicate in the field logbook for documentation and verification purposes. Duplicate samples are identified in the Summary of Analyses Tables in Section 12.

Duplicate water samples will be collected by filling all bottles for the first analysis before filling bottles for the second analysis. Duplicate surface soil samples will be composited, except for those samples to be analyzed for VOCs. Duplicate subsurface samples will be consecutive brass sleeves. Duplicate ambient air samples will be collected by collocating two Summa canisters and collecting simultaneous samples. Duplicate soil gas samples will be collected simultaneously for Level IV analysis, and in series for Level II on-site analysis.

12.12.2 Laboratory QC Samples

Laboratory QA/QC samples are collected to provide the laboratory extra sample volume to perform laboratory QC checks. Lab QC samples will be collected at a frequency of 1 in 20, and will be collected at locations of suspected contamination. For groundwater samples, these QA/QC samples consist of a "double volume"; double volume samples are not required for VOCs. For soil and air samples, it is not necessary to include a double volume. Lab QC samples are identified on the sample labels, and the chain-of-custody forms. Lab QC samples are identified in the Summary of Analyses Tables in Section 12.

12.12.3 Groundwater Field Blanks

Since all groundwater sampling equipment is dedicated, field blanks will be collected rather than equipment blanks. Field blanks will consist of analyte free water that is transported from the analytical laboratory to the sampling site. The analyte free water is decanted into the organic sample containers in the field at a sample collection point. For inorganic parameters, deionized water will be used to prepare the blank. The samples will not be identified as blanks on the sample labels. One blank will be placed in each cooler to accompany field samples during shipment to the laboratory. Field blanks are identified in the Summary of Analyses Tables in Section 12.

The laboratory will be instructed to hold blank samples collected for the analysis of dioxin. These samples will be analyzed only if dioxin is detected in any of the samples.

12.12.4 Air Blanks

Blanks are used to determine if field measurements are affected by contamination due to improper cleaning techniques or carry-over contamination from previous samples. Field blanks for Summa canisters will be prepared on-site by filling a canister with ultra high purity nitrogen. Blanks will be prepared at a frequency of one per day and will be sent blind to the laboratory. Blank samples collected for analysis by the on-site laboratory are discussed in Appendix F.

12.12.5 Background Samples

Two background surface soil samples will be collected at locations 800 ft. east and 400 ft. west of the landfill (Figure 9-1).

Section Thirteen

13.0 DATA QUALITY MANAGEMENT

13.1 FIELD DATA ANALYSIS AND REPORTING

Data and readings taken at the site will be recorded in data logbooks or on pre-printed data sheets using indelible ink. Supplemental records will be recorded in field notebooks. These records will be retained on file at CDM-Walnut Creek for the duration of the contract and for 6 years thereafter.

- Data to be recorded will include date, time, sampling personnel, sample location, sample number, weather conditions, field measurement data, and the signature of the person entering the data.
- When possible, field measurements will be taken with direct-reading instruments so that calculations are not necessary. Regardless of the equipment used to obtain field data, the data will be reviewed in the field for consistency and for reasonable agreement with expected or typical results. Extreme, anomalous, or seemingly unreasonable results will be reported only after the measuring instrument has been checked and verified to be in proper working order, and the anomalous readings have been verified by one or more additional measurements.
- Data and inspection sheets will be checked for completeness, accuracy, and reasonableness by a different project staff member than the person who collected the data. The Field Supervisor and QA Coordinator will be responsible for spot-checking data and inspection sheets. The QA Coordinator will conduct periodic reviews of files, notebooks, logs, and other records to ensure that proper documentation procedures are followed.

The following actions are routinely followed:

- Review completed field data forms, and analysis results for transcription, typographic, and other errors.

- Review data to determine if procedures were followed in the field sample holding times and preservation requirements were met, and Chain-of-Custody procedures were followed.
- Review field equipment calibration data.
- Review monitoring and sampling/analysis data for consistency with expected or historical results.
- Review blank, duplicate, and background/control sample data.
- Review laboratory QA/QC including calibration, method detection limits and quality control checks.

13.2 DATA MANAGEMENT SYSTEM

The data generated through sampling and analysis will be tracked and filed in the CDM Walnut Creek Project File "Fresno Sanitary Landfill RI/FS". Such documentation will include, but is not limited to, the following:

- Field data sheets.
- Chain-of-custody forms.
- Field log books.
- Analytical reports and data.
- Data validation reports.

All of the analytical data, along with their associated qualifiers, will be entered into CDM's computer database. The Project Manager will be responsible for verifying that all data are accurately and completely entered into the database. The QA Coordinator will routinely check at least 10% of the database against raw data sheets to verify that data are not altered during data processing operations.

13.3 DATA VALIDATION

Data validation is the process of screening data and accepting, rejecting, or qualifying it on the basis of sound criteria. Data validation must occur soon after data collection and be objective in its approach. The EPA Contract Laboratory Program (CLP) Data Validation Functional Guidelines will be used for validation of all Level IV data. Data will be validated using methods and criteria appropriate to the type of data and the purpose of measurement. Items to be considered during data validation include the following:

- Comparing data to QA objectives for precision, accuracy, and completeness.
- Evaluating field and laboratory replicates, spikes, blanks, and other QA samples.
- Checking for data "outliers".
- Checking for transcription and calculation errors.
- Qualifying data that does not meet acceptance criteria.
- Verifying sample custody.

In order to provide the deliverables required for data validation, "Laboratory Documentation Requirements for Data Validation" (EPA Region 9, 01/90) will be followed by laboratories compiling Level IV data packages. Deliverable requirements for all analyses will be outlined in the analytical requests sent to each lab.

The procedures used by the laboratories to assess precision, accuracy, and completeness are discussed in Appendix A.

Section Fourteen

14.0 QUALITY ASSURANCE OVERSIGHT

14.1 PERFORMANCE AND SYSTEM AUDITS

At least one performance audit of field activities will be conducted during the course of the project. At a minimum, the audit will include an inspection of field notebooks, equipment calibration and maintenance records, sample collection and equipment decontamination procedures, and overall adherence to procedures outlined in this Plan. The audit will be conducted by a qualified CDM employee not directly involved in the project.

System audits of the field measurement laboratory may be conducted if determined to be necessary by the Quality Assurance Coordinator after consultation with the Field or Site Managers. At a minimum, the audits will include an inspection of the laboratory facilities, lab or field notebooks, control sheets, log sheets, computer files, and equipment calibration and maintenance records.

A written report of the results of all audits will be submitted to the following individuals:

- City of Fresno Program Manager.
- City of Fresno Project Manager.
- EPA Remedial Project Manager.
- CDM Project Manager.

Performance and system audits conducted by the off-site laboratories are discussed in the Laboratory Quality Assurance Manuals provided in Appendix F.

14.2 CORRECTIVE ACTION

If performance or system audits of field activities result in detection of unacceptable conditions or data, as defined by the DQOs in this Plan, the QA Coordinator will be responsible for developing and initiating corrective action. A discussion of the corrective action, any follow-up action and final recommendations will be included in a report to the CDM Project Manager, and in the monthly status report.

14.3 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Monthly reports for the Fresno Sanitary Landfill will be prepared by the CDM Site Manager. These monthly reports will discuss the project status, results of performance and system audits, and any necessary corrective action. Copies of the monthly status report will be sent to the following individuals:

- City of Fresno Program Manager.
- City of Fresno Project Manager.
- EPA Remedial Project Manager.

APPENDIX A

QUALITY ASSURANCE GOALS

APPENDIX A

QUALITY ASSURANCE GOALS

PRECISION

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared to their average value. The overall precision of measurement data is a mixture of sampling and analytical factors. Analytical precision is much easier to control and quantify than sampling precision. There are more historical data related to individual method performance and the "universe" is limited to the samples received in the laboratory. In contrast, sampling precision varies with sampling methods and matrix heterogeneity.

For all analytical measurements, an estimate of analytical precision will be made by calculating the relative percent difference (RPD) between values obtained for the MS and MSD using the following formula:

$$\% \text{ RPD} = \frac{| \text{MS} - \text{MSD} |}{0.5\ (\text{MS}+\text{MSD})} \times 100$$

The way in which precision is used to evaluate the acceptability of analytical data is compound and laboratory specific. These procedures will be described in the data report, and are outlined below.

For Level IV soil and groundwater organic analyses, a control limit that is three times the standard deviation of ten replicate samples is established. For Level IV inorganic analyses, a twenty percent control limit is established. For Level IV air analyses, the control limit is twenty percent for those compounds whose concentrations are less than three times the limit of detection, and thirty percent for those compounds whose concentrations are greater than three times the limit of detection. The precision goals for Level II soil gas analyses are discussed in Appendix F.

Analytical results falling outside these numerical goals will be identified by data qualifiers during the data validation process.

ACCURACY

Accuracy may be estimated from the analytical results obtained from the analyses of laboratory control samples (LCSs) (i.e., internal standards and surrogate samples). Where appropriate, accuracy will be assessed by comparing the analytical result to the actual concentration. Percent accuracy (%A) and percent recovery (%R) may also be determined from the analytical results obtained for surrogate or analyte compounds spiked into samples. For all organic and metal measurements, accuracy will be represented by percent recovery of laboratory matrix spikes using the following equations for accuracy and recovery:

$$\%A = \frac{\text{measured value of analyte}}{\text{true value of analyte}} \times 100$$

$$\%R = \frac{\text{measured value in spiked sample - amount in unspiked sample}}{\text{actual concentration of spike added}} = 100$$

The way in which accuracy is used to evaluate the acceptability of analytical data is compound and laboratory specific. These procedures will be described in the data report, and are outlined below.

For Level IV air analyses, an acceptability range of 70 to 130 percent is established. For Level IV soil and groundwater analyses, compound specific control limits will be established by the laboratory and provided on the analytical reports. The accuracy goals for Level II soil gas analyses are discussed in Appendix F.

Analytical results falling outside these control limits will be identified by data qualifiers during the data validation process.

REPRESENTATIVENESS

Representativeness is defined as the degree to which sample data accurately and precisely represent a characteristic of a sample population, parameter variations at a sample point, or an environmental condition.

Representativeness is a qualitative parameter which most expresses the proper design of a sampling program. The representativeness criterion is best satisfied by making certain that sampling locations are selected properly, sampling technique is described, and a sufficient number of samples are collected. For each aspect of this sampling effort, the rationale for sample location and number of samples are described. Sampling technique is described for each aspect of the sampling program.

COMPLETENESS

Completeness is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is essentially the same for all data uses: that a sufficient amount of valid data be generated. It is important that critical samples are identified and plans made to achieve valid data for them.

For Level IV data, the completeness objective for this project is 85 percent. For the Level II analysis of methane gas, the completeness objective is 70 percent. If the completeness is less than the stated goal, CDM will provide documentation explaining why this objective was not met, and will evaluate how it will affect the project. The decision of whether or not to resample will be made after this evaluation of the adequacy of available data is made.

COMPARABILITY

Comparability of past and future analytical data will be maximized by using standard analytical methods and reporting the data in standard units, and by implementing standardized sampling and handling techniques throughout the project. All results for organic or inorganic constituents will be reported in either mg/l or ug/l. Measurements for pH, conductivity, alkalinity, turbidity, and temperature will be reported in their standard units.

APPENDIX B

ANALYTICAL AND QUALITY CONTROL PROCEDURES

APPENDIX B-1 - CONTENTS

APPENDIX B-1

Analysis of Volatile Organic Compounds SW846 Method 8240

Analytes: Compounds listed below are from SW846 Method 8240 Table 2.

Chloromethane
Bromomethane
Vinyl Chloride
Chloroethane
Methylene Chloride
Acetone
Carbon Disulfide
1,1-Dichloroethene
1,1-Dichloroethene
trans-1,2-Dichloroethene
Chloroform
1,2-Dichloroethane
2-Butanone
1,1,1-Trichloroethane
Carbon Tetrachloride
Vinyl Acetate
Bromodichloromethane
1,1,2,2-Tetrachloroethane
1,2-Dichloropropane
trans-1,3-Dichloropropene
Trichloroethene
Dibromochloromethane
1,1,2-Trichloroethane
Benzene
cis-1,3-Dichloropropene
2-Chloroethyl Vinyl Ether
Bromoform
2-Hexanone
4-Methyl-2-pentanone
Tetrachloroethene
Toluene
Chlorobenzene
Ethyl Benzene
Styrene
Total Xylenes

Sample Matrices: Low concentration groundwater samples and soil samples.

Analytical Procedure and Quantitation Limits: Follow SW846 Method 8240 for GC/MS analysis. Quantitation limits are 5 or 10 μg/l, for groundwater, and 50 or 100 μg/l for soil as listed in Table 2 of the method.

Analytical Holding Times: The analytical holding time is 14 days from the date of sample collection.

Calibration Procedure and Criteria: Follow the calibration procedure specified in the method.

Internal Quality Control Checks, Control Limits, and Corrective Action: Follow the QC requirements specified in the method.

Documentation and Deliverables:

1. Report documentation for sample and blank results, date and time of analysis, surrogate recovery, MS/MSD recovery, blank summary, analytical sequency, initial and continuing

calibrations (including retention time windows), and compound identification. Use forms equivalent to CLP Forms I, II, III, IV, VI, IX and X.

2. Provide all raw data, including chromatograms and area printouts/quantitation reports.

3. Raw data and summary forms are to be organized systematically and each page is to be numbered.

Analysis of Purgeable Halocarbons in Water and Soil by SW846 Method 8010:

Analytes: Compounds listed below are from SW846 Method 8010 Table 1.

Benzyl chloride
Bis(2-chloroethoxy)methane
Bis(2-chloroisopropyl)ether
Bromobenzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon tetrachloride
Chloroacetaldehyde
Chlorobenzene
Chloroethane
Chloroform
1-Chlorohexane
2-Chloroethyl vinyl ether
Chloromethane
Chloromethylmethyl ether
Chlorotoluene
Dibromochloromethane
Dibromomethane
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Dichlorodifluoromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethylene
trans-1,2-Dichloroethylene
Dichloromethane
1,2-Dichloropropane
trans-1,3-Dichloropropylene
1,1,2,2-Tetrachloroethane
1,1,1,2-Tetrachloroethane
Tetrachloroethylene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethylene
Trichlorofluoromethane
Trichloropropane
Vinyl chloride

Sample Matrices: Low concentration groundwater and soil samples.

Analytical Procedure and Quantitation Limits: Follow SW846 Method 5030 for sample introduction by purge-and-trap and SW846 Method 8000 and 8010 for GC analysis. Contract required quantitation limits (CRQL) are 1.0 ug/kg for soil samples. **For water samples, quantitation limits less than 0.5 are required for vinyl chloride and 1,3 dichloropropene.**

1. The use of halogen-specific detectors, such as Hall Electrolytic Conductivity Detector (HECD), is required.

2. Whenever an unusually concentrated sample is analyzed, it should be followed by an analysis of reagent water to check for contamination by carry-over.

Analytical Holding Times: The analytical holding time is 14 days from the date of sample collection.

Calibration Procedure and Criteria: Calibrate according to Sections 5.4 and 7.3 of Method 8010 and Sections 7.4.2 and 7.5 Method 8000, with the following specifications:

1. Five-point initial calibration curve with a low standard at 1.0 ng/mL is required.

2. A continuing calibration at the concentration of 10 ng/mL for each analyte is to be analyzed at the beginning of each day and after each group of 10 samples.

Internal Quality Control Checks, Control Limits and Corrective Actions:

1. Analyze method blanks after each continuing calibration analysis and after the analysis of unusually concentrated samples. The method blanks must contain less than 5 times the CRQL of methylene chloride and must be free of other purgeable halocarbons and any interfering peaks at or above the detection limits.

2. One or more purgeable halocarbon surrogates (such as bromochloromethane, 2-bromo-1-chloropropane, 1,4-dichlorobutane, trifluorotoluene and bromofluorobenzene) must be spiked into the standards, samples, method blanks and QC samples (see Sections 5.6 and 8.3 of Method 8010). Recoveries of 75-125% are required. The samples are to be re-analyzed if the surrogate recoveries are outside the QC limits.

3. Second column confirmation is required for all positive results reported.

4. Samples containing one or more analytes at concentrations above the initial calibration range are to be diluted and re-analyzed. Report the results and documentation for both analyses.

5. Analyze matrix spikes and matrix spike duplicates (MS-MSD) at a frequency of one per group of 20 or fewer samples. Use Table 3 in Method 8010 as a guidance on acceptable spike recoveries. The matrix spike solution must contain all the analytes listed above, at concentrations of 1 to 5 time the sample level or 3 to 5 times the CRQL for non-detected samples, whichever is higher.

6. If these control limits are exceeded, take appropriate actions to correct the problems and re-analyze the affected samples.

Data Calculations and Reporting Units:

1. Calculate the CF and the concentration of individual analytes using the equations in Sections 7.4.2 and 7.8.1 of Method 8000. The sample results are to be reported in the concentration units of micrograms per liter (ug/l) for water samples and micrograms per kilogram (ug/Kg) on a dry weight basis for soil samples.

2. All records of analysis, dilutions and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Documentation and Deliverables:

1. Report documentation for sample and blank results, date and time of analysis, surrogate recovery, MS/MSD recovery, blank summary, analytical sequency, initial and continuing calibrations (including retention time windows), and compound identification. Use forms equivalent to CLP Forms I, II, III, IV, VI, IX and X.

2. Provide all raw data, including chromatograms and area printouts/quantitation reports.

3. Raw data and summary forms are to be organized systematically and each page is to be numbered.

Analysis of Purgeable Aromatics in Water and Soil by SW846 Method 8020:

Analytes: Benzene, Toluene, Chlorobenzene, Ethylbenzene, Total Xylenes, 1,4-Dichlorobenzene, 1,3-Dichlorobenzene and 1,2-Dichlorobenzene.

Sample Matrices: Low concentration groundwater and soil samples.

Analytical Procedure and Quantitation Limits: Follow SW846 Method 5030 for sample introduction by purge-and-trap and SW846 Method 8000 and 8020 for GC analysis. Contract required quantitation limits (CRQL) are 1.0 ug/l for water samples and 1.0 ug/Kg for soil samples.

1. The use of aromatic-specific detectors, such as PID, is required.

2. Whenever an unusually concentrated sample is analyzed, it should be followed by an analysis of reagent water to check for contamination by carry-over.

Analytical Holding Times: The analytical holding time is 14 days from the date of sample collection.

Calibration Procedure and Criteria: Calibrate according to Sections 5.4 and 7.3 of Method 8020 and Sections 7.4.2 and 7.5 Method 8000, with the following specifications:

1. Five-point initial calibration curve with a low standard at 1.0 ng/mL is required.

2. A continuing calibration at the concentration of 10 ng/mL for each analyte is to be analyzed at the beginning of each day and after each group of 10 samples.

3. Less than 10% relative standard deviation (%RSD) in calibration factors (CF) for the initial calibration standards and less than ±15% difference (%D) in CF for the daily continuing calibrations are required.

Internal Quality Control Checks, Control Limits and Corrective Actions:

1. Analyze method blanks after each continuing calibration analysis and after the analysis of unusually concentrated samples. The method blanks must contain less than 5 times the CRQL of toluene and must be free of other purgeable aromatics and any interfering peaks at or above the detection limits.

2. One or more purgeable halocarbon surrogates (such as trifluorotoluene and bromofluorobenzene) must be spiked into the standards, samples, method blanks and QC samples (see Sections 5.6 and 8.3 of Method 8020). Recoveries of 75-125% are required. The samples are to be re-analyzed if the surrogate recoveries are outside the QC limits.

3. Second column confirmation is required for all positive results reported.

4. Samples containing one or more analytes at concentrations above the initial calibration range are to be diluted and re-analyzed. Report the results and documentation for both analyses.

5. Analyze matrix spikes and matrix spike duplicates (MS-MSD) at a frequency of one per group of 20 or fewer samples. Use Table 3 in Method 8020 as a guidance on acceptable spike recoveries. The matrix spike solution must contain all the analytes listed above, at concentrations of 1 to 5 times the sample level or 3 to 5 times the CRQL for non-detected samples, whichever is higher.

6. If these control limits are exceeded, take appropriate actions to correct the problems and re-analyze the affected samples.

Data Calculations and Reporting Units:

1. Calculate the CF and the concentration of individual analytes using the equations in Sections 7.4.2 and 7.8.1 of Method 8000. The sample results are to be reported in the concentration units of micrograms per liter (ug/l) for water samples and micrograms per kilogram (ug/Kg) on a dry weight basis for soil samples.

2. All records of analysis, dilutions and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Documentation and Deliverables:

1. Report documentation for sample and blank results, date and time of analysis, surrogate recovery, MS/MSD recovery, blank summary, analytical sequence, initial and continuing calibrations (including retention time windows), and compound identification. Use forms equivalent to CLP Forms I, II, III, IV, VI, IX and X.

2. Provide all raw data, including chromatograms and area printouts/quantitation reports.

3. Raw data and summary forms are to be organized systematically and each page is to be numbered.

Analysis of Semivolatile Organics in Water and Soil by SW846 Method 8270

Analytes: Compounds listed on the following three pages.

Sample Matrices: Groundwater and soil samples.

Analytical Procedure and Quantitation Limits: Follow SW846 Method 8270 for GC/MS analysis. Quantitation limits are 10 or 50 μg/l, as listed in Table 2 of the method.

Analytical Holding Times: The analytical holding time is 7 days for water and 14 days for soil from the date of sample collection.

Calibration Procedure and Criteria: Follow the calibration procedure specified in the method.

Internal Quality Control Checks, Control Limits, and Corrective Action: Follow the QC requirements specified in the method.

Documentation and Deliverables:

1. Report documentation for sample and blank results, date and time of analysis, surrogate recovery, MS/MSD recovery, blank summary, analytical sequency, initial and continuing calibrations (including retention time windows), and compound identification. Use forms equivalent to CLP Forms I, II, III, IV, VI, IX, and X.

2. Provide all raw data, including chromatograms and area printouts/quantitation reports.

3. Raw data and summary forms are to be organized systematically and each page is to be numbered.

TABLE 1. CHARACTERISTIC IONS FOR SEMIVOLATILE COMPOUNDS

Compound	Retention Time (min)	Primary Ion	Secondary Ion(s)
Acenaphthene	15.13	154	153, 152
Acenaphthene-d_{10} (I.S.)	15.05	164	162, 160
Acenaphthylene	14.57	152	151, 153
Acetophenone	7.96[a]	105	77, 51
Aldrin	--	66	263, 220
Aniline	5.68	93	66, 65
Anthracene	19.77	178	176, 179
4-Aminobiphenyl	19.18[a]	169	168, 170
Aroclor-1016	--	222	260, 292
Aroclor-1221	--	190	224, 260
Aroclor-1232	--	190	224, 260
Aroclor-1242	--	222	256, 292
Aroclor-1248	--	292	362, 326
Aroclor-1254	--	292	362, 326
Aroclor-1260	--	360	362, 394
Benzidine	23.87	184	92, 185
Benzoic acid	9.38	122	105, 77
Benzo(a)anthracene	27.83	228	229, 226
Benzo(b)fluoranthene	31.45	252	253, 125
Benzo(k)fluoranthene	31.55	252	253, 125
Benzo(g,h,i)perylene	41.43	276	138, 277
Benzo(a)pyrene	32.80	252	253, 125
Benzyl alcohol	6.78	108	79, 77
α-BHC	--	183	181, 109
β-BHC	--	181	183, 109
δ-BHC	--	183	181, 109
γ-BHC (Lindane)	--	183	181, 109
Bis(2-chloroethoxy)methane	9.23	93	95, 123
Bis(2-chloroethyl)ether	5.82	93	63, 95
Bis(2-chloroisopropyl)ether	7.22	45	77, 121
Bis(2-ethylhexyl)phthalate	28.47	149	167, 279
4-Bromophenyl phenyl ether	18.27	248	250, 141
Butyl benzyl phthalate	26.43	149	91, 206
Chlordane	--	373	375, 377
4-Chloroaniline	10.08	127	129
1-Chloronaphthalene	13.65[a]	162	127, 164
2-Chloronaphthalene	13.30	162	127, 164
4-Chloro-3-methylphenol	11.68	107	144, 142
2-Chlorophenol	5.97	128	64, 130
4-Chlorophenyl phenyl ether	16.78	204	206, 141
Chrysene	27.97	228	226, 229
Chrysene-d_{12} (I.S.)	27.88	240	120, 236
4,4'-DDD	--	235	237, 165
4,4'-DDE	--	246	248, 176

TABLE 1. CHARACTERISTIC IONS FOR SEMIVOLATILE COMPOUNDS (Continued)

Compound	Retention Time (min)	Primary Ion	SecondaryIon(s)
4,4'-DDT	--	235	237, 165
Dibenz(a,j)acridine	32.55[a]	279	280, 277
Dibenz(a,h)anthracene	39.82	278	139, 279
Dibenzofuran	15.63	168	139
Di-n-butylphthalate	21.78	149	150, 104
1,3-Dichlorobenzene	6.27	146	148, 111
1,4-Dichlorobenzene	6.40	146	148, 111
1,4-Dichlorobenzene-d_4 (I.S.)	6.35	152	150, 115
1,2-Dichlorobenzene	6.85	146	148, 111
3,3'-Dichlorobenzidine	27.88	252	254, 126
2,4-Dichlorophenol	9.48	162	164, 98
2,6-Dichlorophenol	10.05[a]	162	164, 98
Dieldrin	--	79	263, 279
Diethylphthalate	16.70	149	177, 150
p-Dimethylaminoazobenzene	24.48[a]	120	225, 77
7,12-Dimethylbenz(a)anthracene	29.54[a]	256	241, 257
α-,α-Dimethylphenethylamine	9.51[a]	58	91, 42
2,4-Dimethylphenol	9.03	122	107, 121
Dimethylphthalate	14.48	163	194, 164
4,6-Dinitro-2-methylphenol	17.05	198	51, 105
2,4-Dinitrophenol	15.35	184	63, 154
2,4-Dinitrotoluene	15.80	165	63, 89
2,6-Dinitrotoluene	14.62	165	63, 89
Diphenylamine	17.54[a]	169	168, 167
1,2-Diphenylhydrazine	--	77	105, 182
Di-n-octylphthalate	30.48	149	167, 43
Endosulfan I	--	195	339, 341
Endosulfan II	--	337	339, 341
Endosulfan sulfate	--	272	387, 422
Endrin	--	263	82, 81
Endrin aldehyde	--	67	345, 250
Endrin ketone	--	317	67, 319
Ethyl methanesulfonate	5.33[a]	79	109, 97
Fluoranthene	23.33	202	101, 203
Fluorene	16.70	166	165, 167
2-Fluorobiphenyl (surr.)	--	172	171
2-Fluorophenol (surr.)	--	112	64
Heptachlor	--	100	272, 274
Heptachlor epoxide	--	353	355, 351
Hexachlorobenzene	18.65	284	142, 249
Hexachlorobutadiene	10.43	225	223, 227
Hexachlorocyclopentadiene	12.60	237	235, 272
Hexachloroethane	7.65	117	201, 199
Indeno(1,2,3-cd)pyrene	39.52	276	138, 227

TABLE 1. CHARACTERISTIC IONS FOR SEMIVOLATILE COMPOUNDS (Continued)

Compound	Retention Time (min)	Primary Ion	SecondaryIon(s)
Isophorone	8.53	82	95, 138
Methoxychlor	--	227	228
3-Methylcholanthrene	31.14[a]	268	253, 267
Methyl methanesulfonate	4.32[a]	80	79, 65
2-Methylnaphthalene	11.87	142	141
2-Methylphenol (o-cresol)	7.22	108	107, 79
4-Methylphenol (p-cresol)	7.60	108	107, 79
Naphthalene	9.82	128	129, 127
Naphthalene-d_8 (I.S.)	9.75	136	68
1-Naphthylamine	15.80[a]	143	115, 116
2-Naphthylamine	16.00[a]	143	115, 116
2-Nitroaniline	13.75	65	92, 138
3-Nitroaniline	15.02	138	108, 92
4-Nitroaniline	16.90	138	108, 92
Nitrobenzene	7.87	77	123, 65
Nitrobenzene-d_5 (surr.)	--	82	128, 54
2-Nitrophenol	8.75	139	109, 65
4-Nitrophenol	15.80	139	109, 65
N-Nitroso-di-n-butylamine	10.99[a]	84	57, 41
N-Nitrosodimethylamine	--	42	74, 44
N-Nitrosodiphenylamine	17.17	169	168, 167
N-Nitrosodipropylamine	7.55	70	42, 101, 130
N-Nitrosopiperidine	--	42	114, 55
Pentachlorobenzene	15.64[a]	250	252, 248
Pentachloronitrobenzene	19.47[a]	295	237, 142
Pentachlorophenol	19.25	266	264, 268
Perylene-d_{12} (I.S.)	33.05	264	260, 265
Phenacetin	18.59[a]	108	109, 179
Phenanthrene	19.62	178	179, 176
Phenanthrene-d_{10} (I.S.)	19.55	188	94, 80
Phenol	5.77	94	65, 66
Phenol-d_6 (surr.)	--	99	42, 71
2-Picoline	3.75[a]	93	66, 92
Pronamide	19.61[a]	173	175, 145
Pyrene	24.02	202	200, 203
Terphenyl-d_{14} (surr.)	--	244	122, 212
1,2,4,5-Tetrachlorobenzene	13.62[a]	216	214, 218
2,3,4,6-Tetrachlorophenol	16.09[a]	232	230, 131
2,4,6-Tribromophenol (surr.)	--	330	332, 141
1,2,4-Trichlorobenzene	9.67	180	182, 145
2,4,5-Trichlorophenol	13.00	196	198, 200
2,4,6-Trichlorophenol	12.85	196	198, 200
Toxaphene	--	159	231, 233

I.S. = internal standard
surr. = surrogate

[a] Estimated retention times.

Analysis of Organophosphorus Pesticides in Water and Soil by SW846 Method 8080

Analytes: The compounds listed below are from SW846 Method 8080 Table 1.

Aldrin
α-BHC
β-BHC
δ-BHC
γ-BHC (Lindane)
Chlordane (technical)
4,4'-DDD
4,4'-DDE
4,4'-DDT
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Endrin aldehyde
Heptachlor
Heptachlor epoxide
Methoxychlor
Toxaphene
PCB-1016
PBC-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260

Sample Matrices: Low concentration groundwater and soil samples.

Analytical Procedure and Quantitation Limits: Follow SW846 Method 8080 for extraction and analyses. Quantitation limits are 10 μg/l or lower for water samples and 100 μg/kg or lower for soil samples.

Contract Holding Time: Water samples must be analyzed 7 days after collection. Soil samples must be extracted 14 days after collection; extracts must be analyzed within 40 days.

Calibration Procedure and Criteria: Calibrate according to Method 8080 and Sections 7.4.2 and 7.5 of Method 8000, with the following specifications:

1. Five-point initial calibration curve with a low standard at the concentrations of the quantitation limit or lower is required.

2. Continuing calibrations at the mid-point concentration for each parameter are to be analyzed daily.

Internal Quality Control Checks, Control Limits, and Corrective Actions:

1. Analyze method blanks at a frequency of one per group of 20 or fewer samples.

2. Surrogates must be spiked into the standards, samples, method blanks, and QC samples as discussed in Section 5.5. The amount of surrogate added must be at least 10 times the instrument detection limit. Recoveries of 75 to 125 percent are required.

3. Second column confirmation is required for all positive results reported.

4. Analyze matrix spikes and matrix spike duplicates (MS/MSD) at the frequency of one per group of 20 or fewer samples. Concentration of matrix spike solution should be such that the final extracts contain amounts at the mid-range of the calibration curve.

5. If above control limits are exceeded, take appropriate actions to correct the problems and re-analyze the affected samples.

Data Calculations and Reporting Units:

1. Calculate the RF and the concentrations of individual analytes using the equations in SW846 Method 8080. The sample results are to be reported in the concentration units of microgram per liter (μg/l) for water samples, and milligram per kilogram (mg/kg) on a dry weight basis for soil samples.

2. All records of analysis, dilutions, and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Documentation and Deliverables:

1. Report documentation for sample and blank results, sample duplicate results, surrogate recovery, MS recovery, blank summary, analytical sequence, initial and containing calibrations (including retention time windows), and compound identification. Use forms equivalent to the CLP RAS pesticides Forms I, II, III, IV, VI, VII, VIII, IX, and X. Indicate date and time of extraction/analysis.

2. Provide all raw data, including chromatograms and area printouts/quantitation reports.

3. Raw data are to be organized systematically and each page is to be numbered.

Analysis of Purgeable Halocarbons in Water and Soil by SW846 Method 8150:

Analytes: 2,4-D; Dalapon; 2,4-DB; Dicamba; Dichloroprop; Dinoseb; MCPA; MCPP; 2,4,5-T; 2,4,5-TP.

Sample Matrices: Low concentration groundwater and soil samples.

Analytical Procedure and Quantitation Limits:

1. Follow SW846 Method 8150 for extractions and analyses. Contract required quantitation limits (CRQL) are 1.0 ug/L or lower for water samples and 10 ug/Kg or lower for soil samples.
2. Diazomethane is a carcinogen and can explode under certain conditions. Refer to Section 7.3.1 of Method 8150 for precautions.
3. Capillary columns may be used for this analysis, as long as the laboratory demonstrates that the analysis meets all the performance and QA/QC criteria specified in Method 8150 and in this contract.

Analytical Holding Times: Analytical holding times are 7 days for the extraction of water samples, 14 days for the extraction of soil samples and forty (40) days for the analysis of extracts, from the date of sample collection.

Calibration Procedure and Criteria: Calibrate according to Sections 5.11 and 7.5 of Method 8150 and Sections 7.4.2 and 7.5 Method 8000, with the following specifications:

1. Five-point initial calibration curve with a low standard at the concentrations of the CRQL or lower is required.
2. A continuing calibration at the mid-point concentration for each analyte is to analyzed at the beginning of each day and after each group of 10 samples.

Internal Quality Control Checks, Control Limits and Corrective Actions:

1. Analyze method blanks at a frequency of one per group or fewer samples. The method blanks must be free of herbicides and any interfering peaks at or above the detection limits.
2. A herbicide surrogate (e.g., a herbicide that is not expected to be present in the samples) must be spiked into the standards, samples, method blanks and QC samples (see Section 5.13 and 8.3 of Method 8150). The amount of surrogate added must be at least 10 times the instrument detection limit. Recoveries of 75-125% are required.

3. Second column confirmation is required for all positive results reported.

4. Samples extracts containing one or more analytes at concentrations above the initial calibration range are to be diluted and re-analyzed. Report the results and documentation for both analyses.

5. Analyze matrix spikes and matrix spike duplicates (MS-MSD) at a frequency of one per group of 20 or fewer samples. Concentration of matrix spike solution should be such that the final extracts contain amounts at the mid-range of the calibration curve. Recoveries of 75-125% are required.

6. If above control limits are exceeded, take appropriate actions to correct the problems and re-analyze the affected samples.

Data Calculations and Reporting Units:

1. Calculate the CF and the concentration of individual analytes using the equations in Sections 7.4.2 and 7.8.1 of Method 8000. The sample results are to be reported in the concentration units of micrograms per liter (ug/l) for water samples and micrograms per kilogram (ug/Kg) on a dry weight basis for soil samples.

2. All records of analysis, dilutions and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Documentation and Deliverables:

1. Report documentation for sample and blank results, date and time of analysis, surrogate recovery, MS/MSD recovery, blank summary, analytical sequency, initial and continuing calibrations (including retention time windows), and compound identification. Use forms equivalent to CLP Forms I, II, III, IV, VI, IX and X.

2. Provide all raw data, including chromatograms and area printouts/quantitation reports.

3. Raw data and summary forms are to be organized systematically and each page is to be numbered.

Analysis of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans Homologs:

Analytes: Total tetra through octa chlorinated dibenzofurans and dibenzo-p-dioxins.

Sample Matrices: Groundwater and soil samples.

Analytical Procedure and Quantitation Limits:

1. Contract required detection limits (CRDL):

Water, ng/L		Soil, ug/Kg
Tetra & penta CDFs and CDDS	1.0 - 5.0	0.1 - 0.5
Hexa CDFs and CDDs	5.0 - 10.0	0.5 - 1.0
Hepta & octa CDFs and CDDs	10.0 - 50.0	1.0 - 5.0

Calculate and report the detected results or estimated sample detection limits (SDLs, see page 3 for calculation) for the dioxin/furan homologous series.

To achieve the specified detection limits, a final volume of 100 uL or less for the extracts is recommended.

2. Analytical Methodology:

Follow the SW-846 Method 8280 or Method 8290 with the following specifications:

a. Analyze samples by a DB-5 fused silica capillary column or the equivalent. If dioxins/furans are detected in the samples, confirmatory analyses using a SP-2331 fused silica capillary column or the equivalent must be performed. Report all dioxins/furans identified and quantified by both columns. To achieve the chromatographic peak resolution criteria of $\leq 25\%$ between 2,3,7,8-TCDD and 1,2,3,4-TCDD in the column performance check mixture, 60-meter columns are recommended for both DB-5 and SP-2331.

b. The quantitation ions, confirmation ions, and M- COCl ions used for selective ion monitoring (SIM) are specified in Table 2 of the Method 8280. Ions to be monitored are as follow:

Descriptor 1: 243, 304, 306, 316, 318, 257, 320, 322, 332, 334, 376.
Descriptor 2: 277, 340, 342, 293, 356, 358, 410.
Descriptor 3: 311, 374, 376, 327, 390, 392, 402, 404, 446.
Descriptor 4: 345, 408, 410, 418, 420, 361, 424, 426, 480.
Descriptor 5: 379, 442, 444, 395, 458, 460, 470, 472, 514.

Analytical Holding Times: Analytical holding times are 30 days from the date of sample collection.

Calibration Procedure and Criteria: Calibrate according to Sections 6.0 of Method 8280, with the following specifications:

1. Internal standards and recovery standards required are as follow:

Recovery Standard (RStd)	Daily Std Amount	Sample Amount
13C-1,2,3,4-TCDD	0.5 ng/uL	50 ng
13C-1,2,3,7,8,9-HxCDD	0.5 ng/uL	50 ng
Internal Standard (IStd)		
13C-2,3,7,8-TCDF	0.5 ng/uL	50 ng
13C-2,3,7,8-TCDD	0.5 ng/uL	50 ng
13C-1,2,3,6,7,8-HxCDD	0.5 ng/uL	50 ng
13C-1,2,3,4,6,7,8-HpCDF	0.5 ng/uL	50 ng
13C-OCDD	1.0 ng/uL	100 ng

Compound Quantification:

13C-TCDF and 13C-TCDD against 13C-1,2,3,4-TCDD
13C-HxCDD, 13C-HpCDF, and 13C-OCDD against 13C-1,2,3,7,8,9,-HxCDD
TCDF and PeCDF against 13C-2,3,7,8-TCDF
TCDD and PeCDD against 13C-2,3,7,8-TCDD
HxCDD and HpCDD against 13C-1,2,3,6,7,8-HxCDD
HxCDF and HpCDF against 13C-1,2,3,4,6,7,8-HpCDF
OCDF and OCDD against 13C-OCDD

Results are to be calculated using the relative response factors (RRF) from the continuing calibration. The percent recoveries of each internal standard are to be calculated and reported. The samples with one or more internal standard recoveries of less than 40% or greater then 120% must be re-extracted and re-analyzed.

2. A column performance check mixture containing the isomers listed in Method 8280 Paragraphs 6.3 must be analyzed at the beginning and end of a 12-hour period, as described in Paragraph 6.9.1. The QA/QC criteria as described in Paragraph 6.3 must be met.

3. Initial calibration using standard solutions at concentrations of 200, 500, 1000, 2000, and 5000 ng/Ml is required. Percent relative standard deviations (%RSD) of the relative response factors (RRF) for the calibration standards must not exceed 15%. A minimum

signal-to-noise (S/N) ratio of 50:1 for the m/z 320 ion of 2,3,7,8-TCDD must be achieved from the 100 ng/mL standard.

4. A calibration standard solution at concentration of 500 ng/mL must be analyzed at the beginning of a 12-hour period. The measured RRFs of all analytes must be within ±30% of the mean values established by initial analyses of the calibration standard solutions. A minimum S/N ratio of 150:1 for the m/z 320 ion of 2,3,7,8-TCDD must be achieved.

5. Samples and method blanks are not to be analyzed until acceptable calibration criteria as described in Paragraphs 6.3, 6.4, 6.6, and 6.7 of Method 8280 are demonstrated and documented.

Internal Quality Control Checks, Control Limits and Corrective Actions:

1. Alumina/silica column clean-up procedure is required for water and soil samples and chemical wastes. Additional cleanup (such as carbon column) may be needed for highly contaminated samples.

2. Analyze method blanks at a frequency of one per group of 20 or fewer samples. The method blanks must be free of chlorinated dibenzofurans and dibenz-p-dioxins and free of any interfering peaks.

3. Analyze a sample duplicate and a native spike (NS) at the frequency of one per group of 20 or fewer samples. The NS solution must contain at least one x,2,3,7,8 isomer from each of the tetra through octa polychlorinated dibenzofuran and dibenzo-p-dioxin homologous series. Concentrations of NS solutions should be such that the final extracts contain amounts at the mid-range of the calibration curve. Recoveries of 40-140% for tetra through octa polychlorinated dibenzofurans and dibenzo-p-dioxins are required. If the recovery limits are not met, the NS must be re-extracted and re-analyzed, unless a re-injection gives acceptable recoveries.

4. For samples in which the concentration of any isomer in a homologous series is above the five-point initial calibration range, the extracts are to be diluted in such a way that the measured concentration of that particular isomer lies within the calibration range. All computed results and raw data for both the undiluted and the diluted samples analyses are to be submitted.

5. The laboratory will be expected to analyze performance evaluation samples as provided by the EPA on a periodic basis.

6. If above control limits are exceeded, take appropriate actions to correct the problems and re-analyze all affected samples.

Data Calculations and Reporting Units: Follow the calculations specified in Section 11.0 of Method 8280, with the following specification:
Estimated sample detection limit, SDL:

$$SDL = \frac{2.5 * H_x * Q_{is}}{H_{is} * RRF * W}$$

Q_{is} - quantity, in pg, of the internal standard added to sample before extraction.

H_x - peak height for the quantitation ion of the compound of interest.

H_{is} - peak height for the appropriate ion characteristic of the internal standard.

W - weight (in g) of soil or waste sample or volume of water (in mL) extracted.

The sample results are to be reported in the concentration unit of microgram per litre (ug/L) for water samples and microgram per kilogram (ug/Kg) expressed on a dry weight basis for soil/waste samples. All records of analysis and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Documentation and Deliverables: Submit the documentation for sample and blank results, sample duplicate results, internal standard recovery, NS recovery, blank summary, analytical sequence, initial calibrations, and continuing calibrations.

1. Document the sample data summary, raw sample data, quality control data and calibrations on the equivalents of EPA Method 8280 forms 8280-1 to 8280-6. Indicate the scan number of each peak that was identified as dioxins/furans.

2. Provide reconstructed total ion chromatograms (RICs) and selective ion chromatograms (SICs) for all calibrations, blanks, samples and quality control samples.

3. Provide example calculations of estimated SDLs and sample results.

4. For soil/waste samples, all detected results and estimated SDLs are to be reported on dry weight basis.

Analysis of Metals by SW846 Methods 6010, 7061 (Arsenic), 7471 (Mercury), and 7741 (Selenium):

Analytes: Detection Limits:

	Water (ppb)	Soil (ppm)
Aluminum (6010)	50	5
Antimony	50	5
Barium	5	1
Beryllium	5	0.5
Cadmium	5	0.5
Calcium	1	100
Chromium	5	0.5
Cobalt	5	0.5
Copper	5	0.5
Iron	50	5
Lead	20	5
Magnesium	1,000	100
Manganese	5	0.5
Nickel	20	2
Potassium	1,000	100
Silver	10	2
Sodium	1,000	100
Thallium	50	5
Vanadium	5	1
Zinc	20	1
Arsenic (7061)	5	0.5
Mercury (7471)	0.5	0.025
Selenium (7741)	0.001	0.25

Sample Matrices: Groundwater and soil samples.

Analytical Procedure and Quantitation Limits: EPA Methods 6010 (ICP analysis), 7061, 7471, and 7741 procedures and detection limits will be followed.

Analytical Holding Times: Holding time prior to analysis is 6 months from the data of sample collection.

Calibration Procedure and Criteria: Calibration will be executed according to methods described in EPA Methods 6010, 7061, 7471, and 7741.

Internal Quality Control Checks, Control Limits and Corrective Actions: The quality control samples and frequency specified in the EPA Methods 6010, 7061, 7471, and 7741 will be utilized for this task. The following QC samples will be analyzed, as appropriate:

- Method blanks
- Blank/spikes
- Matrix spikes and matrix spike duplicates
- Laboratory duplicates
- Initial and continuing calibration checks

Data Calculations and Reporting Units: The equations in EPA Method 6010 will be used for calculation. The sample results will be reported in concentration units of ug/L.

Documentation and Deliverables: The full CLP data package.

Analysis of Inorganic Anions in Water by Ion Chromatography-EPA Method 300.0:

Analytes: Chloride, nitrate-N, nitrite-N, and sulfate

Sample Matrices: Groundwater samples

Analytical Procedure and Detection Limits: Follow the EPA Method 300.0. Detection limits are 0.10 mg/L for nitrate-N, nitrite-N, and 1.0 mg/L or lower for chloride and sulfate.

1. Samples are to be kept at 4°C until analysis and validation of results are completed.
2. Confirmatory techniques such as sample dilution and spiking must be performed when the identification of a peak in the chromatogram is questionable and for the confirmation of all positive results reported. Spike the sample with an appropriate amount of the relevant standard and re-analyze.
3. A laboratory blank is to be analyzed after the analysis of an unusually concentrated sample, to check for contamination by carry-over.

Holding Times: Holding times are 24 hours for nitrate-N, nitrite-N, and 25 days for chloride and sulfate, from the date of sample receipt by the laboratory.

Calibration Procedure and Criteria: Calibrate according to Section 9 of EPA Method 300.0 with the following specifications:

1. The working standards are to be prepared daily from the stock solutions. Stock standards are to be stored at 4°C and replaced after one month.
2. Use at least five calibration standards (not including zero standard) to obtain a standard calibration curve. Calculate and report the retention time (RT) window, response factor (RF) and percent relative standard deviation (%RSD) for each analyte.
3. Calibration verification standards at the mid-point concentration are to be analyzed at the beginning of each working day, whenever the anion eluent is changed, and after every 20 or fewer samples. Percent differences (%D) in RF or less than ±10% are required. For %D of greater than ±10%, recalibrate as described in Section 9.4 of EPA Method 300.0.

Internal Quality Control Checks, Control Limits and Corrective Action:

1. Analyze laboratory control samples (LCS) at a frequency of one per sample delivery group. Recoveries of 85-115% are required.

2. Analyze laboratory blanks at a frequency of one per group of 20 or fewer samples and after analysis of unusually concentrated samples. Laboratory blanks must not contain any anions at concentrations above the CRDL.

3. Samples containing anions at concentrations above the calibration range are to be diluted and re-analyzed. Report the results and documentation for both analyses.

4. Analyze matrix spikes at a frequency of one per group of 20 or fewer samples. Matrix spike concentrations are to be greater than 30% of the sample concentrations, but spiked samples must not exceed the working range of the standard curve. Recoveries of 85-115% are required.

5. Analyze laboratory duplicates at a frequency of one per group of 20 or fewer samples. The relative percent difference (RPD) of duplicate sample results must be less than 10%.

6. If above control limits are exceeded, take appropriate actions to correct the problems and re-analyze the affected samples.

Data Calculations and Reporting Units: Calculate the sample results according to Section 12 of EPA Method 300.0 Sample results are to be reported in the concentration unit of milligram per liter (mg/L). All records of analysis and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Documentation and Deliverables: Identify the laboratory control sample as to source, reference sample lot number and the corresponding true value with 95% confidence interval. Report all bench records tabulating calibration standards (RT window, RF, %RSD and %D), laboratory control samples, laboratory blanks, samples, matrix spikes, laboratory duplicates, etc. Indicate date and time of analysis. Provide all raw data, including copies of instrument readouts and worksheets used to calculate results. Raw data are to be organized systematically and each page is to be numbered.

Analysis of Carbonate, Biocarbonate and Total Alkalinity in Water by Standard Method 403:

Analytes: Carbonate, biocarbonate and total alkalinity

Sample Matrices: Groundwater samples

Analytical Procedure and Detection Limits: Follow "Standard Methods for the Examination of Water and Wastewater," 16th Ed., Method 403, Procedures 4c and 4d. Detection limit of 2.0 mg/L of $CaCO_3$ or lower are needed for low level samples, and 20 mg/L of $CaCO_3$ for higher level samples.

1. Samples are to be kept at 4°C until analysis and validation of results are completed.

2. Samples will be unfiltered. Report the carbonate, biocarbonate and total alkalinity results for each sample.

3. Do not use titrant volumes greater than 50 mL. Dilute and re-analyze any sample aliquots requiring more than 50 mL titrant.

Holding Times: Holding time is 12 days from the date of sample receipt by the laboratory.

Calibration Procedure and Criteria: Not applicable

Internal Quality Control Checks, Control Limits and Corrective Action:

1. Standardize the pH meter and the titrant each day. Standardize the pH meter using at least 2 buffers which bracket the end points. Use Na_2CO_3 to standardize titrant, according to Section 3 of Method 403.

2. Analyze 1 set of EPA QC Mineral Reference Samples (at 2 concentration levels) at a frequency of one per sample delivery group. Recoveries of 90-110% are required.

3. Analyze laboratory blanks at a frequency of one per group of 20 or fewer samples. Laboratory blanks must contain less than 2.0 mg/L of $CaCO_2$for low level analyses and less than 10 mg/L of $CaCO_2$for high level analyses.

4. Analyze laboratory duplicates at a frequency of one per group of 20 or fewer samples. Difference in duplicate sample results must be less than 10% for concentrations exceeding 20 mg/L and less than 2.0 mg/L for concentrations below 20 mg/L.

5. If above control limits are exceeded, take appropriate actions to correct the problems and re-analyze the affected samples.

Data Calculations and Reporting Units: Calculate and report the carbonate, biocarbonate and total alkalinity results according to Section 5 of Method 403. Sample results are to be reported in the concentration unit of milligram per liter (mg/L) of $CaCO_2$All records of analysis and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Documentation and Deliverables: Identify the QC reference sample lot numbers used and the corresponding true values with 95% confidence intervals. Report all bench records tabulating pH meter calibration, titrant standardization, laboratory control samples, titration and indicator blanks, sample volumes and titrant volumes, matrix spikes, laboratory duplicates, etc. Indicate date and time of analysis. Provide all raw data, including copies of instrument readouts and worksheets used to calculate results. Raw data are to be organized systematically and each page is to be numbered.

Analysis of Total Dissolved Solids (TDS) in Water by EPA Method 160.1:

Analytes: Total dissolved solids (TDS, 180°C)

Sample Matrices: Groundwater

Analytical Procedure and Detection Limits: Follow the EPA Method 160.1 (residue, filterable, gravimetric, dried at 180°C). Detection limit needed is 20 mg/L of dissolved solids or lower.

1. Samples are to be kept at 4°C until analysis and validation of results are completed.

2. If the pH value is less than 4.0 raise the pH of the aliquot (using NaOH titrant) to between ph 4 and 8. Subtract the weight of sodium added from the weight of residue.

3. Residue will be weighed to constant weight pursuant to Section 7.6 of EPA Method 160.1. Constant weight is defined as: a) less than 0.5 mg or less than 4% weight loss from the previous weight, whichever is smaller, or b) dried overnight (12 hours drying time) with a single weight used for calculations.

Holding Times: Holding time is 5 days from the date of sample receipt by the laboratory.

Calibration Procedure and Criteria: Not applicable

Internal Quality Control Checks, Control Limits and Corrective Action:

1. Analyze 1 set of EPA QC Mineral Reference Samples (at 2 concentration levels) at a frequency of one per sample delivery group. Recoveries of 85-115% are required.

2. Analyze laboratory blanks (100 mL of filtered reagent water) at a frequency of one per group of 20 or fewer samples. Laboratory blanks must contain less than 20 mg?l of TDS.

3. Use standard aliquots of 100 mL. If residue in sample is greater than 200 mg, repeat the analysis using a smaller sample aliquot.

4. Analyze sample duplicates at a frequency of one per group of 20 or fewer samples. Difference in duplicate sample results must be less than 10% for concentrations exceeding 200 mg/L and less than 2.0 mg/L for concentrations below 200 mg/L.

5. If above control limits are exceeded, take appropriate actions to correct the problems and re-analyze the affected samples.

Data Calculations and Reporting Units: Calculate the sample results according to Section 8 of EPA Method 160.1. Sample results are to be reported in the concentration unit of milligram per liter (mg/L) or dissolved solids. All record of analysis and concentrations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Documentation and Deliverables: Identify the QC reference sample lot numbers used and the corresponding true values with 95% confidence intervals. Report all bench records of tare weights, final weights, additional weights to determine constant weights and volume filtered for laboratory blanks, reference samples, samples, sample duplicates, etc. Indicate date and time of the determination of tare weights, sample filtration and determination of residue weights and constant residue weights. Provide all raw data, including copies of worksheets used to calculate results. Raw data are to be organized systematically and each page is to be numbered.

Analysis of Chemical Oxygen Demand (COD) in Water by EPA Methods 410.1 and 410.2:

Analytes: Chemical Oxygen Demand (COD)

Sample Matrices: Groundwater

Analytical Procedure and Detection Limits: Follow the EPA Method 410.1 (titrimetric, mid-level) for COD ≥ 50 mg/L and EPA Method 410.2 (titrimetric, low-level) for COD ≤ 50 mg/L. Use procedure specified in Section 7.1 of EPA Method 410.3 to inhibit chloride interference if chloride concentration exceeds 2000 mg/L in a sample. Detection limit needed is 50 mg/L COD for Method 410.1 and 5.0 mg/L COD for Method 410.2

1. Samples will be preserved in the field with 1 mL of H_2SO_4 to pH less than 2. Samples will be unfiltered.
2. Samples are to be kept at 4°C until analysis and validation of results are completed.
3. Fifty (50) mL sample aliquots are to be used for both methods. Homogenize samples as necessary, to obtain aliquots of representative suspended solids.
4. For Method 410.1, use 0.25ON $K_2Cr_20_7$reagent and 0.25N ferrous ammonium sulfate titrant. For Method 410.2, use 0.25N $K_2Cr_20_7$reagent and 0.025N ferrous ammonium sulfate titrant.
5. The samples are to be refluxed for at least 2 hours. Samples with COD values less than 50 mg/L will be determined and reported as COD (low-level) and samples with COD values greater than or equal to 50 mg/L will be determined and reported as COD (mid-level).

Holding Times: Holding time is 25 days from the date of sample receipt by the laboratory.

Calibration Procedure and Criteria: Not applicable

Internal Quality Control Checks, Control Limits and Corrective Action:

1. Separate sets of QA Audits are to be performed for each method if both methods are used.
2. Standardize ferrous ammonium sulfate titrant daily against the standard potassium dichromate solution, according to the procedure specified in Section 6.4.1 of Method 410.1 and Method 410.2.
3. Analyze 1 set of EPA QC Demand Reference Samples (at 2 concentration levels) at a frequency of one per sample delivery group for each method used. Recoveries of 90-

100% or ≤8 mg/L error for Method 410.1 and ≤5 mg/L error for Method 410.2 are required.

4. Analyze titration blanks (used in the calculation of results) at a frequency of at least 2 for each day of analysis (minimum of 2 per sample delivery group) for each method used. Difference in titrant volumes must not exceed 0.1 mL for Method 410.1 and 1.0 mL for Method 410.2.

5. Use potassium hydrogen phthalate (KHP) as a matrix spike compound. Analyze matrix spikes at a frequency of one per group of 20 or fewer samples. For Method 410.1, matrix spike concentrations are to be greater than 30% of the sample concentrations but spiked samples must not exceed 800 mg/L COD. Matrix spike recoveries of 85-115% are required. For Method 410.2, a 20 mg/L matrix spike concentration is to be used and matrix spike recoveries of 75-125% are required.

6. Analyze lab duplicates at a frequency of one per group of 20 or fewer samples. For Method 410.1 difference in duplicate sample results must be less than 10% for concentrations exceeding 80 mg/L and less than 8.0 mg/L for concentrations below 80 mg/L. For Method 410.2 difference in duplicate sample results must be less than 4.0 mg/L for concentrations below 40 mg/L and less than 5.0 mg/L for concentrations below 40 and 50 mg/L.

7. Initial sample values analyzed by Method 410.2 that are ≥ 50 mg/L COD are to be re-analyzed by Method 410.1; initial sample values that are ≤50 mg/L COD analyzed by Method 410.1 are to be re-analyzed by Method 410.2.

8. Any samples with COD values ≥800 mg/L or titrant volumes ≤6.0 mL (analyzed by Method 410.1) are to be diluted and re-analyzed.

9. Sample aliquots that are ≤50 mL are to be diluted to 50 mL so that the COD reaction mixture will be 50% H_2S_4/50% water by volume.

10. A titration blank is needed for each different amount of mercuric sulfate used for the inhibition of chloride interference. SAS Packing Lists will note the samples required assessment of chloride interferences when ≥2000 mg/L of chloride is suspected. Measurement of chloride is to be done using any method of "Standard Methods," 16th Edition or "EPA Methods for Chemical Analysis of Water and Wastes," 1983 Edition, whenever possible chloride interference is noted.

11. If above control limits are exceeded, take appropriate actions to correct the problems and re-analyze the affected samples.

Data Calculations and Reporting Units: Calculate the sample results according to Section 8 of EPA Method 410.1 and EPA Method 410.2. Sample results are to be reported in the concentration unit of milligram per liter (mg/L). All records of analysis and calculations must be legible and sufficient to recalculate sample concentrations and QC results. Include an example of the calculations in the data package.

Documentation and Deliverables: Identify the QC reference sample lot numbers used and the corresponding true values with 95% confidence intervals. Report all bench records tabulating titrant standardization, laboratory control samples, titration or sample blanks (2 or more in number), sample volumes and titrant volumes, matrix spikes, laboratory duplicates, etc. Records of chloride analysis are to be provided for any samples so specified on the RAS/SAS Traffic Report or SAS Packing List. Indicate date and time of analysis. Provide all raw data, including copies of instrument read-outs and worksheets used to calculate results. Separate bench records for any COD determinations of high chloride samples (≥2000 mg/L chloride) are to be provided, including weight of mercuric sulfate used, sample titration volume and titration blank volume for each sample type. Raw data are to be organized systematically and each page is to be numbered.

Analysis of Sulfide in Water by EPA Method 376.1:

Analytes: Sulfide

Sample Matrices: Groundwater

Analytical Procedure and Detection Limits: Follow the EPA Method 376.1 (titrimetric, iodine). Detection limit is 1.0 mg/L of sulfide. If a lower detection limit is necessary, the colorimetric method (EPA Method 376.2) must be used.

1. Samples will be collected in the field without any headspace and in duplicates to allow for any re-analysis and laboratory duplicate analysis. Sample volumes will be 500 m/L or larger.

2. Samples will be preserved in the field by adding 2N zinc acetate at concentration of 1.5 mL/L and add enough 6N NaOH to pH between 9 and 11. Because of the preservation procedure, the entire sample must be used for analysis. Volume of the sample must be accurately known and must be included in the calculation of sample results.

3. Samples are to be kept at 4°C until analysis and validation of results are completed.

Holding Time: Holding time is 5 days from the date of sample receipt by the laboratory.

Calibration Procedure and Criteria: Not applicable

Internal Quality Control Checks, Control Limits and Corrective Action:

1. The following solutions are to be prepared and standardized daily:

    a) Iodine standard, according to EPA Method 376.1, Section 5.2.

    b) Sodium thiosulfate solution, according to Standard Methods 421.B, Sections 2e and 2f (16th Edition). Prepare fresh potassium bi-iodate standard solution each day according to Standard Methods 421.B, Section 2f (16th Edition).

2. All standardization titrations are to be performed in duplicate. Duplicate results for solution standardization must agree to within 0.2 mL. Use the average of the duplicate results for calculations.

3. Analyze titration blanks at a frequency of one per group of 20 or fewer samples. Titration blanks must contain less than 1.0 mg/L of sulfide.

4. Analyze laboratory duplicates at a frequency of one per group of 20 or fewer samples. Difference in duplicate sample results must be less than 10% for concentrations exceeding 3mg/L and less than 0.3 mg/L for concentrations below 3 mg/L.

5. If above control limits are exceeded, take appropriate actions to correct the problems and re-analyze the affected samples.

Data Calculations and Reporting Units: Calculate the sample results according to Section 7 of EPA Method 376.1. Sample results are to be reported to the nearest 0.1 mg/L (above 1mg/L) or to 2 significant figures above 10 mg/L. All records of analysis and calculations must be legible and sufficient to recalculate all sample concentrations and QC results. Include an example of the calculations in the data package.

Documentation and Deliverables: Report all bench records tabulating standardization titrations (in duplicate), titration blanks, sample and laboratory duplicate titrations, sample volumes, etc. Indicate date and time of analysis. Provide all raw data, including copies of instrument read-outs and worksheets used to calculate results. Raw data are to be organized systematically and each page is to be numbered.

Total Kjeldahl Nitrogen (TKN) Using Standard Method (17th ed.) 4500-NH_3 and Norg B

Sample Matrices: groundwater

Analytical Procedure and Detection Limits: Standard Method 4500-NH_3E and Norg B will be followed.

Holding Time: 28 days

Calibration Procedure and Criteria: Calibration will be executed according to methods described in Standard Method 4500-NH_3E and Norg B.

Internal Quality Control Checks, Control Limits, and Corrective Actions: The quality control samples and frequency specified in the 4500-NH_3E and Norg B will be utilized for this task.

Data Calculation and Reporting Units: The equations in 4500-NH_3E and Norg B will be used for calculation and reporting units.

Documentation and Deliverables: The report generated will be in accordance with Methods 4500-NH_3E and Norg B.

Organic-N Using Standard Method (17th ed.) 4500-Norg B and NH_3B and E

Sample Matrices: groundwater

Analytical Procedure and Detection Limits: Standard Method 4500-Norg B and NH_3B and E.

Holding Time: 28 days

Calibration Procedure and Criteria: Calibration will be executed according to methods described in the analytical method.

Internal Quality Control Checks, Control Limits, and Corrective Actions: The quality control samples and frequency specified in the analytical method will be utilized for this task.

Data Calculation and Reporting Units: The equations in the analytical method will be used for calculation and reporting units.

Documentation and Deliverables: The report generated will be in accordance with the analytical method.

Ammonia Nitrogen Using Standard Method (17th ed.) 4500-NH_3B and E

Sample Matrices: groundwater

Analytical Procedure and Detection Limits: Standard Method 4500-NH_3B and E will be followed.

Holding Time: 28 days

Calibration Procedure and Criteria: Calibration will be executed according to methods described in the analytical method.

Internal Quality Control Checks, Control Limits, and Corrective Actions: The quality control samples and frequency specified in the analytical method will be utilized for this task.

Data Calculation and Reporting Units: The equations in the analytical method will be used for calculation and reporting units.

Documentation and Deliverables: The report generated will be in accordance with the analytical method.

Analysis for Total Suspended Solids Using EPA 160.2

Sample Matrices: Leachate

Analytical Procedure and Detection Limits: EPA 160.2

Holding Time: 7 days

Calibration Procedure and Criteria: Calibration will be executed according to methods described in EPA 160.2.

Internal Quality Control Checks, Control Limits, and Corrective Actions: The quality control samples and frequency specified in EPA 160.2 will be utilized for this task.

Data Calculation and Reporting Units: The equations in EPA 160.2 will be used for calculation and reporting units.

Documentation and Deliverables: The report generated will be in accordance with the analytical method.

Analysis for Oil and Grease Using EPA 413.2

Sample Matrices: Leachate

Analytical Procedure and Detection Limits: EPA 413.2 will be followed.

Holding Time: 28 days

Calibration Procedure and Criteria: Calibration will be executed according to methods described in EPA 413.2.

Internal Quality Control Checks, Control Limits, and Corrective Actions: The quality control samples and frequency specified in EPA 413.2 will be utilized for this task.

Data Calculation and Reporting Units: The equations in EPA 413.2 will be used for calculation and reporting units.

Documentation and Deliverables: The report generated will be in accordance with the analytical method.

Analysis for B.O.D. Using EPA 405.1

Sample Matrices: leachate

Analytical Procedure and Detection Limits: EPA 405.1 will be followed.

Holding Time: 48 hours

Calibration Procedure and Criteria: Calibration will be executed according to methods described in EPA 405.1.

Internal Quality Control Checks, Control Limits, and Corrective Actions: The quality control samples and frequency specified in EPA 405.1 will be utilized for this task.

Data Calculation and Reporting Units: The equations in EPA 405.1 will be used for calculation and reporting units.

Documentation and Deliverables: The report generated will be in accordance with the analytical method.

Analysis of Soil Moisture by ASTM D2216-80

Sample Matrices: Soil samples

Analytical Procedure and Detection Limits: ASTM D2216-80 will be followed.

Holding Time: 14 days

Calibration Procedure and Criteria: Calibration will be executed according to methods described in the analytical method.

Internal Quality Control Checks, Control Limits, and Corrective Actions: The quality control samples and frequency specified in the analytical method will be utilized for this task.

Data Calculation and Reporting Units: The equations in the analytical method will be used for calculation and reporting units.

Documentation and Deliverables: The report generated will be in accordance with the ASTM D2216-80 Method.

Analysis of Soil Porosity by ASTM D2116 and 854

Sample Matrices: Soil samples

Analytical Procedure and Detection Limits: ASTM D2116 and 854 will be followed.

Holding Time: 14 days

Calibration Procedure and Criteria: Calibration will be executed according to methods described in the analytical method.

Internal Quality Control Checks, Control Limits, and Corrective Actions: The quality control samples and frequency specified in the analytical method will be utilized for this task.

Data Calculation and Reporting Units: The equations in the analytical method will be used for calculation and reporting units.

Documentation and Deliverables: The report generated will be in accordance with the ASTM D2116 and 854 method.

Analysis of Total Hardness in Water by EPA Method 130.2:

Analytes: Hardness, total

Sample Matrices: Groundwater samples

Analytical Procedure and Detection Limits: Follow the EPA Method 130.2 (titrimetric, EDTA). The method is suitable for all concentration ranges of hardness. Detection limit needed is 5.0 mg $CaCO_3$/Lor lower.

1. Samples will be preserved in the field with HNO_3 to pH of less than 2.
2. Samples are to be kept at 4°C until analysis and validation of results are completed.
3. Sample aliquots containing not more than 25 mg $CaCO_3$are to be used to avoid large titration volumes. This is determined by performing practice runs.
4. Wastewaters and highly polluted waters are to be pretreated by digestions of the sample. Follow Section 7.1.2 of EPA Method 130.2

Holding Time: Holding time is up to 6 months from the date of sample receipt by the laboratory.

Calibration Procedure and Criteria: Not applicable

Internal Quality Control Checks, Control Limits and Corrective Action:

1. The normality of the standard EDTA titrant (0.02N) is to be checked at the beginning of each day that total hardness is performed. Follow Section 6.4.5 of EPA Method 130.2 for the standardization titration procedure of EDTA.
2. Analyze one set of EPA QC Reference Sample at a frequency of one per sample delivery group. Recoveries of 85-115% are required.
3. Analyze titration blanks at a frequency of one per group of 20 or fewer samples. Redistilled, distilled or deionized water of the same volume as the sample is to be used as a blank to which identical amounts of buffer, inhibitor, and indicator have been added. The volume of EDTA used for the blank is to be subtracted from the volume of EDTA used for the sample.
4. Analyze laboratory duplicates at a frequency of one per group of 20 or fewer samples. Relative percent difference (RPD) of less than ±10% are required.

5. Inhibitors are to be added if the end point is not sharp. Excessive amounts of heavy metals interfere by causing fading or indistinct end points. To correct for interferences, refer to Section 7.4 of EPA Method 130.2.

6. If above control limits are exceeded, take appropriate actions to correct the problems and re-analyze the affected samples.

Data Calculations and Reporting Units: Calculate the sample results according to Section 8 of EPA Method 130.2. Sample results are to be reported in the concentration unit of milligram calcium carbonate per liter (mg $CaCO_3$/L). All records of analysis and calculation must be legible and sufficient to recalculate all sample concentration and QC results. Include an example of the calculation in the data package.

Documentation and Deliverables: Identify the QC reference sample lot numbers used and the corresponding true values with 95% confidence intervals. Report all bench records tabulating titrant (EDTA) standardization, titration blanks, sample volumes and titrant volumes, laboratory duplicates, etc. Indicate date and time of analysis. All sample treatment to remove interferences are to be documented. Provide all raw data, including worksheets used to calculate results. Raw data are to be organized systematically and each page is to be numbered.

Geotechnical Analysis for Grain Size Distribution Using ASTM-C136

Analytes: Not applicable

Sample Matrices: Soil samples for grain size distribution.

Analytical Procedure and Detection Limits: ASTM-C136 will be followed.

Holding Time: Not applicable

Calibration Procedure and Criteria: Calibration will be executed according to methods described in ASTM-C136.

Internal Quality Control Checks, Control Limits, and Corrective Actions: The quality control samples and frequency specified in the ASTM-C136 will be utilized for this task.

Data Calculation and Reporting Units: The equations in ASTM-C136 will be used for calculation and reporting units.

Documentation and Deliverables: The report generated will be in accordance with the ASTM-C136 Method.

Analysis of Total Organic Carbon Using Modified ASTM-D4129 and D5136

Analytes: Total Organic Carbon by ASTM-D4129. Carbonate carbon by ASTM-D5136.

Sample Matrices: Low concentration soil samples.

Detection Limits: Detection limit of 0.01% will be specified.

Holding Time: Not applicable

Modifications: ASTM Methods D4129 and D5136 are for water samples. The following soil preparation method will be used. The less than 2-mm fraction and the rock fragment fraction of a soil sample are analyzed separately. Before analysis, the rock fragment fraction is crushed with a jaw crusher, then is powdered to pass a 60-mesh sieve by using either a pulverizer, a hammer mill, or an equivalent unit. The sample is placed in the sample tube of the coulometer, either directly or within a weighing boat. This modification is taken from "Analytical Methods Manual for the Direct/Delayed Response Project Soil Survey" (EPA/600/8-87/020), August 1987.

Calibration Procedure and Criteria: Calibration will be executed according to Methods ASTM-D4124 and D5136.

Internal Quality Control Checks, Control Limits, and Corrective Actions: The quality control samples and frequency specified in ASTM-D4129 and D5136 will be utilized for this task.

Data Calculation and Reporting Units: The equations in ASTM-D4129 and D5136 will be used for calculation. The sample results will be reported in concentration units of mg/l.

Documentation and Deliverables: Method-specified documentation.

APPENDIX B-2 - CONTENTS

- Volatile Organics - EPA TO-14
- Volatile Organics - EPA TO-2

Analysis of Air Samples for Volatile Organic Compounds by EPA Method TO-14

Analytes:

Calderon List	Detection Limits (ppbv)
Vinyl Chloride (VC)	0.2*
Benzene (0)	0.5
Methylene Chloride ($MeCl_2$)	20
Chloroform ($ChCl_3$)	.02
1,2-Dichloroethane (1,2-DCA)	50
1,1,1-Trichloroethane (1,1,1-TCA)	0.1
Carbon Tetrachloride (CCR4)	.05
Trichloroethylene (TCE)	0.1
Tetrachloroethylene (PCE)	0.1
1,2-Dibromoethane (EDB)	0.05
Dichlorodifluoromethane (F-12)	0.2

*Please note the relatively low detection limit needed for vinyl chloride.

A partial Calderon list, eliminating chloroform, carbon tetrachloride, and 1,2 Dibromoethane from the above list, may also be requested.

Matrices: Ambient air samples collected in 6-liter Summa canisters. Canister cleaning and verification of cleanliness is also required.

Analytical Method: EPA Method TO-14. If the laboratory proposes to use GC-Selective detectors (ECD, FID, PID, Hall), a confirmational analysis is required for detected target compounds. This could be accomplished using GC/MS-Full Scan, GC/MS in the Selected Ion Monitoring mode using the ions listed in Table 2 of TO-14, using another selective detector with the necessary sensitivity, or by second column confirmation. Ten percent of the samples from a sample delivery group (SDG) containing detectable analytes will require confirmation. In addition, all samples containing detectable quantities of vinyl chloride will require confirmation for this compound only. If GC/MS-Full Scan is used for confirmation, up to 10 non-target peaks should be tentatively identified.

Canister Cleaning and Verification: Canister cleaning and verification is a requirement. After cleaning, it is considered acceptable if no detectable analytes are present. After cleaning, ten percent (10%) of the canisters will be analyzed for verification of the cleaning procedure. The canister selected for verification will be the one from the sample delivery batch that had previously contained the highest overall concentration of analytes. If no analytes are to be below 0.2 ppbv, present, the entire batch is suitable for shipment. Otherwise, the canisters must either be individually verified, cleaned as necessary and then verified again by the previously mentioned criteria or by recleaning the entire batch and then the canister that had previously failed will be verified following the previously mentioned criteria.

The canister cleaning deliverables are as follows:

- Form I results.
- Raw data/chromatograms.
- Low standard at 0.5 ppbv for the compounds of interest.
- System blank showing those compounds to be less than 0.2 ppbv.

Canister cleaning guidelines are described below:

1. EPA Method TO-14 outlines the most desirable method of cleaning.

2. Any method used must be capable of evacuating the canister to less than 0.05 mm Hg (50M Torr).

3. Any method not utilizing an evacuation/pressure cycle must include heating of the canister to no greater than 160°C but no less than 100°C during evacuation.

4. Any method not utilizing an evacuation/pressure cycle must maintain an evacuation of less than 0.05 mm Hg (50m Torr) for no less than 12 hours.

5. All vacuum pumps utilized in this procedure must include a suitable trap for the prevention of backstreaming.

6. All connections to canisters must be made with brass compression fittings to avoid damage to the canister inlet fitting.

QA/QC Requirements: Holding Time $<$ 72 hours from sample collection.

Initial Calibration: A five (5) point calibration at 0.5, 1.0. 3.0, 5.0, and 10 ppbv. Percent coefficient of variation (%CV) or percent relative standard deviation (%RSD) of the response factors (RF) must be less than 5.0%.

Retention Time Windows: See Method TO-14, Section 10.3.2.

Continuing Calibration: Daily continuing calibration at 1.0 ppb in triplicate. If the response value of the 1.0 ppb calibration analysis differs significantly from the initial calibration response factor (RF) mean at the -.05 level of significance of a 2-tailed t test, a new initial calibration is to be analyzed.

After any change to the system that may alter the signal response which includes but is not limited to: column or carrier gas change, bakeout, or detector cleaning, a daily continuing calibration must be run. If this calibration fails to meet the previously mentioned criteria for daily calibration, a new initial calibration must be run.

Surrogate Standards: Fifty microliters of approximately 5 ppm in zero grade air of Bromochloromethane and 1,2-Bromochloropropane will be spiked into all blanks, standards, samples, and sample duplicates. Other surrogates may also be used. The laboratory must ensure that surrogates do not co-elute with analytes.

System Blank: A system blank will be run after any calibration. For blank analysis use humidified Zero Grade air from a known and consistent source. Identify source on Form 4. The blank must be free of interfering peaks and of volatile organics greater than 0.2 ppbv. To prevent carryover, a system blank must be run after any analysis in which any analyte saturates the detector.

Duplicates: In each batch, one sample for duplicate analysis will be designated. The maximum allowable relative percent difference for each analyte whose concentrations are 3 times greater than the LOD will be 10.0 percent. The maximum allowable relative percent difference for each analyte whose concentrations are less than 3 times the LOD will be 20.0 percent. Failure to meet this criteria will require a reanalysis of the sample.

Identification Criteria: Analytes will be qualitated by matching the retention time windows of the sample and the standard. In the unlikely event of overlapping retention time windows, the laboratory will use the peak whose retention time most closely matches that of the sample. Confirmational analysis will be required for all identified peaks with overlapping RT windows.

Standard Operating Procedures (SOP): All methods and procedures related to the analysis and cleaning of SUMMA passivated canisters should be documented in a logical, step-wise manner. These should include but not be limited to: assembly, calibration, maintenance, and operation of specific systems and equipment, preparation, storage, shipment and handling of samples; canisters cleaning and verification; and all aspects of data recording and processing including hardware and software documentation.

Gas Chromatography/Mass Spectrometry - Full Scan:

All QA/QC requirements for gas chromatography are applicable to GC/MS-full scan analysis (except GC sections on confirmational analysis, detection limits, and identification criteria). In addition, the following QA/QC requirements are applicable to GC/MS analysis:

Instrument Tuning: Each day, prior to initiating any analysis, the gas chromatograph/mass spectrometer (GC/MS) will be tuned with 50 ng. direct column injection of p-Bromofluorobenzene (BFB) as outlined in Section 10.2.2 of TO-14. The main exception to the indicated procedures is the frequency of tuning, which will be performed once in 24 hours or the total period of analysis, whichever is more frequent. Tuning information will be provided on Form 5.

Detection Limits: Instrument detection limits are established by demonstrating the ability of the instrument to detect and produce a complete enhanced or unenhanced mass spectrum in which fragmentation ions greater than 20 percent of base peak must be present from a 500 ml sampling of 5 ppbv standard (approximately 2.0 μg depending on the analyte). Determination of detection limits should follow the guidelines in CFR 40, Part 136, Appendix B.

Identification Criteria: Criteria for identification of the compounds found in Attachment #3 is based upon retention time (RT) matching and mass spectrum matching with the standard. The relative retention time (RRT) must be within ±0.06 RRT of the calibration standard, where RRT is the RT of the hit compound in relation to the RT of the corresponding internal standard. Mass spectra must match according to the following criteria:

1. All m/e greater than 15 percent in the standard spectrum must be present in the sample spectrum.

2. The relative intensities of ions must agree within 20 percent between standard and sample spectra.

3. Fragmentation ion greater than 15 percent in the sample spectrum but not in the standard spectra must be accounted for (background, co-eluting peak, etc.).

The laboratory will also perform NIST (NBS) library searches on all peaks that are greater than 10 percent in height than the previous closest internal standard. The searches will be based on relative fit. The analyst will use the criteria established for spectral matching for TCL compounds to identify TIC (Tentatively Identified Compounds), with the exception that the comparison will be made with the NIST Library searches. A certain amount of flexibility is allowed for professional judgment and interpretation of spectra by the analyst. Those peaks which cannot be identified by the above criteria are reported as unknown. The quantitation is expressed as the percent of peak height of target compound in reference to the peak height of the closest previous internal standard.

Deliverables:

Narrative:

Date samples arrived at the lab.
Sample numbers.
Sampling/analytical problems.
Discussion of any QA/QC outside of the acceptance criteria.

Results:

Report on a Form I equivalent in ppbv analyte/sample.
Volume of sample analyzed.
Include all raw data, chromatograms/mass spectra and quantitation reports for each sample.

Calibration:

Initial calibration with 5 points: 0.5, 1.0, 3.0, 5.0, and 10 ppbv.
Report the calculated: RF, mean retention time, standard deviation, coefficient of variation and the RT window (±3%).
Daily continuing calibration.
All raw data for the initial and continuing calibrations.
Calculate %D.
Chromatograms and area results/quantitation report.
Date and time of analysis.
Report on CLP forms 6 and 7 equivalent.

Blanks:

Method - daily.
Date and time of analysis.
Report on CLP Form 4 equivalent.
Include all raw data.

Duplicate:

Each batch will contain one sample for duplicate analysis.
Date and time of analysis.
Calculate and report the RPD.
Report on CLP Form 3 equivalent.

Surrogates:

Spike into all blanks, standards, samples, and sample duplicates.
Surrogate retention times.
Report the area and the % recovery.
Report on CLP Form 2 equivalent.

Documentation:

Copy of chain of custody.
Copy of airbill.

Analysis of Gas Samples for Volatile Organic Compounds by EPA Method TO-2

Analytes:

	Quantitation Limit (ppbv)*
Vinyl Chloride (VC)	0.02
Benzene (0)	0.01
Methylene Chloride ($MeCl_2$)	0.10
Chloroform	0.01
1,2,-Dichloroethane (1,2-DCA)	0.01
1,1,1-Trichloroethane (1,1,1-TCA)	0.02
Carbon Tetrachloride	0.01
Trichloroethylene (TCE)	0.01
Tetrachloroethylene (PCE)	0.01
1,2-Dibromoethane (EDB)	0.01

*These quantitation limits are obtained with "clean" samples. Interfering compounds may elevate the quantitation limits.

Matrices: Gas samples collected in Supelco Carbotrap 300 thermal desorption tubes. Desorption tube cleaning and verification of cleanliness is also required.

Analytical Method: EPA Method TO-2. See analytical requirements listed for Method TO-14.

Cartridge Cleaning and Verification: Sorbent tube cleaning, as described in Section 9 of Method TO-2, is required. After cleaning, it is considered acceptable if not individual analyte is present at a detectable concentration. After cleaning, 10% of all sorbent tubes will be analyzed for verification of the cleaning procedure. Sorbent tubes will not be reused.

Sorbent cleaning deliverables are equivalent to those described for Method TO-14.

QA/QC Requirements: Holding Time < 30 days from sample collection.

All analytical requirements and deliverables should follow those described for Method TO-14.

APPENDIX C - CONTENTS

APPENDIX C

FIELD FORMS

Revision Date: January 1989

1. FIELD EQUIPMENT LOG

Equipment Number ____________________ Page ____ of ____

Equipment Description ____

1. CALIBRATION 2. CLEANING 3. MAINTENANCE

Personnel Qualified to Operate and Maintain

Reviewed By ________________________________ Date/Time ______________

Entries Complete? [Y or N] _______

UNIFIED SOIL CLASSIFICATION SYSTEM

GRADATION AND PLASTICITY CHARACTERISTICS (Excluding particles larger than 3 in.)					GROUP SYMBOL	SOIL NAMES
PREDOMINANTLY COARSE-GRAINED More than 50% of soil retained by No. 200 Sieve	GRAVEL More than 50% of coarse-grained fraction retained by No. 4 sieve	CLEAN Less than 5% fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	GW	Well-graded GRAVEL or SANDY GRAVEL
				Not meeting all gradation requirements for GW	GP	Poorly graded, uniform, or gap-graded GRAVEL or SANDY GRAVEL
		WITH FINES More than 12% fines*		Atterberg limits below A-line or PI less than 4	GM	SILTY GRAVEL
				Atterberg limits above A-line with PI greater than 7†	GC	CLAYEY GRAVEL
	SAND More than 50% of coarse-grained fraction passes No. 4 sieve	CLEAN Less than 5% fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	SW	Well-graded SAND or GRAVELLY SAND
				Not meeting all gradations requirements for SW	SP	Poorly graded, uniform, or gap-graded SAND or GRAVELLY SAND
		WITH FINES More than 12% fines*		Atterberg limits below A-line or PI less than 4	SM	SILTY SAND
				Atterberg limits above A-line with PI greater than 7†	SC	CLAYEY SAND
PREDOMINANTLY FINE-GRAINED More than 50% of soil passes No. 200 sieve	Plasticity characteristics of fraction passing No. 40 sieve	SILT Atterberg limits below A-line or PI less than 4	INORGANIC	Liquid limit less than 50	ML	Nonplastic, slightly plastic, or moderately plastic SILT, CLAYEY SILT, SANDY SILT, or GRAVELLY SILT
				Liquid limit greater than 50	MH	Highly plastic or very highly plastic SILT, CLAYEY SILT, SANDY SILT, or GRAVELLY SILT
			ORGANIC	Liquid limit less than 50	OL	Slightly plastic or moderately plastic ORGANIC SILT (ORGANIC CLAY if Atterberg limits above A-line)
				Liquid limit greater than 50	OH	Highly plastic or very highly plastic ORGANIC SILT(ORGANIC CLAY if Atterberg limits above A-lin
		CLAY Atterberg limits above A-line with PI greater than 7†		Liquid limit less than 50	CL	Slightly plastic or moderately plastic CLAY, SILTY CLAY, SANDY CLAY, or GRAVELLY CLAY
				Liquid limit greater than 50	CH	Highly plastic or very high plastic CLAY, SILTY CLAY, SANDY CLAY, or GRAVELLY CLAY
HIGHLY ORGANIC (identified by spongy feel)					Pt	PEAT

*Predominantly coarse-grained soil with 5% to 12% fines is borderline case requiring use of dual symbol, such as GW-GC or SM-SP.

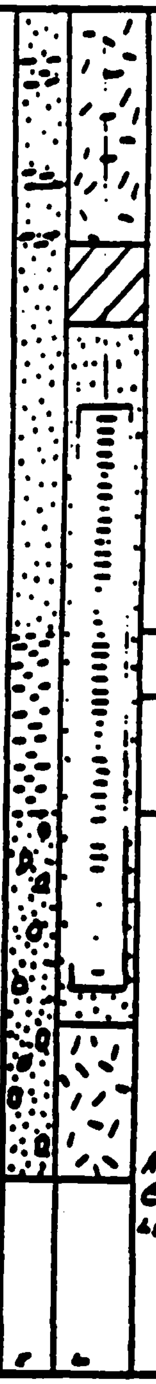
†Atterberg limits above A-line with PI between 4 and 7 is borderline case requiring use of dual symbol, GC-GM or SC-SM for predominantly coarse-grained soil or CL-ML for predominantly fine-grained soil.

REV. DATE: JAN 1989

BORING LOG

BORING/WELL NO.: MW-237
Page 1 of 2
Installation: HIGHTOP A.F.B.
Site: FTA-34
Project No.: 28-247
Client/Project: HAZWRAP/TAC/IRP
HAZWRAP Contractor: E.C. Jordan
Drlg Contractor: J.N. Ranwater Drlg. Assn.
Driller: J. Royce
Drlg Started: 6/11/88 (8:45 Am)
Drlg Ended: 6/11/88 (6:25 Pm)
Borehole dia(s): 8¼
Drlg Method/Rig Type: HSA-CME-55
Logged by: Bob Branston
E-Log (Y/[✓ N]) From ________ to ________
Protection Level: D

Depth (ft)	Sample	Sample No.	Lab Anal (Y/N)	HNU (ppm)	(ppm)	Recovery (ft)	Lithologic Description	USCS	Blows/6 inch
0–5	☒	S-1	Y	0 50 80 10	250+	1.8/2.0	SAND fine to med (80%), Brownish Yellow (10YR 7/3), dirty w/ CLAY (20%) partially laminated, dry to damp	SP/CL	
10–12	☒	S-2	N	3	0	.5/2.0	SAND: fine, Brownish Yellow (10YR 7/3), clean dry, well sorted w/ 1" laminations	SP	3 4 4 4
17–19	☒	S-3	N	0	0	2.0/2.0	CLAY dark brown (10YR 4/3), very moist, ½" to ¼" laminations throughout	CH	3 3 9 10
23–25	☒	S-4	Y	0	0	1.4/2.0	SAND fine to medium (70%), Brown (10YR 7/4), clean, poorly sorted; GRAVEL, medium (30%), well rounded, wet.	SW/GM	5 5 8 8
30							TD @ 30ft		



Water depth & Remarks / Elev.:
1106.75
Fell Down @ 4-6'
6/13/88 1101.63' — 15.7
6/14/88 1:50 — 18.3
6/11/88 1:30 — 20.5
Refusal @ 30ft, LA Formation?

A B C D E F G H I J K L M N

U = Thin wall tube
S = Split spoon (tube)
C = Cuttings
R = Rock coring ________
O = Other [illegible]
Notes: ________
Field G/C (Make/Mod) PhotoVac 10S70
G/C Oper.: E. Alexander

REV. DATE: JAN

BORING LOG

BORING/WELL NO.:

Page ____ of ____

Installation:

Site:

Project No.:

Client/Project:

HAZWRAP Contractor:

Drlg Contractor:

Driller:

Drlg Started: (: __ m)

Drlg Ended: (: __ m)

Borehole dia(s):

Drlg Method/Rig Type:

Logged by:

E-Log (Y/N) From ________ to ________

Protection Level:

Depth (ft)	Sample	Sample No.	Lab Anal (Y/N)	RQD ( )	Recovery ( )	Lithologic Description	USCS	Blows/6 inch.	Graphic Log	Well data	Water d	Re

U = Thin wall tube

S = Split spoon (tube)

C = Cuttings

R = Rock coring ________

O = Other ________

Notes: ________

Field G/C (Make/Mod.) ________

G/C Oper.: ________

EXPLANATION OF MONITORING WELL CONSTRUCTION LOG

The majority of items on this form are self-explanatory. However, some items deserve further clarification.

- Height refers to length above or below ground surface to the nearest tenth of a foot. Elevation is that above mean sea level to the nearest 0.01 ft.
- BGS = below ground surface. TD = total depth. TOC = top of casing. TOS = top of screen.
- Depths and lengths to the nearest 0.1 ft should be supplied within the blocks in the lower left portion of these figures. Borehole diameters should be in inches.
- Under the heading "Built By": include both drilling contractor personnel and prime contractor personnel involved in the well completion.

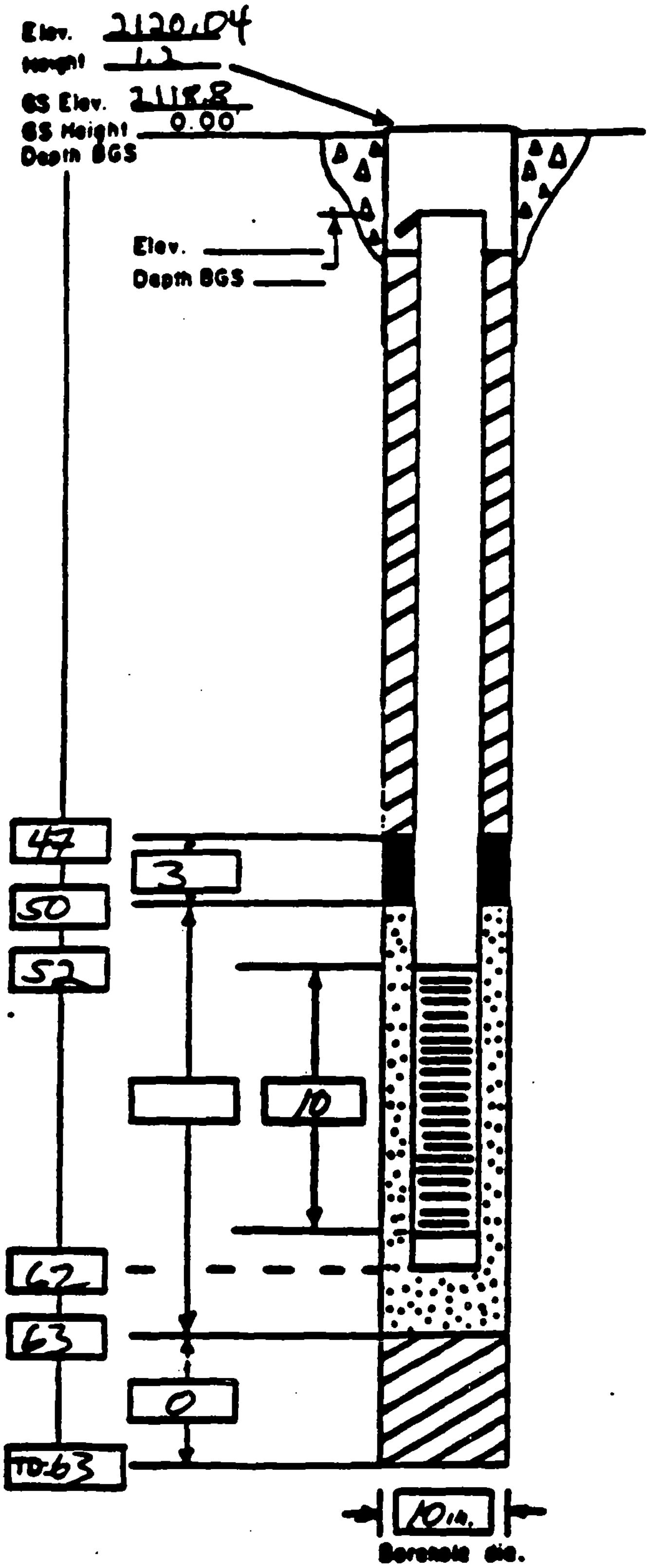
As with the boring log form, this form can be neatly and legibly filled out in the field. Some items such as surveyed well coordinates, however, will require completion in the office.

For unique well completions that do not correspond to any of the six forms provided, modifications to these forms should be made appropriately while maintaining the general format of the forms. These modified forms must have concurrence from the HAZWRAP project staff.

REV. DATE: JAN 1989

MONITORING WELL CONSTRUCTION LOG - Standard Flush Mount

WELL NO.: MW165	Installation: Norton AFB	Site:
Project No.: 7400	Client/Project:	
HAZWRAP Contractor: CDM/FPC	Drlg Contractor: Layne Western	
Comp. Start: 2/20/90 (11:20 am)	Comp. End: 2/20/90 (5:00 pm)	
Built By: Layne WESTERN	Well Coord.:	



PROTECTIVE CSG
Material/Type STEEL
Diameter 8 inches Water Tight Seal ([✓ Y]/N)
Depth BGS 6 inch Weep Hole (Y/N)

SURFACE PAD
Composition & Size Cement - 2 ft x 2 ft

RISER PIPE
Type Schedule 80 PVC
Diameter 4 inch ID
Total Length (TOC to TOS) 52

GROUT
Composition & Proportions Bentonite (Quickseal) + TYPE II Alkali Cement
Tremied ([✓ Y]/N)
Interval 0-47

CENTRALIZERS (Y/[✓ N])
Depth(s)

SEAL
Type Bentonite Pellets
Source
Setup/Hydration time 1 hr Vol. Fluid Added NA
Tremied (Y/[✓ N])

FILTER PACK
Type Monterey #3
Amt Used 10 bags
Tremied (Y/[✓ N])
Source Lonestar
Gr. Size Dist. See #3 specs

SCREEN
Type PVC
Diameter 4 inch
Slot Size & Type 0.010
Interval BGS 52-62

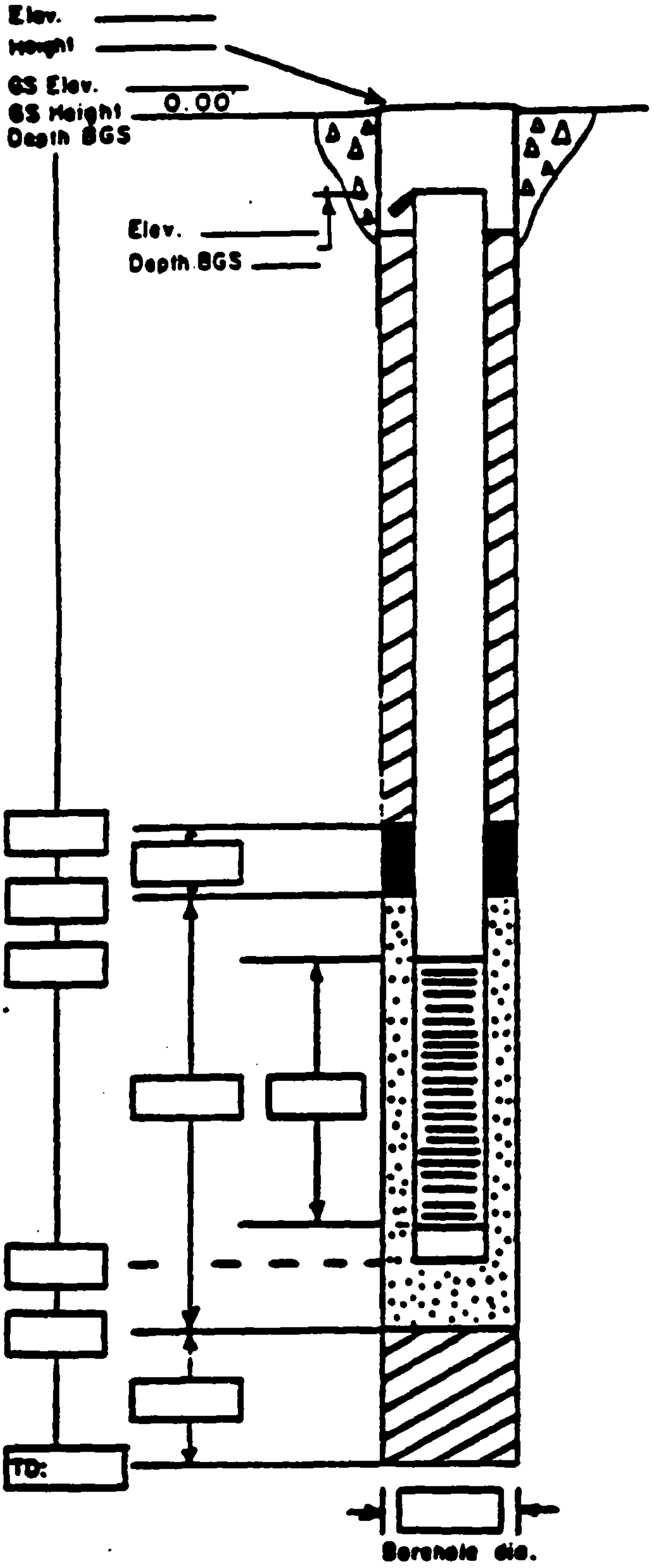
SUMP (Y/[✓ N])
Interval BGS Length
Bottom Cap ([✓ Y]/N)

BACKFILL PLUG
Material NA
Setup/Hydration time
Tremied (Y/N)

REV. DATE: JAN 1989

MONITORING WELL CONSTRUCTION LOG - Standard Flush Mount

WELL NO.:	Installation:	Site:
Project No.:	Client/Project:	
HAZWRAP Contractor:	Drlg Contractor:	
Comp. Start: (: __m)	Comp. End: (: __m)	
Built By:	Well Coord.:	



PROTECTIVE CSG

Material/Type ____

Diameter ____ Water Tight Seal (Y/N)

Depth BGS ____ Weep Hole (Y/N)

SURFACE PAD

Composition & Size ____

RISER PIPE

Type ____

Diameter ____

Total Length (TOC to TOS) ____

GROUT

Composition & Proportions ____

Tremied (Y/N)

Interval ____

CENTRALIZERS (Y/N)

Depth(s) ____

SEAL

Type ____

Source ____

Setup/Hydration time ____ Vol. Fluid Added ____

Tremied (Y/N)

FILTER PACK

Type ____

Amt Used ____

Tremied (Y/N)

Source ____

Gr. Size Dist. ____

SCREEN

Type ____

Diameter ____

Slot Size & Type ____

Interval BGS ____

SUMP (Y/N)

Interval BGS ____ Length ____

Bottom Cap (Y/N)

BACKFILL PLUG

Material ____

Setup/Hydration time ____

Tremied (Y/N)

EXPLANATION OF WELL DEVELOPMENT LOG

Page one of this form is assumed to be self-explanatory and must be filled out for every well during development. Under the heading "Developed By:," include the names of both development (drilling) contractor personnel and prime contractor personnel involved in the well development.

Page two, the plot of postdevelopment water level recovery, should be used as appropriate whenever this task is specified for a project. The water level recovery graph should be plotted for each well immediately following the well development/pumping process but in general should not extend over a period of more than approximately 30 min. If water level recovery to 90% of the original static water level occurs over a period of a few minutes, the recovery plot can be shortened. Conversely, if the need exists, the 30-minute time period can be extended as appropriate.

REV. DATE: JAN 19[illegible]

WELL DEVELOPMENT LOG

WELL NO.:		Page ____ of ____
Installation:		Site:
Project No.:	Client/Project:	
HAZWRAP Contractor:	Dev. Contractor:	
Dev. Start: (: __m)	Dev. End: (: __m)	Csg Dia.:
Developed by:		Dev. Rig (Y/N)

Dev. Method ____

____

____

Equipment ____

____

Pre-Dev. SWL ____________ Maximum drawdown during pumping ________ ft at ________ gpm

Range and Average discharge rate ______________________ gpm

Total quantity of material bailed ______________________

Total quantity of water discharged by pumping ______________________

Disposition of discharge water ____

____

____

Time	Volume Removed (gal)	Water Level ft.BTOC	Turbidity	Clarity/ Color	Temp. °C	pH	Conductivity	Remarks

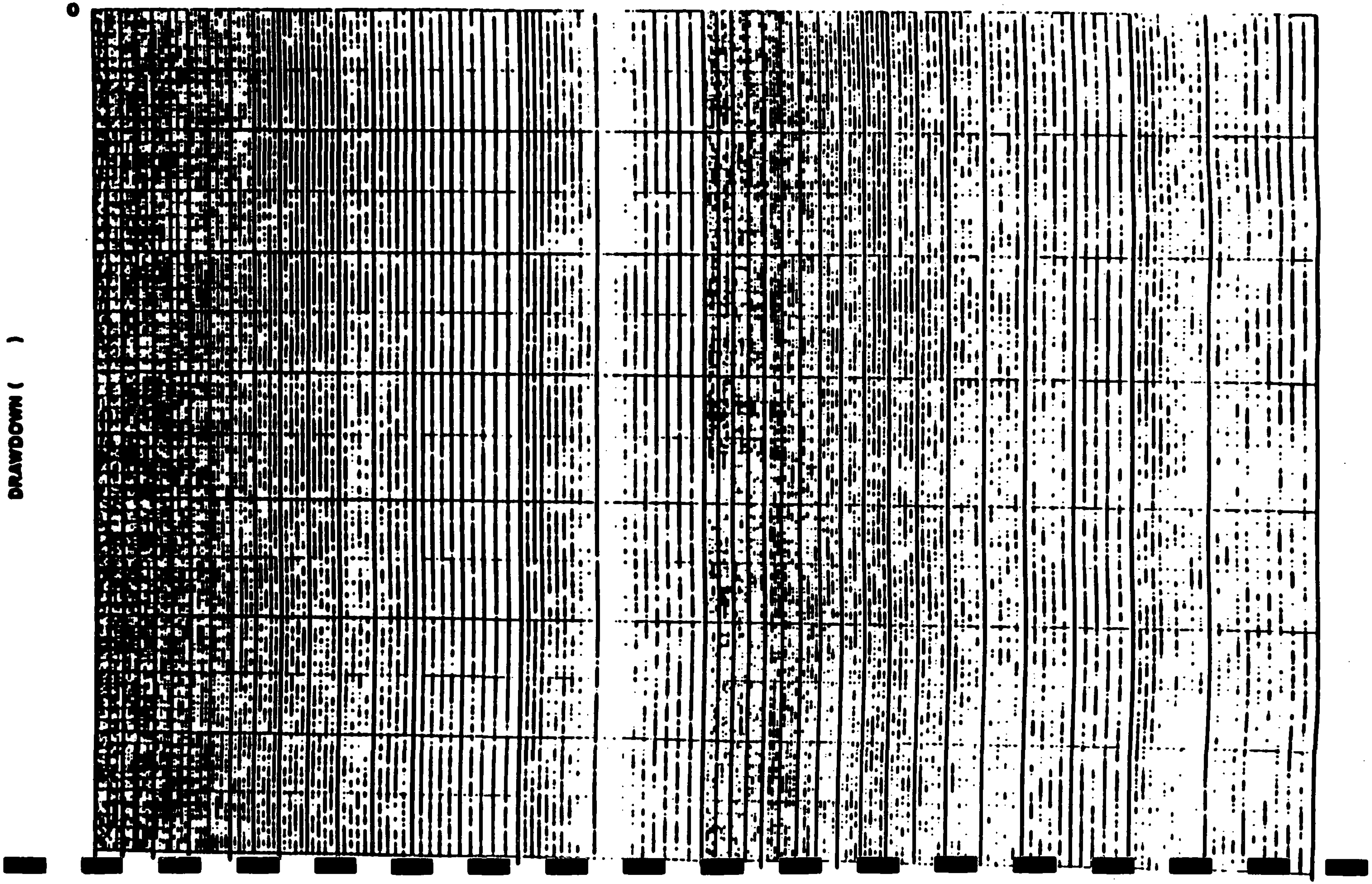
POST DEVELOPMENT WATER LEVEL RECOVERY GRAPH

REV. DATE: JAN 1989

Well Recording Instrument ____________________

Start Recovery: ________ (: __m) End Recovery: ________ (: __m) Total Recovery Time __________

Beginning WL ____________ Final SWL ______________



Camp Dresser & McKee Inc. **Sample Label** **F6261**

Sample ID **Project** **Type** **Station** **Number** **Replicate**

Code __________ __________ __________ __________ __________

Hazardous ____________________, **Environmental** ____________________

Collected by ____________________, **Date** ______________, **Time** __________

Witnessed by ____________________, ____________________, ____________________

Container Prepared by ______________ **Preservative** **Yes** **No** **Type** _____

References/Notes ____

____

Laboratory ____________________ **Lab No.** ____________________

Sample Label Example

-626

CDM

CHAIN OF CUSTODY RECORD

Camp Dresser & McKee Inc.

PROJECT NAME ______________________

PROJECT NUMBER ______________________

Field Log Book
Reference No. _____

LEGEND: Original: Return to [illegible] File Control Center   Copies: Ship with Samples

FOUR PART FORM

SAMPLE NUMBER			DATE	TIME	SAMPLE LOCATION	SAMPLE TYPE	ANALYSES									NUMBER OF CONTAINERS	LOG BOOK PG NO	REMARKS
							EXTR ORG	VOA	PEST PCB	TRACE METALS								

SAMPLED BY (SIGN)

________ / ________ / ________ / ________

RELINQUISHED BY (SIGN) ① ________ DATE/TIME (/)	RELINQUISHED BY (SIGN) ② ________ DATE/TIME (/)	RELINQUISHED BY (SIGN) ________ DATE/TIME (/)	RELINQUISHED BY (SIGN) ④ ________ DATE/TIME (/)	RELINQUISHED BY (SIGN) ⑤ ________ DATE/TIME (/
RECEIVED BY (SIGN) ① ________ DATE/TIME (/)	RECEIVED BY (SIGN) ② ________ DATE/TIME (/)	RECEIVED BY (SIGN) ③ ________ DATE/TIME (/)	RECEIVED BY (SIGN) ④ ________ DATE/TIME (/)	RECEIVED BY (SIGN) ⑤ ________ DATE/TIME (/

METHOD OF SHIPMENT	SHIPPED BY (SIGN)	RECEIVED FOR LABORATORY BY (SIGN)	DATE/TIME

CUSTODY SEAL

SIGNATURE ____________________

DATE ____________________

Revision Date: January 1989

7. FIELD CHANGE REQUEST FORM

Field Change No.________
Page _____ of _____

Project ______________________________

Project No.______________________________

Applicable Document:______________________________

Description:

____

____

____

Reason for change:

____

____

____

Recommended disposition:

____

____

____

Impact on present and completed work:

____

____

____

Final Disposition:

____

____

____

Requested by:
Field/Project Manager:______________________________

Approvals:
HAZWRAP Project Manager:______________________________

FIGURE 8-1

APPENDIX D

STANDARD OPERATING PROCEDURES

APPENDIX D - CONTENTS

Standard Operating Procedure 5-1-1

INVESTIGATION-DERIVED WASTES

1.0 INTRODUCTION

The purpose of this standard operating procedure for investigation-derived wastes is to:

- Provide general guidelines for the identification of potentially hazardous chemicals and materials.
- Provide general guidelines for the control and handling of investigation-derived wastes.
- Establish a necessary inter-office notification network for resolving problems that may arise

Wastes may result during site investigations and remedial activities at Superfund (CERCLA/SARA) sites as well as during investigations or inspections at operating RCRA facilities. The investigation-derived wastes from these activities must be handled, treated or disposed in the proper manner. The following procedures should generally be followed during field-related activities and tailored to the site-specific conditions and objectives of the field activities. The program manager for the specific contract under which the field activities are being conducted should be consulted for general guidance and resolution of specific issues that arise at a particular site.

2.0 WASTE CATEGORIES

Field activities that include monitoring well installation, sampling of surface and ground waters, and sampling of other media often result in environmental and/or hazardous samples being collected for analysis. In addition, there are materials that result from such field activities that will be not be packaged and sent to a laboratory for testing. A representative list of wastes that may be routinely produced, is as follows:

- **Expendable personal protection equipment: tyvek, gloves, booties, respirator cartridges, and empty calibration gas bottles.**

- **Ground water and surface water samples that are not being shipped for laboratory analysis.**

Prepared: ______	**Reviewed:** ______	**Approved for Release:** ______
Date: ______	**Date:** ______	**Date:** ______

- Drilling fluids, cuttings and core samples from well installation.
- Decontamination fluids such as water, solvents, or other mixtures.
- Purged water from wells prior to ground water sampling.
- Drum Sampling equipment.

3.0 GENERAL GUIDELINES

Generally, the following guidelines should be considered during the planning phase for the field activities:

- In the appropriate project operation plan, such as the sampling and analysis plan, health and safety plan, and/or QA/QC plans, the site specific procedures for the identification of investigation-derived waste and the handling of such waste must be specified.
- The program manager should be consulted on a site specific basis regarding the handling (storage, transport, or disposal) of investigation-derived hazardous substances.
- **No generated waste during field activities should be transported off site by CDM employees. The only permissible exception to this policy is the off-site shipment of samples being sent to a laboratory for analysis.**

4.0 CERCLA ACTIVITIES

Pursuant to CERCLA 121, CERCLA remedial activities must be carried out in accordance with federal and state requirements. EPA's policy is that field investigation teams should use best professional judgment in determining when investigation-derived wastes contain appreciable amounts of hazardous waste and then should be handled properly so that federal and state standards are met. When the field team does not know the specific hazard of the waste, EPA expects that reasonable attempts to comply with federal and state requirements will be made. Currently, the general practice is that investigation-derived materials can remain onsite until the remedial activities are complete.

Prior to the any site activities, the field team should determine if the investigation-derived wastes may contain hazardous wastes and identify the logistics required for the proper handling of such wastes.

EPA shall be consulted to ensure that public health and the environment are protected. The field investigation team should address the following considerations and consult with the EPA regional office, if necessary:

- o Determine the likelihood and probability that hazardous waste will be generated from the field activities. This may be accomplished by review of site records, pertinent data and other available information.

- o Identify the sampling procedures in the sampling and plan and address the issue of investigation-derived waste.

- o If sampling of ground water and soil in areas of known or suspected areas of significant contamination is to occur, then purged water or waste samples should be segregated and contained. Certain exceptions to this practice may be allowed with prior EPA consultation and approval (for example, discharging purged water onto the ground). **However, it must be emphasized that off-site transport/storage of such materials by CDM employees is prohibited.**

- o If materials need to be collected in drums or other containers, solids should be segregated from liquids. The drums or containers must be clearly labeled.

- o Disposable protective clothing is segregated and shall be placed in large industrial grade plastic bags and/or 55 gallon drums.

- o Non-disposable items such as boots, sampling equipment, and other field equipment shall be decontaminated using the appropriate decontamination solutions and procedures prior to taking off site.

- o Any wash waters used for decontamination shall be collected in properly labeled drums for disposal on site.

5.0 RCRA ACTIVITIES

Generally, for an investigation or inspection at a RCRA facility, any investigation-derived waste can be handled in the appropriate manner by the RCRA facility. Coordination with the facility manager, prior to the site visit is necessary. The field investigation team should explain the purpose of the visit and list the anticipated investigation-derived wastes that may result. Written documentation is necessary to indicate that the handling of such wastes has been discussed with the facility and that the facility concurs with the waste being left onsite. Documentation may be a letter to the facility, or a telephone log. A CDM field team shall not commence any field sampling activities until arrangements have been made with the facility regarding the handling of the investigation-derived wastes.

6.0 GUIDELINES FOR TRANSPORTING WASTES OFF SITE

When a hazardous waste as defined in 40 CFR Part 261, Subparts C and D, is known or expected to result from field activities, then the field investigation team should be aware that the handling and managing of these wastes off-site must meet the treatment, storage and disposal requirements of RCRA. Guidance for this determination is provided in Exhibits 1, 2, 3, and 4.

In certain instances, contractors may be tasked by EPA to provide assistance with offsite transport of wastes to a treatment/storage/disposal (TSD) facility. In these cases, strict adherence to 40 CFR Part 262 is required.

CERCLA 121(c)(3)(B) requires off-site storage, destruction, treatment, or secure disposition of hazardous substances from Superfund sites to be done at hazardous waste disposal facilities that are in compliance with Subtitle C of RCRA. In this situation, EPA is the generator of the hazardous waste and must comply with the requirements of 40 CFR Part 262, Standards Applicable to Generators of Hazardous Waste and which include:

- Subpart A: General
- Subpart B: The Manifest
- Subpart C: Pre-Transport Requirements
- Subpart D: Recordkeeping and Reporting

Pursuant to 40 CFR Part 262, EPA must:

- Initiate notification.
- Obtain the appropriate EPA ID number.
- Complete EPA form 8700-22 and 8700-22A, Uniform Hazardous Waste Manifest (refer to Exhibit 1).

Standard Operating Procedure 4-1-0

ENVIRONMENTAL SAMPLE SHIPPING

1.0 Application

Shipment of environmental samples (samples of ambient air, water, or soil with little contamination) from a field location to a laboratory. This procedure is summarized in Exhibit 1.

2.0 Packing the Sample

- Leave enough outage (10% by volume) in the sample jar to accommodate thermal expansion.
- Place the sample container, sealed with a lid, in a polyethylene bag.
- Attach a sample identification tag to the jar. Seal the bag.
- Place the bagged sample(s) in a fiberboard container or picnic cooler lined with a large polyethylene bag.
- Pack enough non-combustible, absorbent, cushioning material around the samples to minimize the possibility of container breakage.
- Place the chain-of-custody sheets and the CLP traffic reports in a plastic bag. Tape the bag to the cooler's lid on the inside.
- Seal the large bag.
- Close the cooler with strapping tape and seal it on two sides with custody seals.

3.0 Marking and Labeling

- Mark the outside container; "Environmental Sample" and "This End Up" with arrows placed accordingly. No Department of Transportation (DOT) marking or labeling is required.

4.0 Shipping Papers

- Attach the carrier's waybill form to the cooler. No DOT papers are required.

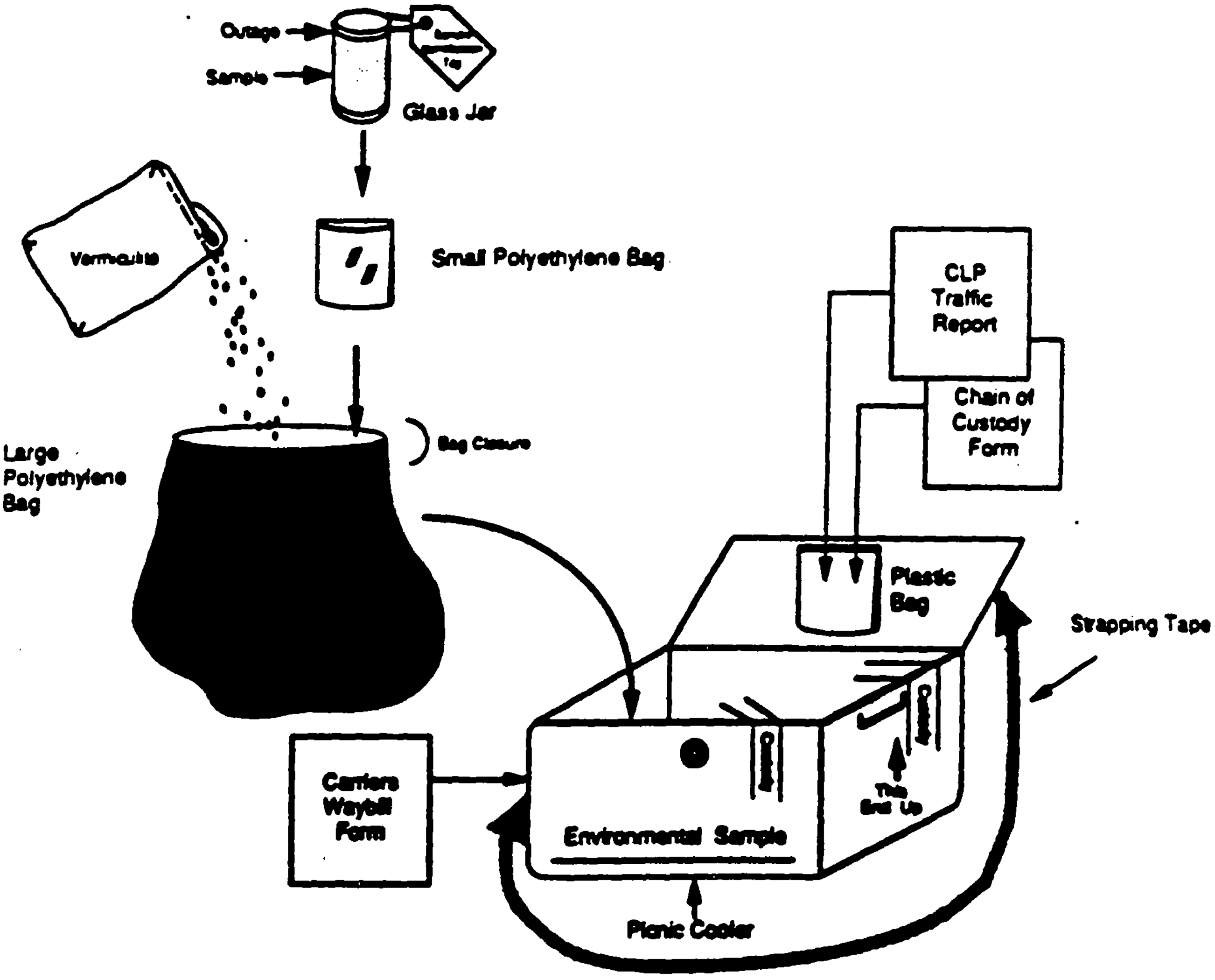
5.0 Modes of Transportation

- The shipment may travel on any mode of transportation.

Prepared: CSEN	Reviewed: MSM	QA: RME	Approved: GAO	Issued:
Date: 2/1/89	Date: 3/30/89	Date: 6/5/89	Date: 6/13/89	Date: 6/13/89

EXHIBIT 1

ENVIRONMENTAL SAMPLE PACKAGING PROCEDURES



Procedure: 5607013
Revision: 0
Date: 4/85
Page: 1 of 5

GENERAL CONSIDERATIONS FOR METEOROLOGICAL MONITORING

1.0 INTRODUCTION

The following discussion defines a general program developed for monitoring wind speed and direction at an uncontrolled hazardous waste site. The program is generic in the sense that equipment specific protocols are dependent on the type of equipment used. Wind monitoring will provide real time continuous on-site data essential for operational safety procedures during clean-up operations.

2.0 SITING AND INSTALLATION

Proper equipment siting along with good instrumentation is a critical factor in obtaining good meterological data. The obvious objective in siting wind recording instruments is to place the equipment in a location that characterizes air flow in the general site area as well as the impact areas of concern. The wind instruments should be located at the standard exposure height of 10 meters in open terrain. Locating the equipment in open terrain will ensure that the equipment will not be exposed to disturbed air flow resulting from air interactions in and around obstructions. Obstructions can be buildings, fences, signs, trees, vegetation, elevated terrain, or any other object that would unduly influence the general air flow in the area. Open terrain is defined as an area where the distance between the instrument and any obstruction is at least 10 times the height of the obstruction. This convention is adopted by the World Meteorological Organization (WMO) and is generally observed in order to compare recorded data to other observed wind data. Secondary considerations should also be taken into account but should not be allowed to compromise the quality of the recorded data. Secondary considerations include accessibility as well as equipment security.

The instrument should be firmly positioned on a mast or tower which will not twist, rotate, or sway. Wind instruments mounted on the roof of a building should be placed high enough to be out of the area in which air flow is disturbed. This height can be determined using standard WMO and EPA guidelines.

Orientation of the wind vane to the true north is another necessity in instrument siting. Equipment manufacturers will provide some means to identify which way to align the translator to the north. This is usually accomplished by an engraving mark on the equipment housing or by supplying, as an option, a mounting jig for keeping the vane in proper alignment for orientation. This jig is also handy for periodic calibration of equipment which is described in section 3.2 on calibration.

The most accepted procedure for determining true north involves shooting the North Star with a first-order theodolite. A land surveying handbook will describe this technique and contain all the necessary tables. The preferred method of establishing true north is to utilize a registered land surveyor who may be involved in the project to carry out the above mentioned procedure. USGS maps of the site area also give the compass declination. Another acceptable method to establish true north is by the location of the sun at solar noon. This can be accomplished by using an empirical formula based on the site's longitude and "Equation of Time" found in standard Meterological tables (List, 1979).

3.0 OPERATION

3.1 Equipment Maintenance

Operational checks are important to assure the best quality data. The use of time marks on chart rolls is a very effective means to check the recorder clock mechanism. This can be done manually and should be performed every 24 hours.

The establishment of a preventive maintenance program and the performance of operational checks will ensure the highest possible quality data. Operational checks include time syncs, data retrival, data inspection and visual equipment inspection. The anemometer should never come to an abrupt stop or start but should come to a slow start and stop. Abrupt stopping and starting of the anemometer would indicate worn bearings. Bearings can be checked with a torque watch. Oilless bearings should never be oiled. Bearings should be replaced every 12 months. Other operational/maintenance items include system cleaning, tightening, lubricating and a zero and span adjustment every time the strip chart is replaced (frequency determined by type of equipment, refer to equipment specification for frequency). Physical checks of the equipment should be made as often as possible, at least monthly. These checks include an examination of the sensors and the readout equipment. At some locations with heavy pollution, it may be necessary to routinely change the bearings in both the anemometer and vane housing.

Light freezing rain with little wind is the most detrimental condition for cups and especially for propellers. It has been found that a LIGHT spray coating of SILICONE, or an equivalent non-sticking spray, helps to retard the formation of ice. Spare parts for anemometers and vanes should include replacement bearings. A log should be kept on all maintenance and operational checks.

3.2 Equipment Calibration

There are two basic types of calibrations: bench and field. The bench calibration is conducted under controlled laboratory conditions (i.e., wind tunnel) where known inputs are compared to observed outputs. Adjustments are then made to equalize output to input. Bench calibrations may be performed by the manufacturer or by the user, providing the proper equipment is available. During a bench calibration, it is desirable to simulate as closely as possible the field configuration of the sensor system. How often field calibrations are needed depends upon the length of the measurement program and the stability of the specific instrument. (Stability is the time period an instrument is expected to retain its calibration.) If portable mobile instrumentation is available, bench calibrations may actually be possible on site, minimizing down time.

Bench calibrations check specific dynamic response characteristics such as threshold speeds, damping ratios, delay distances and distant constants which can only be checked in a wind tunnel, and must be performed by qualified personnel or returned to the manufacturer for major calibration.

Field calibrations would check the output of the transducer by coupling the anemometer shaft through a flexible, universal connector to a synchronous motor and gear assembly that will run at a fixed, known RPM. Calibration units are commercially available with 1800 RPM or 300 RPM output when powered by standard 60 Hz line voltage (115 V).

Calibrating the electronic system exclusive of the sensor/trasducer involves the substitution of a stable, known voltage for a voltage generator, or a known frequency for a frequency generator.

Some equipment contains an internal calibration mechanism to check the system electronics. This is usually accomplished by a built-in reference frequency (or voltage) to supply a known value to check the anemometer system electronics excluding the sensor/translator but including the readout device. The wind vane system electronics can be checked using precision resistors and comparing the known values to the output. The output of the wind vane itself can be compared using a test fixture which allows the wind vane potentiometer to be set at certain directions. With these set directions known, the readout can be verified. It is also useful to rotate the vane both clockwise and counter clockwise observing the readout. The size of the gap where there is no electrical signal is significant in single potentiometer, 360-degree direction vanes. The fidelity with which the transition at north is made is significantly improved in 540-degree direction vanes.

Field calibration or calibration checks should be performed at least once every 3 months.

COAST - TO - COAST ANALYTICAL SERVICES

Air, Water & Hazardous Waste Sampling, Analysis & Consultation
Certified Hazardous Waste, Chemistry, Bacteriology & Bioassay Laboratories

141 Suburban Road • San Luis Obispo, CA 93401 • (805) 543-2553 • Fax (805) 543-2685
751 S. Kellogg, Suite A • Goleta, CA 93117 • (805) 964-7838 • Fax (805) 967-4386
1885 North Kelly Road • Napa, CA 94558 • (707) 257-7211 • Fax (707) 226-1001
9333 Tech Center Dr., Ste. 800 • Sacramento, CA 95826 • (916) 368-1333 • Fax (916) 362-2484
2400 Cumberland Dr. • Valparaiso, Indiana 46383 • (219) 464-2389 • Fax (219) 462-2953

COAST-TO-COAST ANALYTICAL SERVICES
AIR SAMPLING PROCEDURE
SUBATMOSPHERIC "GRAB" TECHNIQUE

Equipment:

1) Stainless steel SUMMA canister, evacuated to -29.5"Hg

2) Teflon, stainless steel or copper tubing, 1/4" OD with 1/4" swagelok fittings attached.

3) Vacuum gauge 0 to -30"Hg in 1" increments.

Procedure:

1) Connect vacuum gauge to sample canister, open valve, check and record initial vacuum, close valve, remove vacuum gauge.

2) Attach a length of tubing, of appropriate length, to the sample canister.

3) Connect or position the opposite end of the tubing in such a way so as to access the sampling point.

4) Open the valve for a period of 30 to 60 seconds.

5) Close the valve, disconnect the tubing and attach a label to the sample canister with pertinent sample information.

Discussion:

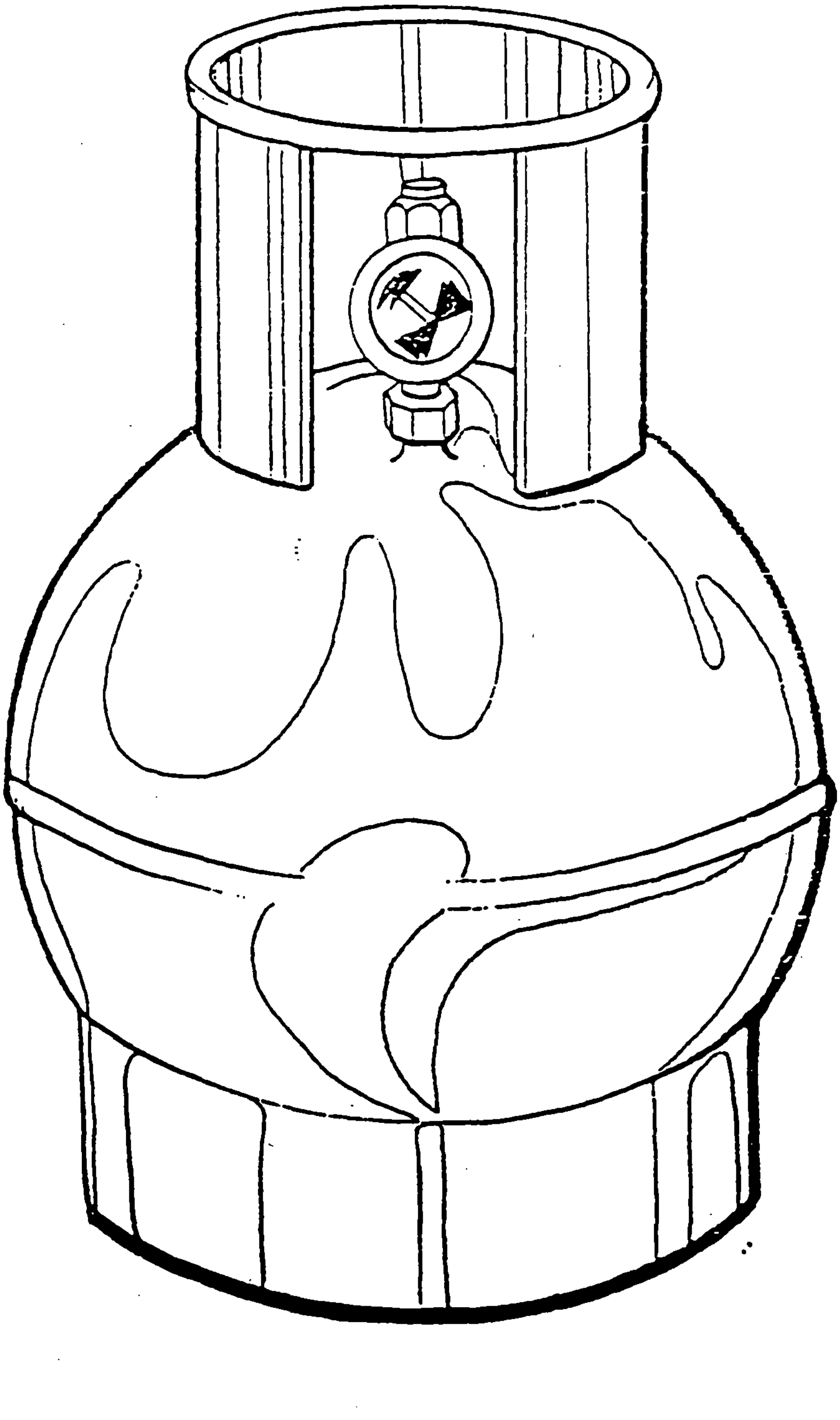
When opened to the atmosphere containing the VOC's to be sampled, the differential pressure causes the sample to flow into the canister. The tubing is used to access an otherwise awkward sampling point, eg. tank headspace, manhole, monitoring well, exhaust stack etc., and may be omitted if unnecessary.

11/11/90
RFP4

COAST - TO - COAST ANALYTICAL SERVICES

Air, Water & Hazardous Waste Sampling, Analysis & Consultation
Certified Hazardous Waste, Chemistry, Bacteriology & Bioassay Laboratories

141 Suburban Road • San Luis Obispo, CA 93401 • (805) 543-2553 • Fax (805) 543-2685
751 S. Kellogg, Suite A • Goleta, CA 93117 • (805) 964-7838 • Fax (805) 967-4386
1885 North Kelly Road • Napa, CA 94558 • (707) 257-7211 • Fax (707) 226-1001
9333 Tech Center Dr., Ste. 800 • Sacramento, CA 95826 • (916) 368-1333 • Fax (916) 362-2484
2400 Cumberland Dr. • Valparaiso, Indiana 46383 • (219) 464-2389 • Fax (219) 462-2953



SUMMA POLISHED SAMPLING CANNISTER

COAST TO COAST ANALYTICAL SERVICES

CRYOGENIC GRAB SAMPLING METHOD
FOR
VOLATILE ORGANIC COMPOUNDS IN AIR

Equipment needed:

1) Six liter SUMMA-Stainless Steel sampling canister (Can). Sample Cans are supplied under vacuum.
2) Teflon (TFE) tubing 1/4 inch diameter by 2 feet in length. The TFE tubing must have a ferrule attached, and a 1/4 inch brass swagelok nut in place.
3) Ice chest, 34 quart minimum.
4) Liquid Nitrogen (LN_2), 25-30 liters. More LN_2 may be required if many samples are to be collected.
5) Gloves suitable for use with cryogenic liquids, safety glasses, protective clothing.

Procedure:

1) Exercise care when handling cryogenic liquids. Wear proper protective clothing. Check site safety plan regarding possible need for extra protective clothing and equipment.

2) Check sample Can to be sure that valve is closed (knob fully clockwise).

3) Remove protective nut from top of Can and attach TFE tubing.

4) Fill Ice chest 1/2 to 3/4 full with LN_2.

5) Hold Can by valve assembly. Immerse sample Can in LN_2 for 3 minutes.

6) Hold TFE tube upright and open canister valve fully. After 2 minutes close valve.

7) Allow Can to warm to ambient temperature. Open valve to flush sample from Can.

8) Repeat steps 5, 6, and 7 three times to flush Can thoroughly.

9) Finally, repeat steps 5, and 6 to collect grab sample.

COAST - TO - COAST ANALYTICAL SERVICES

Air, Water & Hazardous Waste Sampling, Analysis & Consultation
Certified Hazardous Waste, Chemistry, Bacteriology & Bioassay Laboratories

141 Suburban Road • San Luis Obispo, CA 93401 • (805) 543-2553 • Fax (805) 543-2685
751 S. Kellogg, Suite A • Goleta, CA 93117 • (805) 964-7838 • Fax (805) 967-4386
1885 North Kelly Road • Napa, CA 94558 • (707) 257-7211 • Fax (707) 226-1001
9333 Tech Center Dr., Ste. 800 • Sacramento, CA 95826 • (916) 368-1333 • Fax (916) 362-2484
2400 Cumberland Dr. • Valparaiso, Indiana 46383 • (219) 464-2389 • Fax (219) 462-2953

CANISTER SAMPLING FIELD DATA SHEET

A. GENERAL INFORMATION

SITE LOCATION: ____________________
SITE ADDRESS: ____________________
____
____
SAMPLING DATE: ____________________

SHIPPING DATE: ____________________
CANISTER SERIAL NO.: ____________________
SAMPLER ID: ____________________
OPERATOR: ____________________
CANISTER LEAK
CHECK DATE: ____________________

B. SAMPLING INFORMATION

TEMPERATURE

	INTERIOR	AMBIENT	MAXIMUM	MINIMUM
START			X	X
STOP				

PRESSURE

CANISTER PRESSURE	
X	

SAMPLING TIMES

	LOCAL TIME	ELAPSED TIME METER READING
START		
STOP		

FLOW RATES

MANIFOLD FLOW RATE	CANISTER FLOW RATE	FLOW CONTROLLER READOUT

SAMPLING SYSTEM CERTIFICATION DATE: ____________________
QUARTERLY RECERTIFICATION DATE: ____________________

C. LABORATORY INFORMATION

DATE RECEIVED: ____________________
RECEIVED BY: ____________________
INITIAL PRESSURE: ____________________
FINAL PRESSURE: ____________________
DILUTION FACTOR: ____________________
ANALYSIS
GC-FID-ECD DATE: ____________________
GC-MSD-SCAN DATE: ____________________
GC-MSD-SIM DATE: ____________________
RESULTS*: ____________________
____
GC-FID-ECD: ____________________
GC-MSD-SCAN: ____________________
GC-MSD-SIM: ____________________

____
SIGNATURE/TITLE

* ATTACH DATA SHEETS

GAS MONITORING WELL MONITORING

The standard operating procedures (SOPs) for data collection at soil gas monitoring wells with the used the Bacharach HPK combustible gas and oxygen indicator is described below.

DESCRIPTION OF AND ACCESS TO THE MONITORING WELLS

The monitoring wells consist of one or more probes constructed of 1/4" polyethylene tubing connecting the ground surface to gravel packs at specific depths. The probes may be under positive pressure requiring the field personnel to perform the necessary monitoring as described in the Health and Safety Plan.

Many gas wells contain more than one probe. The probes are coded with colored tubing to identify the depth at which they are completed. The data collection forms shall indicate which color corresponds to the specific probe. Collect the gas quality data from the probes in the order in which they appear on the data sheet.

EQUIPMENT AND SUPPLIES NEEDED

- HPK combustibles/oxygen meter configured per Appendix D, Calibration and Operating Procedures.
- Protective equipment required for the task by the Health and Safety Officer.
- 1/4" Tygon^R tubing (approximately 25').

COMBUSTIBLES MEASUREMENT

Turn the HPK combustible gas indicator to ON. Perform the HPK startup procedure (Appendix D). Attach the probe to the stopcock with a length of 1/4" Tygon^R tubing. The pump should almost stop. If it does not, there is a leak in the sample line. Locate and repair the leak before proceeding.

Open the stopcock. Watch closely for water in the sampling line. Turn the HPK off quickly if water enters its liquid trap. Read the combustible and oxygen meters when the needle on the oxygen meter reaches its low point. Close the stopcock. Disconnect the Tygon^R tubing at the stopcock let the HPK vent. With the pump running until the oxygen meter reads 21 percent again.

APPENDIX E

CALIBRATION AND OPERATING PROCEDURES

APPENDIX E - CONTENTS

- Calibration for the Hnu PI 101
- YSI Model 33 Conductivity Meter
- Orion SA 250 pH Meter
- Bacharach HPK Combustible Gas & Oxygen Indicator
- Foxboro Century 128 OVA Flame Ionization Detector

Procedure: 6607001
Revision: 0
Date 3/85
Page 1 of 15

CALIBRATION PROCEDURE FOR THE HNu PI 101

1.0 INTRODUCTION

1.1 Content

This procedure presents the steps required to calibriate the HNu Model PI 101 photoionization analyzer. This instrument should be calibrated once daily for each day of field use. The principle of detection and operating proceudres are described in Procedure 5607001. This procedure presents calibration steps only.

1.2 Equipment

- Calibration Gas (2 ranges)

  Low range 0-20 ppm and mid range 20-200 ppm Isobutylene gas for standard field operation when contaminants are unknown or a mixutre of gases is present. Isobutylene is the gas used for general calibration because of the instrument's relatively high sensitivity to it and the non-toxic nature of the gas.

  Note: A specialty gas may be required if a single atmospheric contaminant is present and the contaminant has a sensitivity different from that of the calibration gas. See procedure for 5607001 for a discussion on specialty calibration.

- Tubing and fittings (See Figure 1).
- Rotomoter or bubble flow meter.
- Calibration Form F6264.
- Table 1 for ionization potentials for compounds of interest.

Section 1.1 modified on 11/19/90 by JW, KB
Reviewed JW Date 11/19
Approved
Issued 11/19/90
Date 11/19

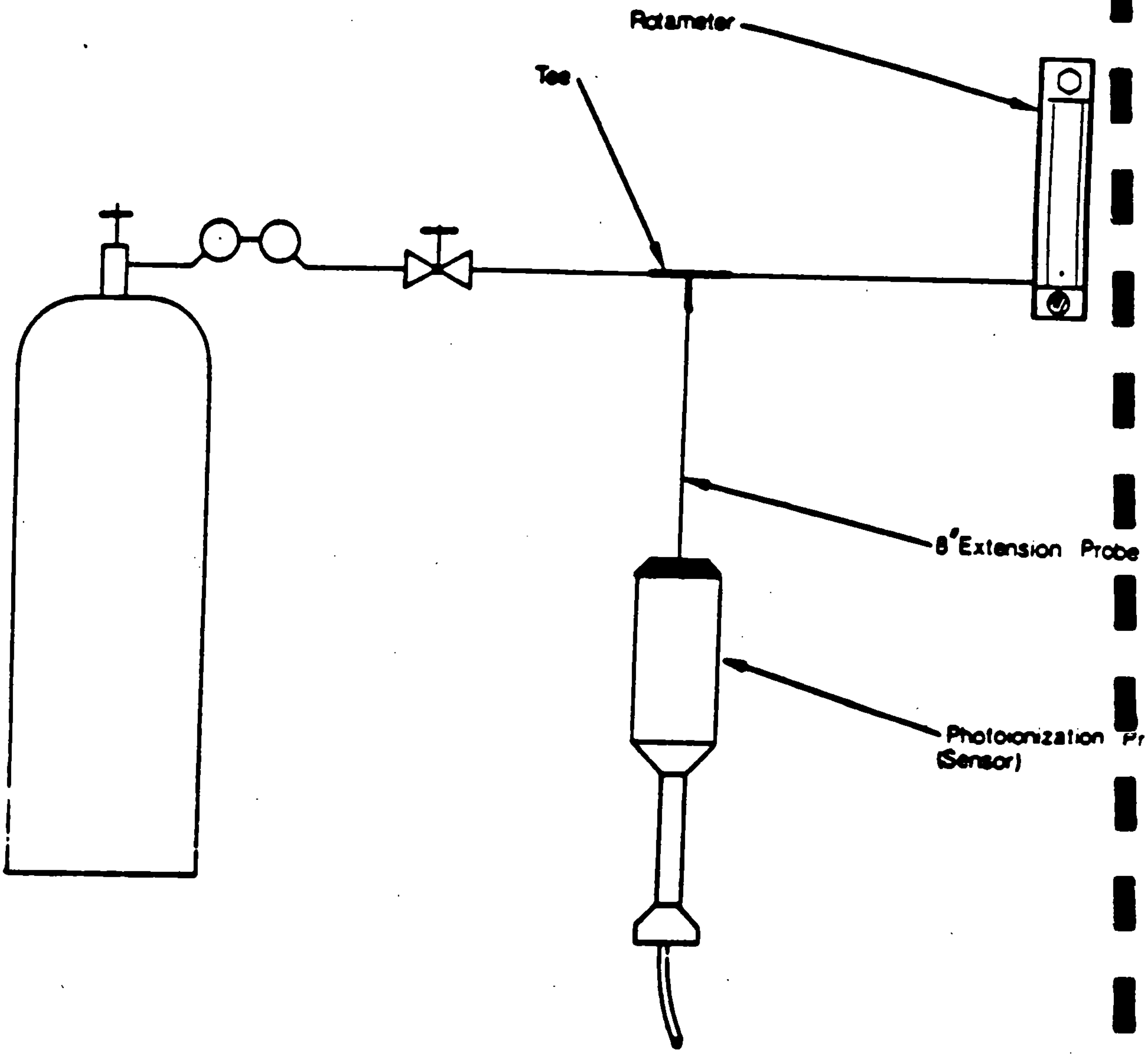


FIGURE 1 RECOMMENDED CALIBRATION PROCEDURE FOR PHOTOIONIZATION ANALYZER

TABLE 1 RELATIVE SENSITIVITIES FOR VARIOUS GASES (10.2 eV Lamp)

Species	Photoionization Sensitivity*
p-xylene	11.4
m-xylene	11.2
benzene	10.0 (reference standard)
toluene	10.0
diethyl sulfide	10.0
diethyl amine	9.9
styrene	9.7
trichloroethylene	8.9
carbon disulfide	7.1
isobutylene	7.0
acetone	6.3
tetrahydrofuran	6.0
methyl ethyl ketone	5.7
methyl isobutyl ketone	5.7
cyclohexanone	5.1
naptha (85% aromatics)	5.0
vinyl chloride	5.0
methyl isocyanate	4.5
iodine	4.5
methyl mercaptan	4.3
dimethyl sulfide	4.3
allyl alcohol	4.2
propylene	4.0
mineral spirits	4.0
2,3-dichloropropene	4.0
cyclohexene	3.4
crotonaldehyde	3.1
acrolein	3.1
pyridine	3.0
hydrogen sulfide	2.8
ethylene dibromide	2.7
n-octane	2.5
acetaldehyde oxime	2.3
hexane	2.2
phosphine	2.0
heptane	1.7
allyl chloride (3-chloropropene)	1.5
ethylene	1.0
ethylene oxide	1.0
acetic anhydride	1.0
a-pinene	0.7
dibromochloropropane	0.7
epichlorohydrin	0.7
nitric oxide	0.6

TABLE 1 RELATIVE SENSITIVITIES FOR VARIOUS GASES (10.2 eV Lamp) (Continued)

Species	Photoionization Sensitivity*
b-pinene	0.5
citral	0.5
ammonia	0.3
acetic acid	0.1
nitrogen dioxide	0.02
methane	0.0
acetylene	0.0

*Expressed in ppm (v/v).

2.0 CALIBRATION PROCEDURE

2.1 CDM employs a two-point standardization procedure to facilitate proper instrument calibration over the 0-20 ppm and 20-200 ppm operating ranges. Two distinct mixtures of the calibration gas (isobutylene) in air are used. Each mixture should give a 3/4 scale deflection in its respective operating range.

2.2 Instrument Setup.

2.2.1 Remove Instrument cover by pulling up on the side straps.

2.2.2 Prior to calibration, check the function switch (Figure 2) on the control panel to make sure it is in the OFF-positon. The probe nozzle, is stored inside the instrument cover. Remove cover plate by pulling up on the pins that fasten the cover plate.

2.2.3 Remove the nozzle from the cover. Assemble probe by screwing nozzle into casing.

2.2.4 Attach probe cable to instrument box by inserting 12 pin interface connector of the probe cable into the connector on the instrument panel. Match the alignment keys and insert connector. Turn connector in clockwise direction until a distinct snap and lock is felt.

2.2.5 Turn the function switch to the Battery Check position. When the battery is charged, the needle should read within or above the green battery arc on the scale plate. If the needle is below the green arc or the red LED light

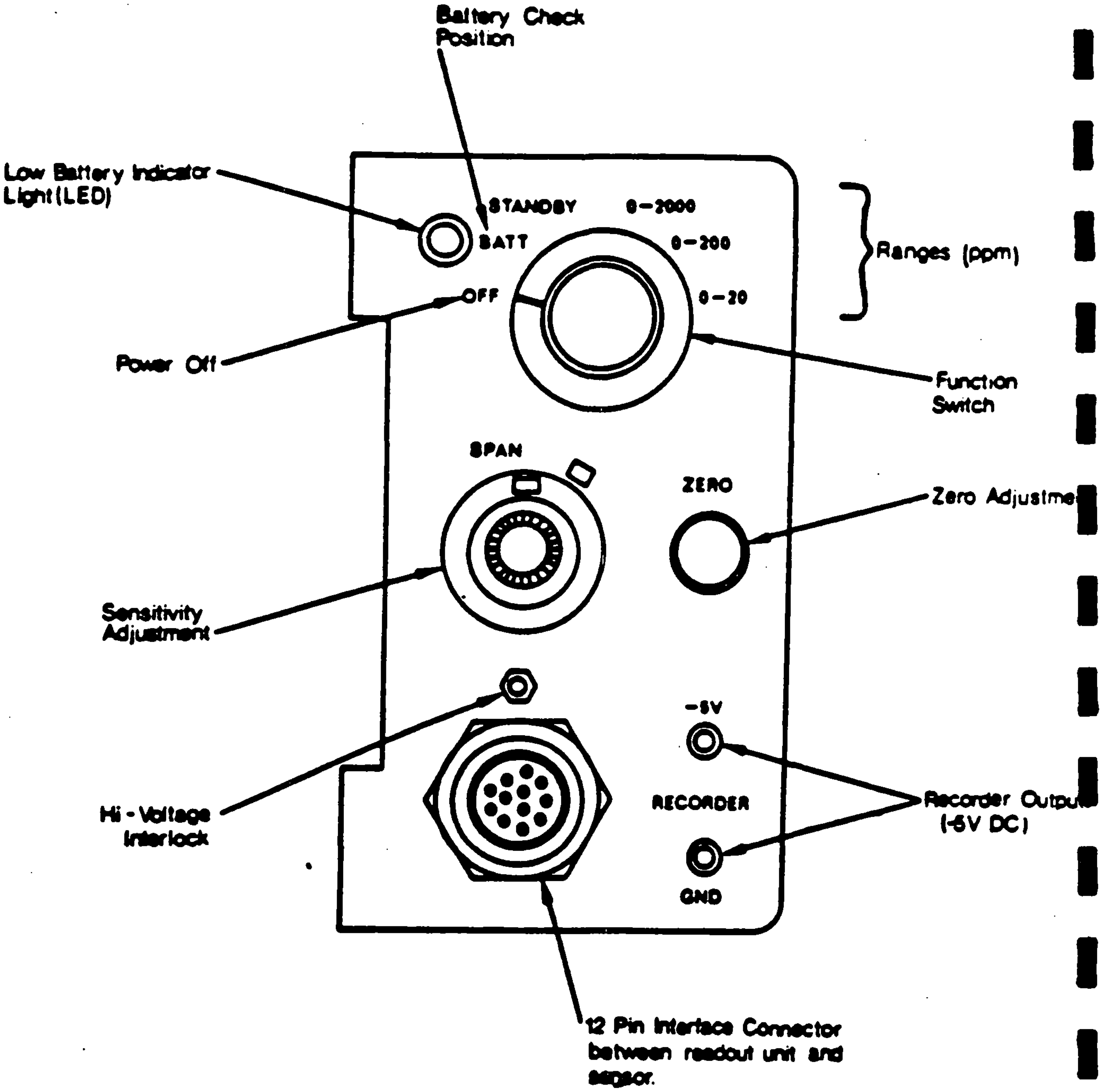


FIGURE 2 CONTROL PANEL FEATURES

comes on, the instrument should be recharged prior to making any measurements. Implement step 3.0 to recharge battery.

2.2.6 Turn the function switch to the ON position. In this position, the UV light source should be on. To verify, gaze at the end of the probe for a purple glow. <u>Do not look directly at the lamp itself.</u> If the lamp does not come on refer to maintenance step 4.1.2.

2.2.7 To zero the instrument, turn the function switch to the standby position and rotate the zero potentiometer until the meter reads zero. Clockwise rotation of the zero potentiometer produces an upscale deflection while counter clockwise rotation yields a downscale deflection. (Note: no zero gas is needed since this is an electronic zero adjustment.) If the span adjustment is changed during instrument calibration, the zero should be rechecked and adjusted. If necessary wait 15 to 20 seconds to ensure that the zero reading is stable. Readjust as necessary.

2.3 Calibration Steps

2.3.1 Insert one end of T tube (Figure 1) into probe. Insert second end of probe into calibration gas in the 20-200 ppm range. The third end of probe should have the rotometer (bubblemeter) attached.

2.3.2 Set the function switch in the 0-200 ppm range.

2.3.3 Crack the valve on the pressured calibration gas container until a slight flow is indicated on the rotometer. The instrument will draw in the volume required for detection with the rotometer indicating excess flow.

2.3.4 Adjust the span potentiometer so that the instrument is reading the exact value of the calibration gas. (Calibration gas value is labeled on the cylinder).

2.3.5 Turn instrument switch to the standby position and check the electronic zero. Reset zero potentiometer as necessary following step 2.3.7.

2.3.6 Record on form F6264 all original and readjusted settings as specified in the form.

2.3.7 Next, set the function switch to the 0-20 ppm. Remove the mid range (20-200 ppm) calibration gas cylinder and attach the low range (0-20 ppm) calibration gas cylinder as described above.

2.3.8 Do not adjust the span potentiometer. The observed reading should be ± 3ppm of the concentration specified for the low range calibration gas. If this is not the case, recalibrate the mid range scale repeating procedures 3.3.1 to 3.2.7 above. If the low range reading consistently falls outside the recommended tolerance range, the probe light source window likely needs cleaning. Clean window following step 4.1.3. When the observed reading is within the required tolerances, the instrument is fully calibrated.

2.3.9 Complete forms F6264 and F6265 for the respective instrument being calibrated.

3.0 BATTERY RECHARGING

3.1 Place plug on end of charger cable into jack on left side of instrument case

3.2 Plug charger into 120V AC supply.

3.3 To ensure that charger is functioning, turn the function switch to the battery check position. The meter should go upscale if the charger is working correctly and correctly inserted.

3.4 The battery is completely charged overnight (ca, 14 hours).

3.5 When disconnecting charger, remove from 120 V AC before removing mini phone plug.

4.0 TROUBLE SHOOTING AND MAINTENANCE

4.1 General Fault Determination and Correction

4.1.1 Battery level is low. Recharge if necessary implementing step 3.0. If the battery will not recharge it will have to be replaced.

4.1.2 UV lamp function. Gaze at sample inlet when mode switch is on an instrument function position and observe for purple glow of lamp. If the lamp does not glow in any of the three instrument function positions, it may be burned out and will have to be replaced. To replace the lamp:

1. Turn the function switch to the off position and disconnect the probe connector from the readout unit.

2. Remove the exhaust screw found near the base of the probe (Figure 3).

3. Grasp the end cap in one hand and the probe shell in the other and gently pull to separate the end cap and lamp housing from the shell.

4. Loosen the screws on the top of the end cap and separate the end cap and ion chamber from the lamp and lamp housing. Care must be taken so that the ion chamber does not fall out of the end cap and the lamp does not slide out of the lamp housing.

5. Turn the end cap over in your hand and tap on the top of it; the ion chamber should fall out of it.

6. Place one hand over the top of the lamp housing and tilt slightly. The light source will slide out of the housing.

7. Replace lamp with one of same energy source as the one removed by sliding it into the housing. Note: the amplifier board and instrument circuitry are calibrated for one light energy source. Insertion of a lamp of a different energy level will produce false instrument readings.

8. Place the ion chamber on top of the lamp housing, checking to ensure that the contacts are aligned.

9. Place the end cap on top of the ion chamber and replace the two screws. The screws should be tightened only enough to seal the "O" ring. Do not overtighten.

10. Line up the pins on the base of the lamp housing with the pins inside the probe shell. Gently slide the housing assembly into the probe shell. Do not force the assembly as it only fits one way.

11. Replace and tighten the exhaust screw.

12. Reconnect the 12 pin connector and turn instrument mode switch to a function position. Check for glow of lamp. If lamp still does not function the instrument has an electrical short or other problem that will have to be corrected at the factory.

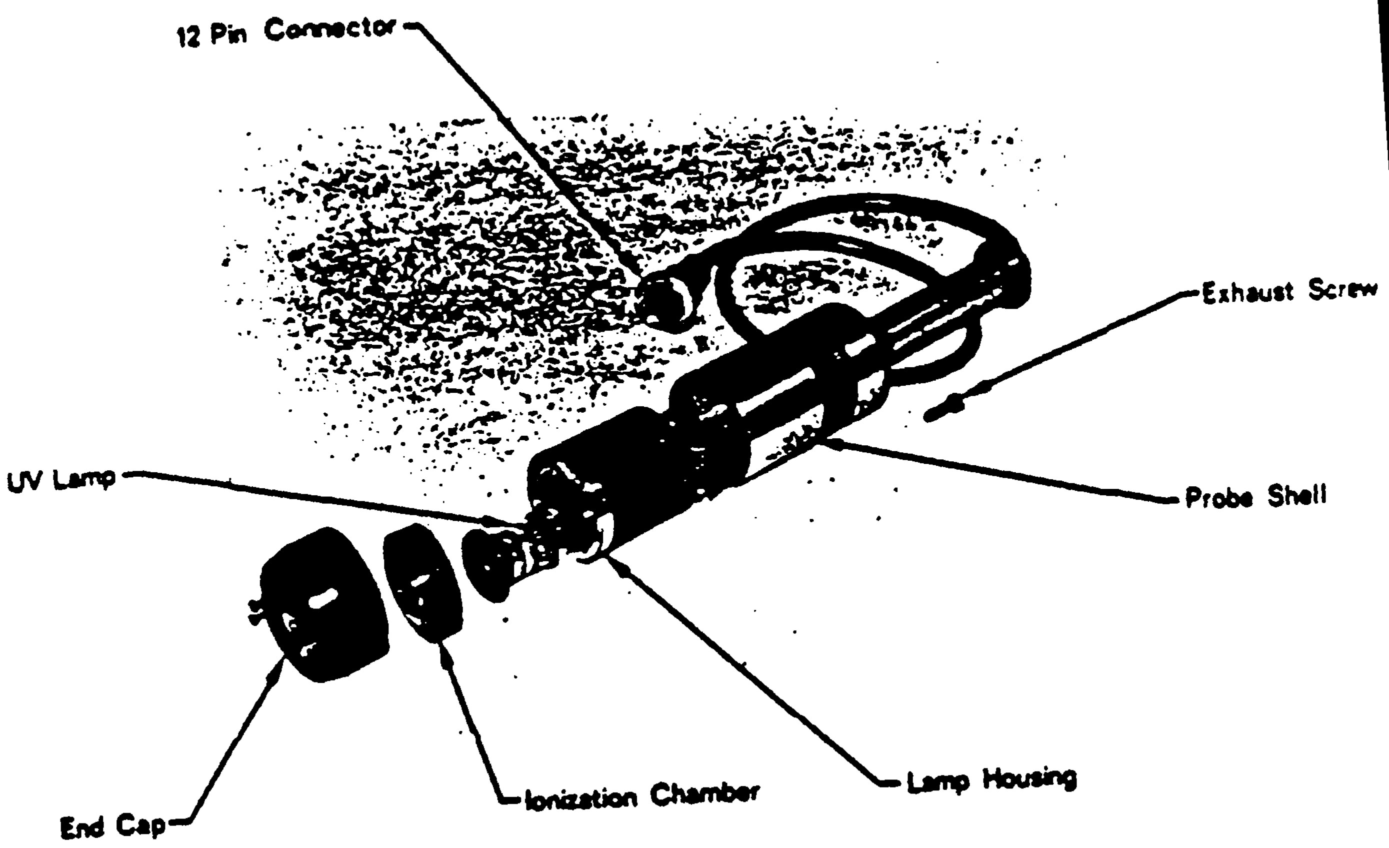


FIGURE 3 COMPONENT PARTS OF PROBE

4.1.3 Instrument appears to be functional, but responses are lower than expected or erratic. The window of the light source may be dirty and need to be cleaned. To clean the light source window:

1. Disassemble the probe assembly by repeating steps 1 through 6 under 4.1.2 above.
2. Clean the window of the light source using compound provided with instrument and soft clean cloth. Important: use cleaning compound on the window of the 10.2 eV lamp only. The cleaning compound may damage the windows of the 9.5 and 11.7 eV lamps.
3. Reassemble the probe assembly repeating step 7 through 12 above.

4.2 Specific Faults

4.2.1 No meter response in any switch position (including BATT CHK)

1. Broken meter movement: Tip instrument rapidly from side to side. Meter needle should move freely, and return to zero.
2. Electrical connection to meter is broken: Check all wires leading to meter and clean the contacts of quick-disconnects.
3. Battery is completely dead: Disconnect battery and check voltage with a volt-ohm meter.
4. Check 2 amp fuse.
5. If none of the above solves the problem, consult the factory.

4.2.2 Meter responds in BATT CHK position, but reads zero or near zero for all others.

1. Power supply defective: Check power supply voltages per Figure 4. If any voltage is out of specification, consult the factory.

2. Input transistor or amplifier has failed: Rotate zero control; meter should deflect up/down as control is turned. Open probe; both transistors should be fully seated in sockets.

3. Input signal connection broken in probe or readout: Check input connector on printed circuit board. Should be firmly pressed down. Check components on back side of printed circuit board. All connections should be solid, and no wires should touch any other object. Check all wires in readout for solid connections.

4.2.3 Instrument responds correctly in BATT CHK, and STBY, but not in measuring mode.

1. Check to see the light source is on (See Section 4.1.2).

2. Check high voltage power supply (see Figure 4).

3. Open end of probe, remove lamp and check high voltage on lamp contact ring.

4. If high voltage is present at all above points, light source has most likely failed. Consult the factory.

4.2.4 Instrument responds correctly in all positions, but signal is lower than expected.

1. Check span setting for correct value.

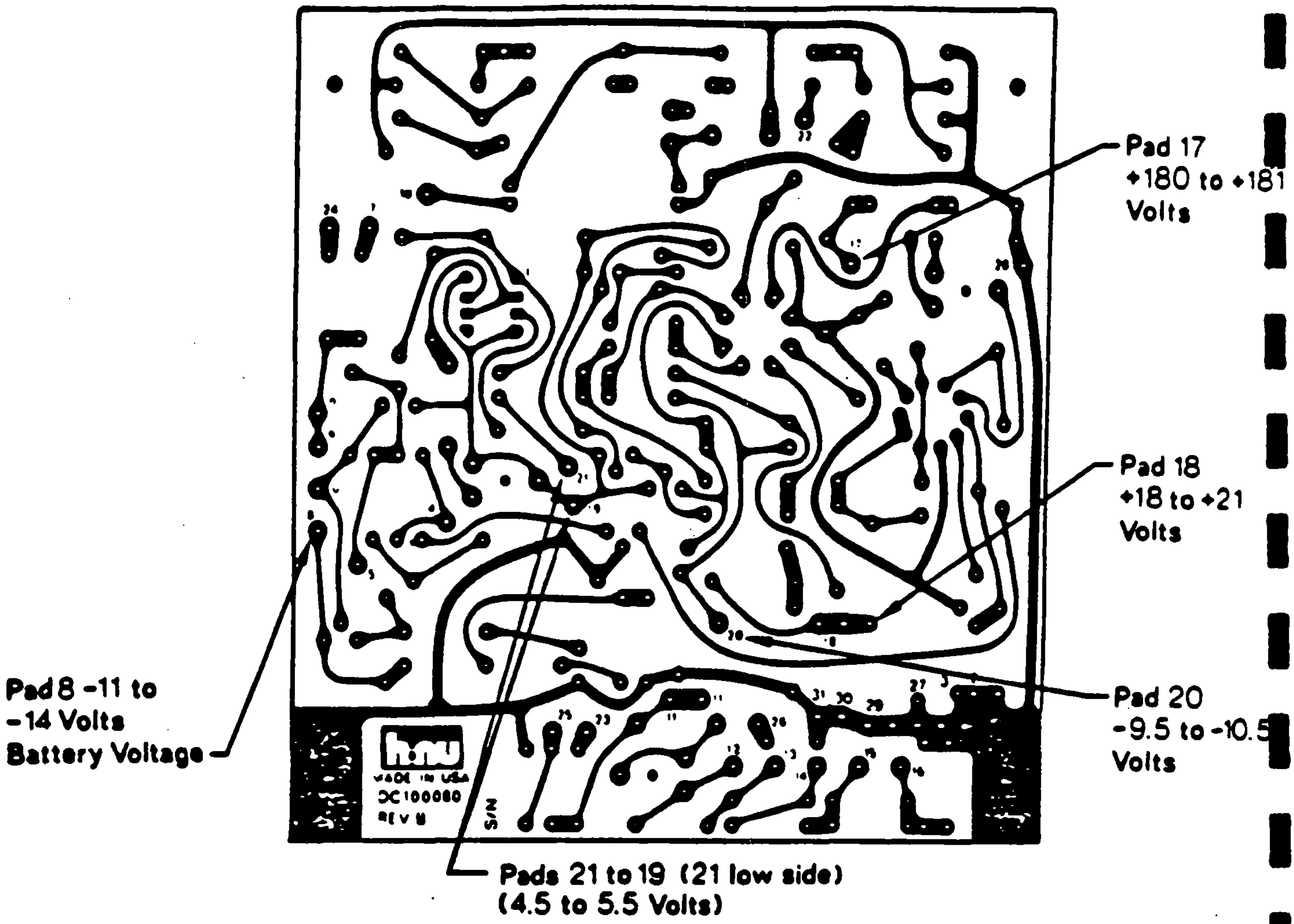
2. Clean window of light source (See 4.1.3).

3. Double check preparation of standards.

4. Check power supply 180 V output. See Figure 4.

5. Check for proper fan operation. Check fan voltage. See Figure 4.

6. Rotate span setting. Response should change if span pot is working properly.



All Voltages Respect to Ground							
pads	voltage	pads	voltage	pads	voltage	pads	voltage
1	− 5.7V	9	− 12.2V	17	180V	25	0
2	GRD	10	− 12.1V	18	+ 19.4V	26	0
3	GRD	11	0	19	− 10.6V	27	GRD
4	−10.7V	12	0	20	− 9.7V	28	0
5	− 11.3V	13	0	21	−14.5V	29	GRD
6	− 12.1V	14	0	22	−400V	30	GRD
7	0	15	0	23	0	31	GRD
8	− 12.2V	16	0	24	0		

Figure 4 Power Supply PC Board

4.2.5 Instrument responds in all switch positions, but is noisy (erratic meter movement).

1. Open circuit in feedback circuit. Consult the factory.
2. Open circuit in cable shield or probe shield. Consult the factory.

4.2.6 Instrument response is slow and/or irreproducible.

1. Fan operating improperly. Check fan voltage. See Figure 4.
2. Check calibration and operation.

4.2.7 Low battery indicator.

1. Indicator comes on if battery charge is low.
2. Indicator also comes on if ionization voltage is too high.

Standard Measurement Procedure 9-1-3

YSI MODEL 33 CONDUCTIVITY METER

1.0 INTRODUCTION

This document describes procedures that employees must perform when using the YSI Model 33 S-C-T meter. Field personnel must perform the procedures that appear in Sections 1.2 to 1.7. The procedures in Section 1.8 may only be performed by authorized service technicians.

1.1 INSTRUMENT PROFILE

Function:	Salinity, conductivity, and temperature measurements.
Application:	Conductivity measurements in µmhos/cm indicate the concentration of salt and ionic contaminants in a water sample. Water with high conductivity can not be consumed by people or used in industrial processes. Organic contaminants are poorly soluble in highly conductive water.
Components:	Meter with analog readout; Temperature Adjustment knob; Mode Select knob; Redline control knob; Cell Test button; 2 "D" size alkaline batteries; and probe assembly.
Operation:	The model 33 S-C-T meter face yields a reading of the conductivity of a water sample by measuring the current flow between two electrodes in the probe. Salinity is calculated from the conductivity measurement, which includes a user-adjusted temperature compensator. The meter measures temperature by measuring changes in the resistance of a precision thermistor in the probe.
Readout:	Conductivity is scaled 0-500, 0-5000, and 0-50000 µmhos/cm with YSI 3300 series probes. Salinity is scaled 0-40 parts per thousands in temperature range -2 to +45 degrees C. Temperature is scaled -2 to +50 degrees C.
Calibration:	The S-C-T meter and probe is factory calibrated. The meter's calibration is checked against a test solution of known conductivity prior to use to generate a correction factor which is used to obtain accurate readings.
Inherent Safety:	The S-C-T meter is not approved for use in areas where flammable or explosive gases or vapors are present.

Prepared: CSEM	Reviewed: DOJ	QA: LME	Approved: GAD	Issued: JAK
Date: 3/27/89	Date: 3/31/89	Date: 6/1/89	Date: 6/13/89	Date: 6/13/89

1.2 EQUIPMENT AND SUPPLIES

1.2.1 Equipment needed:

- YSI Model 33 S-C-T Meter
- YSI Model 3310 Combination S-C-T Probe
- NITS-traceable laboratory thermometer (e.g. SAMA types CP10 or CP15)
- Hard-shell plastic carrying case

1.2.2 Supplies needed:

- Thirty disposable 150 ml beakers, such as Sherwood Lancer Tri-Pour polypropylene beakers
- One liter of distilled water
- One laboratory wash bottle for distilled water
- Two standard "D" size alkaline batteries
- Conductivity calibration solutions (potassium chloride in water) 1,000 (YSI 3167), 1,413 (VWR 51430), or 10,000 (YSI 3168) µmhos/cm
- Conductivity probe platinizing solution (YSI 3140).

1.3 START UP

a. Place the meter in the position in which it will be used, either vertical or flat on its back. Record the instrument model and serial numbers and last warehouse preventive maintenance date of the conductivity meter in the field log book. If the preventive maintenance occurred over a month ago, send the meter back to CDM for service (Section 1.7.5).

b. With the Mode Select knob in the OFF position, adjust the meter with the screw on the dial face until the red needle and its reflection in the dial mirror line up with the zero on the conductivity scale.

c. Plug the probe into the plug receptacle in the side of the meter. Place the probe body in distilled water.

d. Turn the Mode Select knob to the RED LINE position.

e. Adjust the Red Line control knob so that the meter needle and its reflection in the dial mirror line up with the red line on the meter face. If this cannot be accomplished, replace the batteries.

f. Perform a calibration check (Section 1.4.3). If the instrument has not been used today, perform a full calibration (Section 1.4.2)

1.4 INSTRUMENT CALIBRATION

1.4.1 Frequency of Calibration

a. The user should calibrate the S-C-T meter (Section 1.4.2) before each day of use.

b. The user should check the calibration of the S-C-T meter (Section 1.4.3) whenever it is powered up and after every tenth reading.

c. CDM service technicians must perform the monthly preventive maintenance check described in Section 1.8.1.

1.4.2 Field Calibration

The S-C-T meter and probe is factory-calibrated. Check its calibration against the conductivity standard closest to the values expected in the samples. A calculated factor is used to obtain accurate readings.

a. Attach the probe to the meter and rinse it with distilled water. Soaking the probe in distilled water for up to 24 hours improves accuracy of calibration.

b. Select a conductivity standard (1,000, 1,413, or 10,000 μmhos) closest to the values expected in the samples.

c. Perform the start up procedure (Section 1.3).

d. Allow the meter to warm up for one or two minutes.

e. Place the standard in a laboratory-clean beaker or glass jar. Gently shake the probe in air to remove distilled water. Immerse the probe. Move the probe up and down in the standard to soak the electrodes.

f. Empty the beaker and refill it with solution. Repeat step "e" with this aliquot of standard before reading the meter.

g. Rotate the Mode Select knob to X10 or X100 to yield an on-scale reading.

h. Read the point on the conductivity scale at which the red needle and its reflection on the dial mirror rest. Record the meter reading and the conductivity standard's value in the field log book.

i. Depress the Cell Test button. Enter the changed reading in the field log book. If the reading changes by more than 2%, the electrode is fouled and needs to be cleaned. Measurements collected on that meter will be unreliable. See Section 1.7.3.

j. Calculate a cell constant by dividing the standard's conductivity value by the meter reading and the scale factor (10, or 100). Write this constant on the calibration sticker.

Cell Constant = Standard Value / (Meter Reading X Scale Factor)

k. Enter the time and place of calibration, the standard used, the meter readings, and the resulting cell constant in the field log book.

l. Rinse the probe with distilled water.

1.4.3 Field Calibration Check

a. Place standard solution in a laboratory-clean beaker or glass jar. Gently shake the probe in air to remove distilled water. Immerse the probe. Move the probe up and down in the standard to soak the electrodes.

b. Read the point on the conductivity scale which aligns with the red needle and its reflection on the dial mirror.

c. If the meter reading diverges from that found in the calibration step [Section 1.4.2 (j)] by 5% or more, repeat steps "a" and "b" with another aliquot of standard.

d. If this repeated meter reading diverges from that found in the calibration step (Section 1.4.2) by 5% or more, recalculate the cell constant by the method in 1.4.2 (j).

e. If the meter reading agrees within 5%, note that you performed a calibration check. If a new cell constant is necessary, enter the time and place of calibration, the standard used, the meter readings, and the resulting cell constant in the field log book.

1.5 FIELD MEASUREMENTS

1.5.1 Measuring Temperature and Conductivity

a. Place the sample, or an aliquot of medium identical to the sample, in a laboratory-clean beaker or glass jar. The beaker can be re-used if rinsed with the next sample medium.

b. Gently shake the probe in air to remove distilled water and place it into the sample solution. Move the probe up and down in the beaker to soak the electrodes with the sample.

c. Repeating steps "a" and "b" with two aliquots of sample medium before reading will improve accuracy.

d. Set the Mode Select knob to TEMPERATURE. Read the temperature on the bottom scale of the meter in degrees Celsius. Allow time for the probe to achieve temperature equilibrium before reading it. Record the temperature in the field log book.

e. Adjust the Red Line control knob so the meter needle and its reflection in the dial mirror lines up with the red line on the meter face. (Note: Temperature compensation has no affect on conductivity readings.)

f. With the probe in the solution to be tested, set the Mode Select knob to the lowest conductivity range that yields a meter reading below full scale.

g. Multiply the meter reading, in µmhos/cm, by the scale factor (1, 10, or 100) selected and the cell constant from instrument calibration procedure (1.4.2). Record the direct measurement, and the calculated value directly in the field log book.

Sample Conductivity = Meter Reading X Scale Factor X Cell Constant

h. Rinse the probe with distilled water between samples.

i. Conductivity measurements may be taken by immersing the probe into rivers, tanks, lakes, etc. Keep the probe at least 6" from metallic objects.

1.5.2 Measuring Salinity

a. If the conductivity is above 500 µmhos, don't try to determine the salinity.

b. Adjust the temperature compensator dial to the water's temperature.

c. Set the Mode Select knob to SALINITY. Read the salinity in parts per thousand from the "%S" scale.

1.6 SHUT DOWN AND STORAGE

a. Store the probe in distilled water whenever feasible.

b. Store the unit in the case.

c. Don't store conductivity meters on site unless staff are on site.

d. If the meter will be inactive for more than a week, return it to the Regional Equipment Warehouse for service and/or reassignment.

1.7 TROUBLE-SHOOTING (By Instrument Users)

1.7.1 Preventive Maintenance

Warehouse service technicians must perform a monthly preventive maintenance (PM) check which is described in Section 1.8.1. Don't use the conductivity meter unless a calibration sticker showing a PM date within the last month appears on the meter.

1.7.2 Indicators of Instrument Malfunction

a. If the Red Line adjustment [Section 1.3 (e)] won't align the needle, its reflection, and the red line, replace the batteries.

b. If the meter reads over 10 μmhos when the probe is in distilled water, replace the water. If it still reads over 10 μmhos, the meter zero may need adjustment [Section 1.3 (b)].

c. If a reading on the X10 and X100 scales decreases more than 2% when you depress the Cell Test button, the electrode is fouled and needs to be cleaned. Measurements collected on that instrument will be unreliable. Field personnel may clean probe following the procedure in Section 1.7.4.

d. If calibrations (Section 1.4.2) performed with two different strengths of standard yield cell constants that differ by 10% or more, return the meter and probe to the CDM warehouse for service.

1.7.3 Battery Replacement

a. Replace the batteries with alkaline "D" cells only. Carbon/zinc batteries can cause errors.

b. Replace the batteries every six months to avoid damage to the meter from leaking battery fluids.

1.7.4 Probe Cleaning

a. Immerse the probe in a commercially available bathroom tile cleaner such as Lysol^{R} Basin, Tub, & Tile Cleaner. Use the cleaner at full strength.

b. Soak the probe in the cleaner for five minutes.

c. Rinse the probe thoroughly with tap water.

d. Rinse the probe thoroughly in distilled water.

e. Re-calibrate the meter and probe (Section 1.4.2).

1.7.5 Other Types of Repair

a. All other types of repair may be performed only by the YSI or CDM service technicians.

b. Meters must return to the warehouse for a preventive maintenance check (Section 1.7.1) at least once a month.

c. Complete and send an Equipment Condition Report Form for the instrument each time you send it to the warehouse.

1.8 PREVENTIVE MAINTENANCE AND SERVICE (By CDM Warehouse)

1.8.1 Preventive Maintenance Check

Service technicians must perform a preventive maintenance (PM) check once a month. The PM check shall consist of:

a. Calibrating the thermistor against an NITS-traceable glass thermometer (see Section 1.8.2).

b. Calibrating the meter against both the 10,000 and the 1,000 or the 1,413 μmhos solutions before shipping the meter to the field (Section 1.4.2). If the meter is working properly, the cell constants will be equal at both strengths. If not, the electrode may need platinizing (Section 1.8.4)

c. Performing a Cell Test on the probe. If the meter reading changes by 2% or more, the probe needs cleaning (Section 1.8.3)

1.8.2 Calibrating the Thermistor

a. Perform this temperature calibration with both cold and warm water prepared as follows:

- Withdraw tepid water from a tap, or allow cold tap water to rise to room temperature in a closed container.
- Mix approximately 400 ml of cold tap water with 400 ml of ice for 5 to 10 minutes. Decant the ice from the water before using it.

b. Fill a beaker that is at least 400 ml in volume with the cold water to a height of three inches.

c. Perform the start up procedure (Section 1.3) on the conductivity meter.

d. Place the probe in the water.

e. Place the NITS-traceable glass thermometer in the water alongside the probe.

f. Move the probe up and down in the water until the temperature readings stabilize.

g. If the two temperature readings agree within two degrees Celsius, note the two temperature readings on the maintenance and calibration worksheet.

h. If the temperature readings diverge by more than two degrees Celsius, contact YSI for a replacement.

i. Repeat the procedure with the warm water.

1.8.3 Probe Cleaning

a. Immerse the probe in a solution of ten parts distilled water, ten parts isopropanol, and one part hydrochloric acid.

b. Soak the probe in the solution for five minutes.

c. Rinse the probe thoroughly with tap water.

d. Rinse the probe thoroughly in distilled water.

e. Re-calibrate the meter and probe (Section 1.4.2).

f. Fill in the calibration/maintenance log.

1.8.4 Re-Platinizing

a. Clean the probe according to the procedure in 1.8.3.

b. Perform the start up procedure (Section 1.3).

c. Place the probe in a clean 150 ml glass beaker and add enough platinizing solution (YSI 3140) to cover the electrode.

d. Plug the probe into the meter and set the meter on the X100 scale.

e. Read the conductivity of the platinizing solution on the meter.

f. The time required to re-platinize is determined as follows:

Meter Reading (µmhos/cm)	Time (minutes)
30,000	5
25,000	6
20,000	8
15,000	11
10,000	16

g. After the elapsed time, rinse the probe thoroughly in tap water.

h. Rinse it thoroughly in distilled water.

i. Return the platinizing solution to its container.

j. Store the probe in distilled water.

k. Complete the calibration/maintenance log.

1.8.5 Other Types of Repair

Service technicians may perform other types of repair with the advice of YSI technical service.

ORION SA 250 pH METER

This section outlines procedures for field operations with the ORION SA 250 pH meter.

Instrument Profile

Application:	To measure the pH of waters, wastewaters, and some types of solids.
Components:	The pH meter consists of a plastic body, electrode and an automatic temperature compensation probe.
Read Out:	The meter can display 0.1 or 0.01 pH resolution.
Calibration:	The meter is calibrated prior to use and after every 10 samples with standard buffer solutions. The calibration procedure is described in the Orion manual. If fresh buffers are prepared prior to instrument calibration, the buffer lot number, date prepared, and the technician's initials are entered in the field logbook. If standard bottled pH buffer solutions are used, the lot number(s) and expiration date(s) are entered in the field logbook.
Inherent Safety:	None.

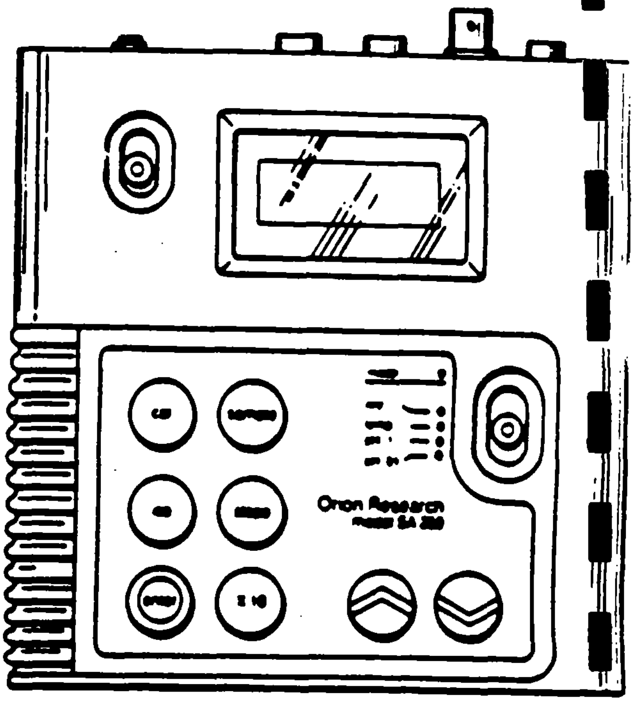
Field Procedures

The Orion manual details the procedures to be followed in the field. EPA Method 9045 describes the soil pH procedure.

ORION

Orion Research Incorporated
Laboratory Products Group

SA 250 pH METER
TRAINING GUIDE



The ORION SA 250 Meter is an advanced portable pH meter with many features previously found only in bench-top meters.

- Autocalibration recognizes and enters 4.01, 7.00, or 10.01 pH buffers. Other buffer values can be manually entered.
- Choice of .1 or .01 pH resolution. You choose speed or better accuracy.
- Prompting you through 1 or 2 point calibration to sample measurement.
- Assistance codes diagnose errors.
- Superior design for outdoor, process, or active lab environments.
- Durable splash, dust, and corrosion-resistant housing.
- Lightweight, no slip grip for hand-held operation.
- Convenient carrying case with ROSS pH Electrode, ATC probe, and all the accessories you need for immediate start-up.

Turn this card over for instructions on a calibration with two buffers using the ATC probe. Consult the meter instruction manual for initial check out, specifications, and further operational information.

ORION SA 250 pH METER

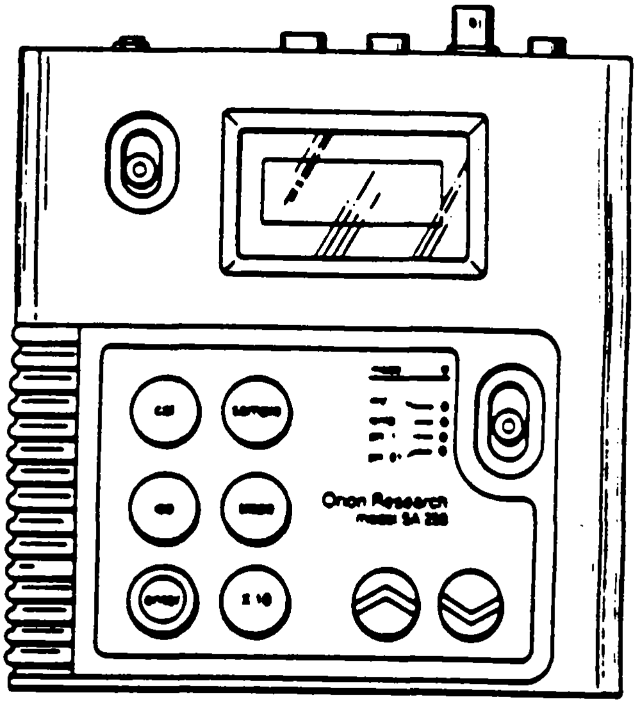
Autocalibration With Two Buffers and an ATC Probe

Select either 4.01 and 7.00, or 7.00 and 10.01 buffers, whichever will bracket the expected sample range.

An ATC probe is used for convenience and accuracy. Once the ATC probe is plugged into the input jacks, and placed into solution, entering temperature values manually is not possible. The ATC probe automatically senses buffer or sample temperature for use in calculating accurate pH values.

1. Connect electrodes and ATC probe to meter.
2. Select pH mode and resolution by sliding the mode switch to pH .1 or pH .01.
3. Press iso and verify that the isopotential point is 7.00.
4. Place electrodes and ATC probe into 7.00 buffer.
5. Press cal. The display will alternate between **.1.** and the pH value of the buffer, indicating that the electrodes are in the first buffer and a value has not yet been entered.
6. Wait for the pH value to stabilize. Press **enter**. The correct display will freeze for 3 seconds, then advance to **.2.**, indicating the meter is ready for the second buffer.
7. Rinse electrodes and ATC probe and place into the second buffer, either 4.01 or 10.01. The display will alternate between **.2.** and the pH value of the buffer.
8. Wait for the pH value to stabilize. Press **enter**. The letters ***pH*** will be displayed. The SA 250 Meter is now calibrated and automatically advances into the sample mode.
9. Rinse electrodes and ATC probe and place into sample. Read the pH directly from the display.

NOTE: A different isopotential point can be entered. However, if you do not know the isopotential point of your pH electrode, the 7.00 default setting is recommended for Ag/AgCl and ROSS pH Electrodes.



ORION

Orion Research Incorporated
Laboratory Products Group
THE SCHRAFFT CENTER
529 MAIN STREET, BOSTON, MA 02129
TEL 800-225-1480, 617-242-3900 / TLX 4430019
IN EUROPE: ORION RESEARCH AG
FAHNLIBRUNNENSTRASSE 3
CH-8700 KUSNACHT, SWITZERLAND
TEL 01 910 7858 / TLX 825787

Form No. 250TG/5850
Printed in U.S.A.
Part No. 205379-001

INTRODUCTION

ORION Automatic Temperature Compensation (ATC) Probes transmit a signal to the pH meter, which automatically corrects pH measurements for variation in electrode slope due to temperature change. The 917001 and 917002 ATC Probes are designed for use with the following ORION Meters:

SA 230
231
SA 250
501
SA 520
SA 720
811
EA 920
EA 940

These probes may also be used with other meters requiring a PT-100 type thermistor automatic temperature compensator with dual banana plugs.

The 917001 ATC Probe has a break resistant epoxy body. The epoxy is not recommended for use in organic solvents, but may be used on an intermittent basis in methanol or ethanol.

The 917002 ATC Probe is an all glass probe. This probe is preferred for use in solutions containing organic solvents or at temperatures over 80°C.

For automatic temperature compensation and temperature measurement procedures, consult the appropriate meter instruction manual.

SPECIFICATIONS

Temperature Range
917001: 0-80°C
917002: −5 to 100°C (ATC), 120° (TEMP only)

pH Range
0 to 14 pH

Accuracy
± 0.1°C or 1%, whichever is greater

Storage
Store in air

Connector
Dual banana plugs

Size
Probe length: 15 cm
Cable length: 100 cm
Probe diameter: 8 mm

Specifications subject to change without notice

7

GENERAL INFORMATION

Introduction

The ORION SA 250 pH Meter is an advanced, portable pH meter with many features previously found only on bench-top meters.

Automated functions such as autocalibration, prompting, automatic temperature compensation, and diagnostic operator assistance codes make the SA 250 Meter very easy to use.

With your choice of .1 or .01 pH resolution, you decide if you need speed or better accuracy.

The meter comes with a ROSS Combination pH Electrode and ATC probe for fast, accurate results no matter what the temperature difference between samples and standards.

Created for the outdoor, process, or active lab environment, the meter is lightweight, with a no-slip grip, large LCD display and has a rugged splash and dust-resistant housing. The SA 250 Meter meets or exceeds tests to Department of Transportation and Mil specs for shock, vibration, and moisture.

See Figure 1.

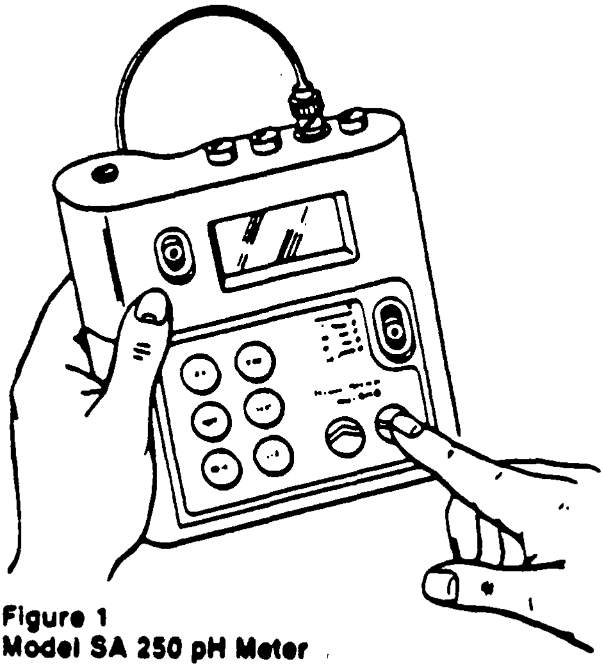


Figure 1
Model SA 250 pH Meter

INSTRUMENT DESCRIPTION

Refer to **Figure 2**.

1. **ON/OFF Switch** Controls power to the meter. Memory is maintained even when the instrument is turned off.
2. **LCD Display** SA 250 pH Meter automatically displays data on an easy-to-read 3 1/2 digit LCD.
3. **Mode Switch** Used to select mV, temp, pH .1, or pH .01 modes.
4. **Keys** Eight touch keys are used to control the meter. Each key is labelled as to the function performed. The following table summarizes the function of each key:

Key	**Function**
sample	Press to display pH of the sample.
cal	Press to start the calibration sequence.
iso	Press to display current isopotential point.
slope	Press to display slope in percent of theoretical.
enter	Press to enter a value into the meter memory.

The following keys, X10, ∧, ∨, are used to change the numeric display. This process is called scrolling.

X10	Increases the displayed value to the next decade – for example, pH 6.14 would increase to 7.00. At the upper end of the scale pressing X10 will cause the display to wrap around – for example: pH 19.00 would go to –2.00.
∧ **up**	Increases the value displayed by increments equal to the least significant digit.
∨ **down**	Decreases the value displayed by increments equal to the least significant digit.

If the ∧ or ∨ key is pressed and held, the next significant digit will change.

The sample, cal, iso, and slope keys function only while the mode control is in either pH .1 or pH .01.

The ∧ or ∨ keys function in temp, pH .1, or pH .01 modes.

5. **Electrode Input**: Accepts BNC connector from combination or sensing electrodes. A separate pin tip input accepts reference electrodes.
6. **ATC Probe Jack**: Accepts ATC probe for automatic temperature compensation.
7. **Line Converter Jack**: Accepts an AC line converter for use without batteries.

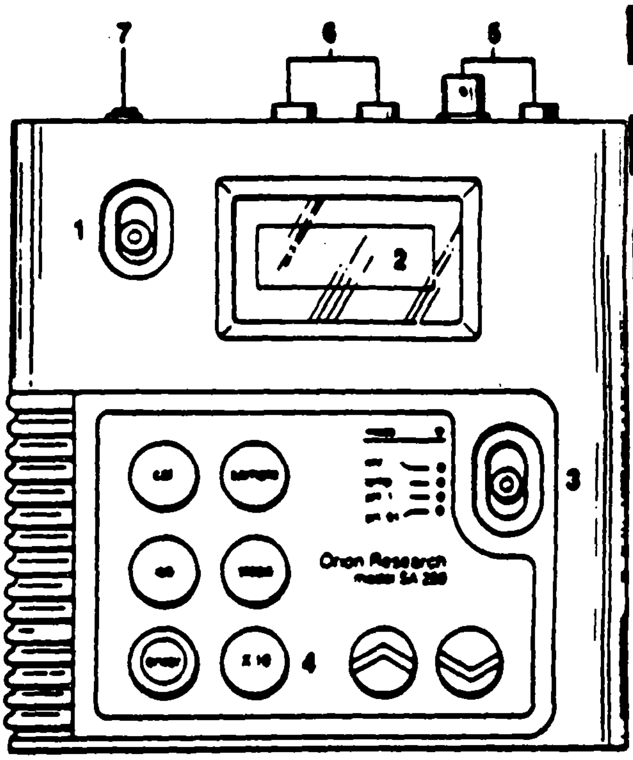


Figure 2
SA 250 Meter Controls

INSTRUMENT SET-UP

Support Rod

See Figure 3.

1. Attach support rod base to side of meter carrying case and tighten clamp screw
2. Insert support rod into base. Tighten rod by turning clockwise.
3. Attach electrode holder to top of support rod.

Power Source

The ORION SA 250 pH Meter operates on one 9 volt nonrechargeable alkaline battery. If the SA 250 pH Meter is left on while using battery power, there will be approximately 30 hours of continuous life. Optional AC line converters are available for both 110 and 220 volt mains. Refer to **ORDERING INFORMATION**.

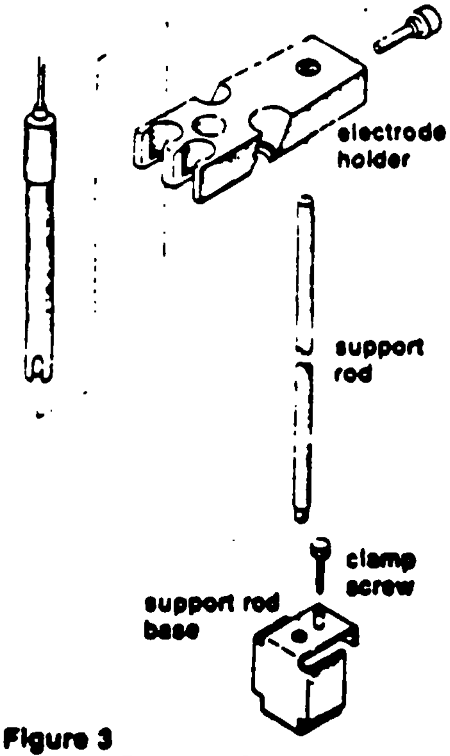


Figure 3
Support Rod and Clamp

Battery Installation

See Figure 4.

1. Remove access panel on back of meter, by sliding cover towards bottom of meter.
2. Attach battery connector clip to battery terminals, install battery and replace access panel.

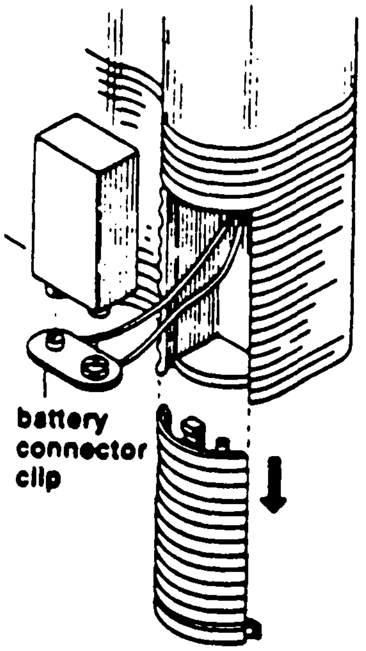


Figure 4
Battery Installation

Meter Check Out Procedure

1. Slide power switch to ON position. Attach BNC Shorting Plug (Orion Cat. No 090045) to BNC connector on top of meter. Refer to **Figure 5**.
2. If using optional AC line converter, connect it to meter and appropriate power source. Proceed to step 4.
3. If **LO BAT** indicator on LCD remains on, the battery must be replaced.
4. Slide mode switch to mV. Display should read **0 ± 0.3**.
5. Slide mode switch to temp. Display should read ***25.0***. If ***25.0*** is not displayed, scroll, using ∧, ∨, and X10 keys, until ***25.0*** is displayed and press enter.
6. Slide mode switch to pH .01. Press iso. Display should read the letters ***ISO*** then a value of ***7.00***. If ***7.00*** is not displayed, scroll until ***7.00*** is displayed and press enter.
7. Press slope. Display should read the letters ***SLP*** then a value of ***100.0***. If ***100.0*** is not displayed, scroll until ***100.0*** is displayed and press enter.
8. Press sample. Observe the letters ***pH*** then a steady reading of ***7.00 ± 0.02*** should be obtained. If not, press cal and scroll until ***7.00*** is displayed and press enter. Press sample and observe a reading of ***7.00***.
9. Remove the shorting plug. After a successful completion of steps 1-8 the meter is ready to use with an electrode.

Electrode Connections

Refer to **Figure 5**.

1. Attach electrodes with BNC connectors to sensor input by sliding connector onto input, pushing down and turning clockwise to lock into position. Connect reference electrodes with pin tip connectors by pushing connector straight into reference input.

NOTE: If using a combination electrode with a BNC connector, the reference pin-tip jack is not used (4 in Figure 5).

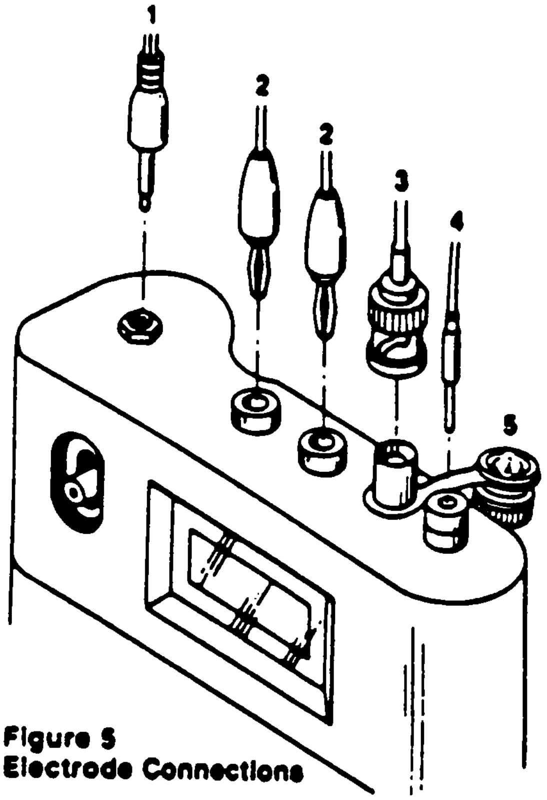


Figure 5
Electrode Connections

Legend

1 AC line converter to line converter jack
2 ATC plugs to ATC jacks
3 BNC connector to sensor input (shown with shorting plug disconnected)
4 Reference pin-tip plug to reference input
5 BNC shorting plug (Orion Cat. No. 090045)

MEASUREMENT PROCEDURES

pH Measurements

See Figure 6

A calibration with one or two buffers should be performed before pH is measured. It is recommended that a calibration with two buffers be performed at the beginning of each day to determine the correct slope of the electrode. This serves the dual purpose of determining if the electrode is working properly and storing the slope value in the meter's memory. Perform a one buffer calibration every two hours to compensate for electrode drift.

Check the stored value for ***ISO*** before calibration. Unless the isopotential point of the electrode is known verify that the display reads ***7.00***. If not, scroll until ***7.00*** is displayed and press **enter**. See **Isopotential Point**.

There are two ways of calibrating the SA 250 Meter, autocalibration or manual calibration.

NOTE: It is recommended to select either autocalibration or manual calibration and not use a combination of the two methods. Following is a description and instructions for each method.

Autocalibration

Autocalibration is a feature of the SA 250 Meter that automatically recognizes the 7.00, 4.01 and 10.01 buffers with a range of ±0.5 pH units. The user waits until the pH display is stable and presses **enter**. The SA 250 Meter automatically calibrates to the correct buffer value using temperature compensation. Do not scroll when using autocalibration.

When calibrating, the SA 250 Meter compares actual values to theoretical values to determine if the buffer is within range. Buffers greater than ±0.5 pH units from the correct value will trigger an operator assistance code.

It is recommended that an ATC probe be used for autocalibration. If an ATC probe is not used, all samples and buffers should be at the same temperature or use manual temperature compensation. See **Temperature Mode**.

Autocalibration With Two Buffers

1. Connect electrode(s) to meter. Slide the mode switch to either pH .1 or pH .01. Choose either 4.01 and 7.00, or 7.00 and 10.01 buffers, whichever will bracket your expected sample range.
2. Place electrode(s) into either 4.01, 7.00 or 10.01 buffer.
3. Press **cal**. The display will alternate between ***.1.*** and the pH value of the buffer, indicating this is the first buffer and a value has not been entered. Wait for a stable pH display and press **enter**. The correct display will freeze for 3 seconds then advance to ***.2.*** indicating the meter is ready for the second buffer.
4. Rinse electrode(s) and place into a second buffer. Wait for a stable pH display and press **enter**.

   After the second buffer value has been entered the letters ***PH*** will be displayed. The meter is now calibrated and automatically advances to sample mode.
5. Rinse electrode(s), place into sample. Record pH directly from the meter's display.

Autocalibration With One Buffer

1. Check slope term by pressing **slope**. If necessary, scroll and enter the correct value. If slope value is unknown, either enter 100.0 or perform a two buffer calibration. A single buffer calibration does not change the slope term.
2. Connect electrode(s) to meter. Slide mode switch to either pH .1 or pH .01.
3. Place electrodes into either 4.01, 7.00 or 10.01 buffer.
4. Press **cal**. The display will alternate between ***.1.*** and the pH value of the buffer, indicating this is the first buffer and a value has not been entered.
5. Wait for a stable pH reading and press **enter**.

   After **enter** is pressed the correct display will freeze for 3 seconds then advance to ***.2.***, indicating the meter is ready for the second buffer. By pressing **sample** the letters ***PH*** will be displayed, indicating the meter has advanced into the sample mode.
6. Rinse electrode(s) and place into sample. Read the pH directly from the display.

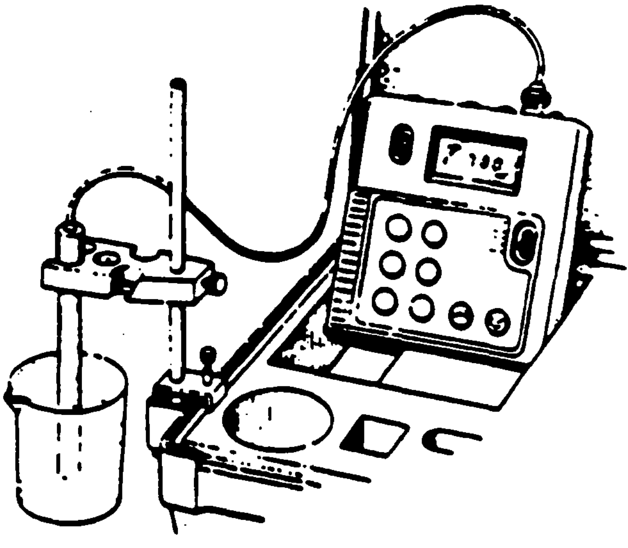


Figure 6
Optional Way to Set Up SA 250 Meter for Sample Measurements

Manual Calibration

To calibrate with buffers other than 4.01, 7.00 or 10.01, use the manual calibration technique. The calibration sequence is the same as autocalibration, except buffer values are scrolled in.

It is recommended that an ATC probe be used. If an ATC probe is not used, all samples and buffers should be the same temperature or use manual temperature compensation. See **Temperature Mode**.

NOTE: Even if scrolling is not necessary, scroll one digit and return to correct value before pressing enter. Otherwise meter will assume autocalibration is to be used.

Manual Calibration With Two Buffers

1. Connect electrode(s) to meter. Slide mode switch to either pH .1 or pH .01. Choose two buffers that will bracket your expected sample range.
2. Place electrode(s) into the first buffer.
3. Press **cal**. The display will alternate between ***.1.*** and the pH value of the buffer, indicating this is the first buffer and a value has not been entered.
4. Wait for a stable pH display. Using ^, v or X10 keys, scroll in the correct value and press enter.

   The display will freeze for 3 seconds then advance to ***.2.*** indicating the meter is ready for the second buffer.
5. Rinse electrode(s) and place into the second buffer. Wait for a stable pH display. Scroll in the correct value and press enter.

   After the second buffer value has been entered the letters ***PH*** will be displayed. The meter is now calibrated and automatically advances to the sample mode.
6. Rinse electrode(s) and place into sample. Record pH directly from the meter's display.

Manual Calibration With One Buffer

1. Verify slope by pressing slope. If necessary scroll in correct value, using ^, v and X10 keys, and press enter. If correct slope is unknown, either enter ***100.0*** or perform a two buffer calibration.
2. Connect electrode(s) to meter. Slide mode switch to either pH .1 or pH .01.
3. Place electrodes into the buffer.
4. Press cal. The display will alternate between ***.1.*** and the pH value of the standard, indicating this is the first buffer and a value has not been entered.

   Wait for a stable pH display, scroll until the correct value is displayed and press enter.

   The display will freeze for 3 seconds then advances to ***.2.*** indicating the meter is ready for the second buffer. By pressing sample the letters ***PH*** will be displayed. The meter is now calibrated and automatically advances to sample mode.
5. Rinse electrode(s) and place into sample. Read the pH directly from the display.

NOTE FOR MANUAL CALIBRATION: In the event that scrolling was started but the value was not entered and the mode switch was changed, either a P1 or a P2 will be displayed upon returning to the pH mode. P1 indicates that a value has not been entered for the first buffer while P2 indicates a value has not been entered for the second buffer.

Slope

By pressing the slope key the slope is displayed as a percent of theoretical. A properly functioning electrode will have a 92% to 102% slope. See **Troubleshooting**, if the slope is out of range. The slope value is retained in the meter's memory until another two buffer calibration is performed or another value is entered. A one buffer calibration does not change the slope value.

At the beginning of each day and every time a different electrode is used a two buffer calibration should be performed for accurate measurements.

To enter a slope value:

1. Slide the mode switch to either pH .1 or pH .01.
2. Press the slope key.
3. Scroll, using ^, v or X10 keys, until the correct value is displayed.
4. Press enter.

Isopotential Point

The isopotential point is the pH at which the potential (mV) of the electrode will not vary with temperature.

For the majority of pH electrodes the isopotential point is pH 7.00. There are some exceptions where the operating range used for a particular electrode is primarily at one end of the pH scale.

If your pH electrode has an isopotential point other than 7.00, the correct value may be entered as follows:

1. Slide mode switch to pH .1 or pH .01.
2. Press iso.
3. Scroll, using ^, v, or X10 keys, until correct value is displayed.
4. Press enter.

A two buffer calibration should be performed after an isopotential point value has been changed. It is good practice to verify the isopotential point whenever the meter has been turned on.

Temperature Mode

Sliding the mode switch to temp will display the temperature in °C. When the temperature is outside of the operating range −5.0 to 105.0°C, an operator assistance code will be displayed. ***E*-*1*** for below −5°C, or ***E 1*** for above 105°C.

During a calibration or sample measurement, the mode switch can be changed to temp. When an ATC probe is connected the temperature can be monitored and automatic temperature compensation will take place.

To use manual temperature compensation:

1. Using a thermometer accurate to ± 1°C determine the temperature of the solutions to be measured.
2. Slide mode switch to temp.
3. Scroll, using ^, v or X10 keys, until the correct temperature value is displayed.
4. Press enter.
5. Return mode switch to either pH .1 or pH .01.

When an ATC probe is not connected, the last entered value of temperature is displayed. If a temperature value has not been entered since the removal of an ATC probe, a default value of 25°C is displayed.

Potentiometric Measurements

Potentiometric titrations are performed in mV mode using either pH, ion-selective or redox electrodes. Detailed instructions for any ORION Electrode are given in the electrode instruction manual. Titration instructions are included in ORION Redox Electrode (Model 96-78 or 97-78) Instruction Manual, or in standard analytical texts. Electrodes that have a U.S. Standard Connector need a U.S. Standard to BNC Adaptor which are available from Orion (Cat. No. 090033).

Dissolved Oxygen Measurements

Dissolved oxygen measurements are displayed in ppm O_2 when ORION Model 97-08 Dissolved Oxygen Electrode is used with ORION SA 250 Meter. Follow these instructions for calibrating the electrode.

1. Connect the Model 970899 to meter and leave electrode mode switch "off".
2. Unplug and do not use an ATC probe.
3. Set the mode switch of the SA 250 Meter to temp and scroll in 25.0°C, press enter.
4. Set the mode switch to pH .1 or pH .01.
5. Press the slope key. Scroll until the value ***100.0*** appears and press enter.
6. Press the iso key and verify that it is ***7.00***. If not, scroll in the value ***7.00*** and press enter.
7. Press the cal key. Scroll in the value ***7.00*** and press enter.
8. Press sample.
9. Turn the mode switch on the electrode to BT CK. Good battery operation is indicated by a reading of ***13.00*** or greater on the meter.
10. Turn the mode switch on the electrode to ZERO. Use the zero calibration control on the electrode to set the meter to read ***0.00***.
11. Insert the reservoir (funnel) into a BOD sample bottle containing enough water to just cover the bottom. Insert the electrode, making sure that the electrode tip is *not* immersed in the water and does not have water droplets clinging to the outside of the membrane. Let stand approximately 30 minutes to ensure water saturation of air in BOD bottle. This bottle should be used for electrode storage between measurements.
12. Turn the electrode mode switch to the AIR position. If measurements are being made at sea level, use the AIR calibration control on the electrode to set the pH meter reading to the prevailing barometric pressure in mm Hg (divided by 100). If the barometric pressure is unknown, if the elevation is above sea level or if the sample has a salinity greater than 2 parts per thousand, consult Table 1 found in the Model 97-08 Instruction Manual to obtain the correct AIR setting.
13. Turn electrode mode switch to H_2O for sample analysis.

OPERATOR ASSISTANCE CODES

Operator assistance codes are used to inform the user of an out of range value. The following table outlines the operator assistance codes that are available in the SA 250 pH Meter and suggests a remedy. The table is divided according to the modes of the meter.

Code	Problem	Remedy
MV MODE		
E 1 *E-1*	mV out of range	1. If occurs when electrodes are out of solution, code will disappear when electrodes are returned to solution. 2. Verify electrodes are properly connected and filled. 3. Dilute standards or samples. 4. Review calibration and operating procedures.
TEMP MODE		
E 1 *E-1*	Temp out of range	1. Verify ATC probe is properly connected.
pH .1 or pH .01 MODES while in sample function		
E 1 *E-1*	mV, temp or pH out of range	1. Go to mV mode and check. If mV is out of range, perform remedy steps described above for mV mode. 2. Go to temp mode and check. If temp is out of range, perform remedy steps described above for temp mode. 3. Check the sample. 4. Check slope and iso values. 5. Recalibrate.
While in cal function:		
E 1 *E-1*	mV, temp or pH out of range	1. Go to mV mode and check. If mV is out of range, perform remedy steps described above for mV mode. 2. Go to temp mode and check. If temp is out of range, perform remedy steps described above for temp mode. 3. Check the buffer. 4. Check iso value.
E21	Slope not in the range 80.0 to 100.0%	1. Press enter to acknowledge code and repeat calibration using fresh buffers. 2. Clean electrode and refill reference. 3. Refer to electrode instruction manual for check out.
E31	First cal point out	1. Press enter and repeat calibration using fresh buffers. 2. Check iso, slope, and temp values. 3. Verify electrodes are properly connected.
E35 *E36*	pH Autocalibration error. Electrode voltage being measured is greater than ±0.5 pH units from nominal value for the pH buffer	1. Press enter and repeat calibration using fresh buffers. 2. Clean electrodes and refill reference. Recalibrate. 3. Perform a manual calibration. Certain electrodes may operate out of acceptable range for pH autocalibration

TROUBLESHOOTING GUIDE

Malfunction	Possible Cause	Remedy
No Display	No power to meter	1 Check that switch is in ON position. 2 Replace battery. 3. Check that adaptor is receiving power and is plugged in securely.
Erratic readings or reading out of range	Meter or electrode failure	1 Follow meter checkout procedure. 2. Follow instructions in electrode instruction manual.
Unable to calibrate	Isopotential error	1. Verify iso.
Unable to calibrate in autocalibration	Certain electrodes may operate outside the limits of ± 0.5 pH units.	1 Try scrolling value to within range and press enter to cal if ***E 1*** or ***E-1*** appearing. 2. Check temp. slope. and iso and repeat.

Orion Technical Service Chemists can be consulted for troubleshooting advice by calling 800-225-1480 or 617-242-3900. Outside North America contact your local authorized Orion Representative

Required Equipment

Meter – Any ORION pH or ion selective meter, or other pH/ISE meter with appropriate connectors

Combination pH Electrode or pH and Reference Electrode Half Cells – Use the ORION Model 81-01 ROSS pH Half Cell only with a ROSS Reference Half Cell Electrode, Model 80-05

Thermometer – Readable to ±0.5°C

Beakers – Plastic or glass

Magnetic Stirrer – Suggested for precision measurements.

Required Solutions

pH Buffers – Two are recommended for precise measurement. The first near the electrode isopotential point (pH 7) and the second near the expected sample pH (e.g., pH 4 or 10)

ROSS Internal Filling Solution – 3M KCl Orion Cat. No. 810007. *Do not use any filling solution which contains silver.* (Electrode damage may result.)

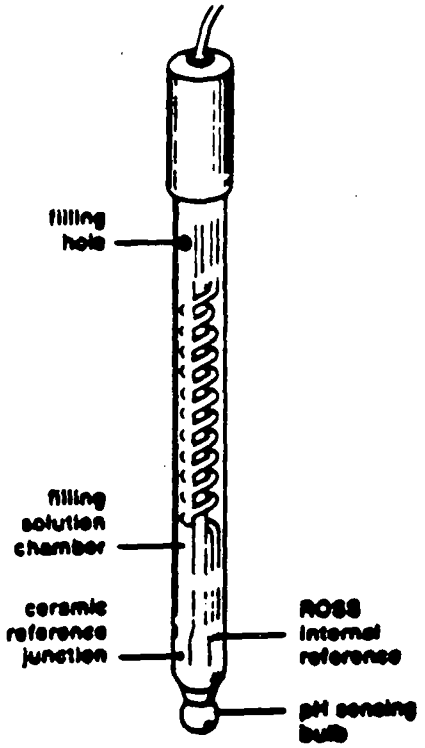


Figure 1
ROSS Combination Electrode – Cat. No. 81-02

USING THE ELECTRODE

Set up

Electrode Preparation

1. Remove the protective shipping cap from [illegible] se element and save for storage. Remove plas[illegible]ov ing from sleeve junction of Model 81-66.
2. Clean any salt deposits from exterior by rinsing w distilled water.
3. Uncover filling hole and add ROSS Filling Solutic Orion Cat. No. 810007, to electrode. See Figure To maintain an adequate flow rate, the level [illegible] fill solution must always be above the referen[illegible]jur tion and at least one inch above the sample [illegible]el immersion. The filling hole should be open whene the electrode is in use.
4. Place the electrode in the electrode hold[illegible] ar suspend in air for 15 minutes to thoroughly [illegible]et tr reference junction. Once the junction is wet, do r allow the electrode to dry out.
5. Shake down the electrode (as a clinical thermo[illegible]ete to remove air bubbles.
6. Soak electrode in pH Electrode Storage Solutio Orion Cat. No. 910001, for one hour. If O[illegible]O Storage Solution is not available, use 200 m[illegible]H buffer to which about 1 g KCl has been added, a temporary substitute.
7. Connect electrode to meter.

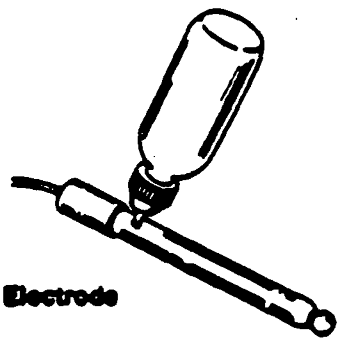


Figure 2
Filling an Electrode

Before Analysis

Sample Requirements

One of the benefits of the ROSS pH Electrode is that the filling solution composition may be changed depending on sample requirements.

The ROSS pH Electrode Filling Solution, Orion Cat. No. 810007 is 3M KCl. For solutions which precipitate in the presence of chloride ion, the ROSS pH Electrode could be filled with 10% KNO_3.

Samples should be aqueous if using epoxy body electrodes (e.g., Models 81-55 or 81-35).

In organic solutions, use an all-glass ROSS Electrode. For good results a minimum of 20% water must be present in the sample. If there is a great deal of drift when using the ROSS Electrode filled with ROSS Filling Solution (Orion Cat. No. 810007), try filling the ROSS Electrode with a mixture of 2 parts methanol and 8 parts ROSS Electrode Filling Solution.

Measuring Hints See Figure 3

- Always use fresh buffers for calibration. Choose buffers that are no more than 3 pH units apart.
- Check electrode slope daily by performing two-buffer calibration. Slope should be 92 to 102%.
- Only use ROSS Internal Filling Solution, Orion Cat. No. 810007, for ROSS Combination pH and Reference Electrodes. Do not use any filling solution which may contain silver.
- Remove filling hole cover during measurement to ensure uniform flow of filling solution.
- Between measurements, rinse electrodes with distilled water and then with the next solution to be measured.
- Stir all buffers and samples.
- Place a piece of insulating material (e.g., styrofoam or cardboard) between magnetic stirrer and beaker to prevent error from transfer of heat to sample. Since ROSS Electrodes respond faster than conventional electrodes, changes in pH which result from temperature changes will be noticed.
- Avoid rubbing or wiping electrode bulb, to reduce chance of error due to polarization.
- Model 81-35 may be used on any moist surface or in liquids. See Figure 4.
- Model 81-63 should not be forced into solids; cut an X into sample and insert electrode. Always immerse electrode to the same depth. See Figure 5.
- Model 81-66 is shipped with parafilm between the ground glass sleeve and cone. Carefully remove parafilm before use. Immerse the entire sleeve assembly when measuring. See Figure 6.

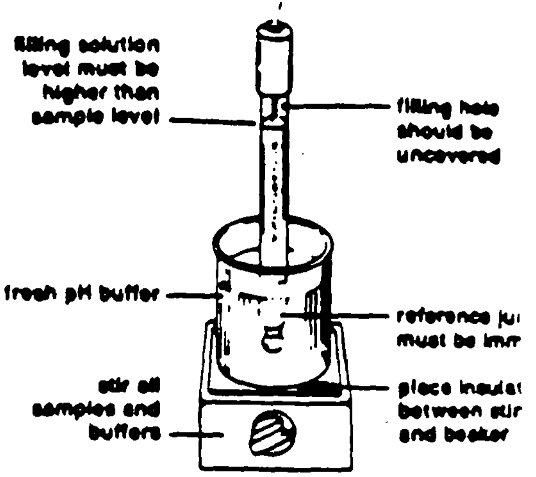


Figure 3
Measuring Hints

Figure 4
Use of Model 81-35

Figure 5
Use of Model

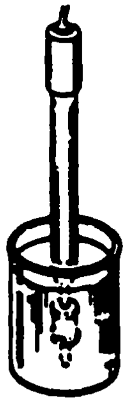


Figure 6
Use of Model 81-66

pH Calibration & Measurement

General Calibration Procedure

For detailed calibration and temperature compensation procedures, consult your meter instruction manual.

Single Buffer Calibration

1. Ensure that all buffers are at room temperature. If samples are at varying temperatures, temperature compensation is recommended. (See meter instruction manual).
2. Set up meter according to meter instruction manual.
3. Rinse electrode first with distilled water and then with the buffer being used for calibration (the buffer should be near the expected sample pH.) Place the electrode in the buffer.
4. Wait for a stable display. Set the meter to the pH value of the buffer at its measured temperature. **See Table 1.** (A table of pH values at various temperatures is supplied on the buffer bottle.) Proceed to **pH Measurement** section.

Two Buffer Calibration

This procedure is recommended for precise[illegible]ea ment.

1. Ensure that all buffers are at the same tempera If samples are at varying temperatures, temper compensation is recommended. (See me[illegible] ins tion manual).
2. Select two buffers which bracket the expected ple pH. The first should be near the electrode is tential point (pH 7) and the second near the[illegible]xp sample pH (e.g., pH 4 or pH 10).
3. Rinse electrode first with distilled water and then pH 7 buffer. Place the electrode in pH 7 buff
4. Wait for a stable display. Set the meter to th[illegible]H of the buffer at its measured temperatur[illegible] (A of pH values at various temperatures is supplie the buffer bottle.) **See Table 1.**
5. Rinse electrode first with distilled water an[illegible]her the second buffer. Place the electrode in the sec buffer.
6. When display is stable, set meter to the [illegible]tua value of the buffer as described in the met[illegible]ns tion manual.
7. If all steps are performed correctly, proc[illegible]d to **pH Measurement** section. If any of the a[illegible]ve cedures does not work, refer to Troubleshoo

pH Measurement

1. Calibrate the electrode as described in[illegible]rev section.
2. Rinse the electrode with distilled water and then sample.
3. Place the electrode in the sample.
4. When the display is stable, record sample pH

Table 1
pH Values of Buffers at Various Temperatures

Nominal value at 25°C	Temperature 0°C	5°C	10°C	20°C	30°C	40°C	50°C	60°C	70°C	80°C	90°C
1.68	1.67	1.67	1.67	1.67	1.68	1.69	1.71	1.72	1.74	1.77	1.7
3.78	3.86	3.84	3.82	3.79	3.77	3.75	3.75				
4.01	4.00	4.00	4.00	4.00	4.02	4.03	4.06	4.08	4.13	4.16	[illegible]
6.86	6.98	6.95	6.92	6.87	6.85	6.84	6.83	6.84	6.85	6.86	6.8
7.00	7.11	7.08	7.06	7.01	6.98	6.97	6.97				
7.41	7.53	7.50	7.47	7.43	7.40	7.38	7.37				
9.18	9.46	9.40	9.33	9.23	9.14	9.07	9.01	8.96	8.92	8.89	8.8
10.01	10.32	10.25	10.18	10.06	9.97	9.89	9.83				

Electrode Storage

To ensure a quick response and free-flowing liquid junction, the sensing element and reference junction must not be allowed to dry out

Short-term Storage (up to one week)

Soak electrode in pH Electrode Storage Solution Orion Cat No 910001 If ORION Storage Solution is not available, use about 200 ml pH 7 buffer to which about 1 gram KCl has been added as a temporary substitute

Long-term Storage

The reference chamber should be filled and the filling hole securely covered Cover the sensing element and/or reference junction with its protective cap containing a few drops of storage solution The Model 81-66 also requires that the ground glass sleeve and cone be separated and the liquid junction securely covered with a plastic film Before returning the electrode to use, prepare it as a new electrode.

Electrode Maintenance

Weekly

1. Inspect the electrode for scratches, cracks, salt crystal build-up, or membrane/junction deposits
2. Rinse off any salt build-up with distilled water and remove any membrane/junction deposits as directed in the cleaning procedures below.
3. Drain the reference chamber, flush it with fresh ROSS Filling Solution, Orion Cat No 810007, and refill the chamber.

Cleaning Electrode

General — Soak in 0 1M HCl or HNO_3 for half an hour, followed by soaking in storage solution for at least one hour.

Removal of Membrane/Junction Deposits

Protein — Soak in 1% pepsin in 0 1M HCl, for 15 minutes *

Inorganic — Soak in 0.1M tetrasodium EDTA solution for 15 minutes *

Grease and Oil — Rinse with mild detergent or methanol solution *

** After any of these cleaning procedures, drain and refill the reference chamber and soak the electrode in storage solution for at least one hour.*

Troubleshooting Guide

Follow a systematic procedure to isolate the proble
pH measuring system can be divided into four comp
for ease in troubleshooting: pH meter, electrode:
ple/application, and operator error

pH meter
The meter is the component which is easiest to el
as a possible cause of error ORION pH meters a
vided with an instrument checkout procedure and
ing strap for convenience in troubleshooting Cons
pH meter instruction manual for directions

Electrodes
To test electrode operation

1. Connect electrode to a working meter
2. Set function switch to absolute mV mode
3. Immerse electrode in fresh pH 7 buffer
4. Displayed value should be 0 ± 30 mV
5. Rinse electrode and immerse in fresh pH 4 t
6. Displayed value should be approximately 16
   greater than in step 4

If electrode fails this procedure, clean thorough
directed in **Maintenance**

If electrode response is slow or drifting, drain and ref
fresh ROSS Filling Solution, Orion Cat. No 810007
Measuring Hints.

If cleaning and maintenance fail to rejuvenate the
trode:

1. For separate pH and reference half cells, subs
   each electrode (one at a time) with a known wo
   electrode and repeat test procedure By proce
   elimination, determine which electrode shoul
   replaced.
2. For combination electrodes, replace the e
   electrode.

Sample/Application
The electrode and meter may operate with buffers bu
with your sample. In this case, check sample compos
for interferences, incompatibilities, or temperature effe

Operator Error
If trouble persists, review operating procedures Re
calibration and measurement sections, to be sure pro
technique has been followed.

Troubleshooting (cont.)

Assistance

If after checking each component of your measuring system the source of the trouble remains unknown, call Orion's Technical Service Chemists.

In the United States (except Massachusetts, Alaska, and Hawaii) 1-800-225-1480. In Massachusetts, Alaska, and Hawaii or Canada, call 617-242-3900.

In Europe, the Middle East, and Africa contact your local authorized Orion dealer, or

ORION RESEARCH AG
Fahnlibrunnenstrasse 3
CH-8700 Kusnact, Switzerland
TEL 01-910-7858 / TLX 57829

Elsewhere, contact your authorized Orion dealer or:

ORION RESEARCH INCORPORATED
Laboratory Products Group
The Schrafft Center
529 Main Street, Boston, MA 02129 U.S.A.
TLX 4430019

ELECTRODE CHARACTER T

Temperature Effects

The most common cause of error in pH mea er
temperature. Ordinary electrodes drift with te pe
changes. The ROSS pH Electrode eliminates s
problems associated with the use of conventiona
trodes in samples of varying temperature.

There are, however, two effects of temperatu ch
that should be kept in mind.

1. Electrode slope will change with varying tem
ture. This slope change may be compe at
either manually, or, automatically with an utc
temperature compensator (ATC) probe and pro
designed pH meter. Consult your pH meter
tion manual for details.
2. Buffer and sample pH values vary with te per
because of their temperature dependent che
equilibrium. The problem of differing pH valu
easily solved by calibrating the elect de
characterized standard buffers whose true H v
at different temperatures are known. Buffer va
at different temperatures are given in Table 1
problem of the sample equilibrium var g
temperature in an uncharacterizable ma ne
always remain. Therefore, pH values shoul
reported along with the temperature at which
measurement was made.

Interferences

Sodium ion is the principal interference of the pH e trc
causing increasing error at higher pH (lower hydroger
activities) and at higher temperatures. Because the RC
pH membrane is composed of special low sodiu e
glass, error due to sodium is negligible when me sur
at pH values less than 12. When measuring at pH val
greater than 12, add the correction value from the nor
graph in **Figure 7** to the observed pH reading.

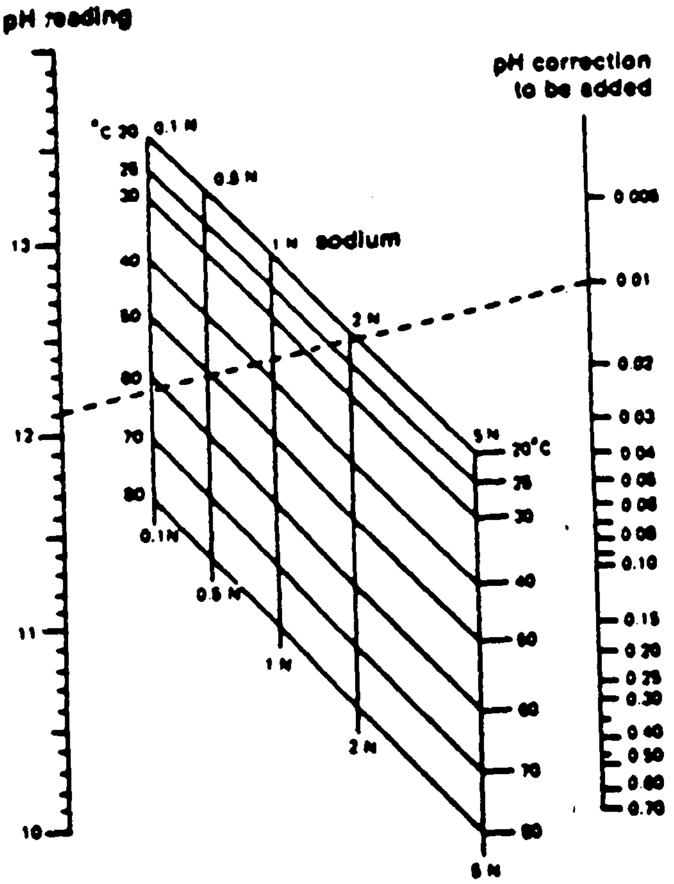


Figure 7
Typical Sodium Error Observed at pH >12

Example:

pH reading	12.10
Sodium concentration	0.5N
Temperature	50°C
Correction	0.01
Corrected pH reading	12.11

WARRANTY

Laboratory instruments are warranted to be free fr defects in material and workmanship for a period of twe (12) months from the date of purchase by the user or eig een (18) months from date of shipment from Orion, whi ever is earlier provided when used under normal laborat conditions and in accordance with the operating limitatic and maintenance procedures in the instruction manual a when not having been subjected to accident, alteratic misuse or abuse.

In the event of failure within the warranty period, Orion, its authorized distributor, will, at Orion's option, repair replace product not conforming to this warranty, or refund the purchase price of the non-conforming produ There may be additional charges, including freight, for w ranty service performed in some countries. For service, c Orion or its authorized dealer. Orion reserves the right ask for proof of purchase, such as the original invoice packing slip.

Economy Line electrodes are warranted to be free fro defects in material and workmanship for a period of thr (3) months from date of purchase by customer or six months from date of shipment if the electrode fails for a reason (including breakage) except abuse, provided t electrode is not used in solutions containing silver, sulfic perchlorate, or hydrofluoric acid; or in solutions more th 1 molar in strong acid or base at temperatures above 50° and providing the electrode is used at room temperatu (use at extreme temperatures can shorten electrode li For service, Orion or its authorized dealer will replace pro uct not conforming to this warranty or refund the purcha price of the nonconforming product.

Ion-selective electrodes and pH electrodes (excluding the Economy Line electrodes) are warranted to be free from defects in material and workmanship for a period of twelve (12) months from the date of purchase by the customer or eighteen (18) months from date of shipment from Orion, except this warranty does not cover etching of the sensing elements of Models 94-17, 96-17, 97-17, and 94-06 or the breakage of non-Economy Series pH electrodes. 93 Series sensing modules are warranted to give six (6) months of operation if placed in service before the date indicated on the package, except the nitrate sensing modules are warranted to give thirty (30) days of operation if placed in service before the date indicated on the package. Replacement parts for the 92 and 95 Series electrodes and 97-08 electrode (O-rings, membranes, filling solution, etc.) are warranted to be free of defects in material and workmanship for thirty (30) days from the date of shipment.

THE WARRANTIES DESCRIBED ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER STATUTORY, EXPRESS OR IMPLIED INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND ALL WARRANTIES ARISING FROM THE COURSE OF DEALING OR USAGE OF TRADE. THE BUYER'S SOLE AND EXCLUSIVE REMEDY IS FOR REPAIR OR REPLACEMENT OF THE NON-CONFORMING PRODUCT OR PART THEREOF, OR REFUND OF THE PURCHASE PRICE, BUT IN NO EVENT SHALL ORION (ITS CONTRACTORS AND SUPPLIERS OF ANY TIER) BE LIABLE TO THE BUYER OR ANY PERSON FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHETHER THE CLAIMS ARE BASED IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE), OR OTHERWISE WITH RESPECT TO OR ARISING OUT OF THE PRODUCT FURNISHED HEREUNDER.

Representations and warranties made by any person, including its authorized dealers, representatives, and employees of Orion which alter or are in addition to the terms of this warranty shall not be binding upon Orion unless in writing and signed by one of its officers.

ORDERING INFORMATION

Electrodes

ROSS Electrodes are available with a variety of cor
tors. For more information, consult your ORION H
trode Catalog and price list or your local ORION

Model Number	Description	Type o Conne
800500	ROSS Reference Half Cell, glass body	Pin-tip
810100	ROSS pH Half Cell, glass body	U S Std
8101BN	Same as above	BN
810200	ROSS Combination pH Electrode, glass body	U S Std
8102BN	Same as above	BN
810300	Semimicro ROSS pH Electrode, glass body	U S Std
8103BN	Same as above	BN
810400	ROSS Combination pH Electrode, glass body with rugged bulb	U S Std
8104BN	Same as above	BN
811500	Semimicro ROSS Combination pH Electrode, epoxy body	U S Std
8115BN	Same as above	BN
813500	ROSS Combination Flat Surface pH Electrode, epoxy body	U S Std
8135BN	Same as above	BN
815500	ROSS Combination pH Electrode, epoxy body with bulb guard	U.S Std
815600	Same as above	BNC
816300	ROSS Combination Spear-tip pH Electrode, glass body	U S Std
8163BN	Same as above	BNC
816600	ROSS Combination pH Electrode, sleeve reference junction, glass body	U.S Std
8166BN	Same as above	BNC

Standard Measurement Operating Procedure for:

BACHARACH HPK COMBUSTIBLE GAS & OXYGEN INDICATOR

8.0 INTRODUCTION

This document describes procedures that field personnel should perform when taking measurements with the Bacharach HPK combustible gas and oxygen indicator. The procedures that should be observed by the CDM service technicians will be documented in the CDM Field Equipment Operation, Maintenance, and Calibration Manual.

8.1 PURPOSE OF MEASUREMENT

The Bacharach HPK-2 continuously measures oxygen and combustible gas concentrations. Field technicians monitor measure oxygen and combustibles in landfill gas to indicate the air-tightness of the landfill cap. The health and safety officer measures: 1) oxygen to evaluate oxygen deficiency hazards and 2) combustible gas to evaluate the potential for explosions and fires. Combustible gas measurements are also needed to determine the reliability of measurements on the HNu photoionization detector.

8.2 SUPPLIES AND EQUIPMENT

8.2.1 Equipment needed

- Bacharach HPK-2 oxygen/combustible gas meter
- HPK aspirator bulb - #347-017
- HPK battery charger - #360-218.1
- HPK short probe and nylon hose assembly #505-015
- HPK Gas Kit case #340-180
- Flammable gas regulator - 10 psi output
- Gas control needle valve for above
- 0 - 5 liter / minute gas delivery gauge for above

- Non-flammable gas regulator - 10 psi output
- Gas control needle valve for above
- 0 - 5 liter / minute gas delivery gauge for above
- Phillips head screwdrivers (1/8", 3/16", and 1/4")
- Flat blade screwdrivers (1/8", 3/16", and 1/4")
- Soldering iron
- Slip joint pliers
- 1/4" box wrench
- Volt/Amp/Ohm multimeter

8.2.2 Supplies needed

- 4 nickel cadmium, size D, rechargeable batteries
- Size K cylinder of high purity air
- Size K cylinder of high purity 100% methane
- Size B cylinder of 2.5% methane
- Distilled water
- 1/4" Tygon^R tubing - approximately 25'
- HPK combustible gas filaments (catalytic) - #800-011
- HPK combustible gas filaments (thermal) - #800-027
- HPK dust filter refills #550-070
- HPK oxygen cell reactivation kit #514-001
- Electrical solder

8.3 START-UP

a. Place the instrument upright on a flat surface in an area free of combustibles. The instrument should be OFF.

b. The needles on both meters should rest over zero. If not, adjust the Mechanical Zero screw, located at the base of the needle, with a phillips head screwdriver until the needle rests over the zero.

c. Attach the HPK's water trap to its inlet.

d. Attach the HPK sampling hose to the inlet of the water trap.

e. Place a cotton filter in the wide part of the short probe, and screw the probe on to the sampling hose. Replace filters when they become wet or dirty.

f. If the specific monitoring procedure for the station where the HPK will be used requires an aspirator bulb, attach one to the exhaust port of the instrument.

g. Seal the end of the probe with your thumb. The HPK pump should almost stop. If it continues to pump without laboring, there is a leak in the sampling line. See Section 8.7.8.

h. Set the Range Switch (the metal lever in the middle of the control panel) to the range on which the HPK will be used (normally 100% for landfill gas and 4% for ambient air measurements).

i. Turn the Function Switch (the rotary control switch on the far right of the control panel) to VOLT TEST. Both the oxygen and combustible meters should deflect up-scale. The integral sampling pump should come on.

j. Pull upwards on the Volt Adjust knob (inner left control knob) to set the needle on the combustibles meter just over the green "Set Voltage" arrow.

k. If the needle will not rest on the green arrow, recharge the batteries (Section 8.7.2). Do not use the meter if the voltage can not be set to the green arrow.

l. Turn the Function Switch to ON.

m. Pull upwards on the Oxygen Calibrate knob (the far left control knob). Use it to place the needle of the oxygen meter just over the word "CALIBRATE" on the meter.

n. If the meter can not be set to read 21%, replace the oxygen cell assembly (Section 8.7.6).

o. Use the Zero Adjust (inner right control knob) to set the needle on the combustibles meter over the zero. Note: When the meter cannot be set to zero on fresh air, the active or reference filament may require replacement (Section 8.7.7).

p. Calibrate the instrument (Section 8.4.2 or 8.4.3).

8.4 INSTRUMENT CALIBRATION

8.4.1 Frequency of Calibration

Test	Section Number	Calibration Standard	Frequency
Mechanical zero	8.3 (b)	Internal	Every power-up
Leak check	8.3 (g)	Flow blockage	1 / day
Voltage adjust	8.3 (j)	Internal	Every power-up
Oxygen calibration	8.3 (m)	Ambient air	Every power-up
Operational zero	8.3 (o)	Ambient air	Every power-up
Analytical zero	8.4.4	High-purity air	1 / week
Gas calibration	8.4.2	Ultra-pure methane	1 / day and when changing ranges
Combustible Calibration	8.4.3	2.5% methane in air	1 / day and when changing ranges
Gas flow rate	8.4.5	Flow meter	1 / month

8.4.2 **Combustibles Calibration (100% Range)**

a. Attach a gas pressure regulator set to 10 psi to a cylinder of high purity (99.9% minimum) methane. Attach a gas flow gauge and valve to the regulator.

b. Perform start-up procedure (Section 8.3).

c. Set the Range Switch to the 100% position.

d. Attach a length of 1/4" Tygon^R tubing between the cylinder and the inlet of the HPK. This length of tubing may be used only for HPK calibration.

e. Set the valve to release methane at the flow rate shown on the label of that HPK (Section 8.4.5). Flow meter procedures are described in Section 10.5.

f. Read the position of the needle on the combustibles meter when it stops changing.

g. **If the needle does not rest over the 100 on the lower scale, adjust its position by turning the slotted shaft which is reached through a hole just below the Voltage Adjust Knob in the instrument case. Use a 3/16" flat-bladed screwdriver to turn the shaft. (Clockwise moves the needle up. Counterclockwise moves it down). CAUTION: If the control resists turning in one direction, it may have reached the limit of rotation. DO NOT force it. If this occurs, investigate the trouble as described in Section 8.7.7.**

h. **While performing this procedure, confirm that the oxygen meter reads 0%. If the reading is over 1%, reactivate the Oxygen Cell Assembly as described in Section 8.7.6.**

8.4.3 Combustibles Calibration (4% Range)

a. Attach a high-purity gas regulator set to release 10 psi to a cylinder of 2.5% methane in air. Attach a gas flow gauge and valve to the regulator.

b. Perform start-up procedure (Section 8.3).

c. Set the Range Switch to the 4% position.

d. Attach a length of 1/4" Tygon^R tubing between the cylinder and the inlet of the HPK. This length of tubing may be used only for HPK calibration.

e. Set the valve to release gas at the flow rate that appears on the face of that HPK (Section 8.4.5). Flow meter procedures are described in Section 10.5.

f. Read the position of the needle on the combustibles meter when it stops changing.

g. If the needle does not rest over the line between the 2 and the 3 on the upper scale, adjust its position by turning the slotted shaft which is reached through a hole just below the Voltage Adjust knob in the instrument case. Use a 3/16" flat-bladed screwdriver to turn the shaft. (Clockwise moves the needle up. Counterclockwise moves it down.) Caution: If the control resists turning in one direction, it may have reached the limit of rotation. DO NOT force it. If this occurs, investigate the trouble as described in Section 8.7.7.

8.4.4 Analytical Zero

a. Attach a high-purity gas regulator to a cylinder of high-purity compressed air. Attach a gas flow gauge and valve to the regulator.

b. Perform the start-up procedure (Section 8.3).

c. Set the Range Switch to the position in which the HPK will next be used.

d. Attach a length of 1/4" Tygon^{R} tubing between the cylinder and the inlet of the HPK. This length of tubing may be used only for HPK calibration.

e. Set the valve to release air at the flow rate that appears on the label on the face of that HPK (Section 8.4.5). Flow meter procedures are described in Section 10.5.

f. Read the position of the needle on the combustibles meter when it stops changing.

g. If the needle does not rest over the zero on the meter, adjust its position by rotating the Zero Adjust knob. Note: when the meter cannot be set to zero on fresh air, the active or reference filament may require replacement (Section 8.7.7).

h. Calibrate the instrument (Section 8.4.2 or 8.4.3).

i. Read the position of the needle on the oxygen meter.

j. Pull upwards on the Oxygen Calibrate knob (the far left control knob). Use it to place the needle of the oxygen meter just over the word "CALIBRATE" on the meter.

8.4.5 Flow Rate Check

a. Set the Function Control knob to ON.

b. Attach the discharge port of an analytical flowmeter to the inlet of the HPK. Note: An SMP for flow rate measurement is presented in Section 10.5.

c. Observe the flow rate as shown on the meter.

d. Write the flow rate, in liters per minute, on a label.

e. Place the label on the HPK instrument panel.

f. If the flow rate is below 1.0 liter per minute, perform the charger circuit tests (Section 8.7.3).

8.5 FIELD MEASUREMENTS

8.5.1 Measuring Gas Quality (100% Range) and Oxygen

a. Perform the start-up procedures (Section 8.3) every time you turn the HPK on. Calibrate the instrument (Section 8.4.2) each day before taking measurements.

b. Attach a 12′ length of 1/4" Tygon tubing to the exhaust port of the HPK. If you use an aspirator bulb, attach the tubing to the bulb outlet.

c. Attach the probe to the landfill gas sampling port (described in Sections 1.1, 1.2, 1.3, 1.6, 1.7, and 1.8) with a length of 1/4" Tygon^R tubing. The pump should almost stop. If it doesn't, there is a leak in the sample line. Locate and repair the leak (Section 8.7.8) before proceeding.

d. Open the sampling port.

e. Watch closely for water in the sampling line. Turn the HPK off quickly if water enters its liquid trap.

f. Read the combustible and oxygen meters when their needles stabilize.

g. If the needles waver, record your estimate of the average meter reading.

h. Close the gas sampling port.

i. Disconnect the Tygon^R tubing at the sampling port.

j. Let the HPK vent with the pump running until the combustibles meter reads 0% before shutting it off.

k. Take care not to expose the HPK to excessive moisture, dirt, or contamination. Do not place it on contaminated surfaces.

8.5.2 Measuring Explosivity (4% Range) and Oxygen

a. Perform the start-up procedures (Section 8.3) every time you turn the HPK on. Calibrate the instrument (Section 8.4.3) each day before taking measurements.

b. Sweep the tip of the HPK probe through the work area at chest height and at ground level.

c. Read the combustible and oxygen meters continuously.

d. Record the highest meter reading you observe while monitoring. Record the location of that high reading as well.

e. Let the HPK vent in clean air with the pump running until the combustibles meter reads 0% before shutting it off.

f. Take care not to expose the HPK to excessive moisture, dirt, or contamination. Do not place it on contaminated surfaces.

8.5.3 Calculation and Recording

a. The HPK reads directly in percent of gas by volume. Write the numbers down as they appear.

b. Any combustible gas concentration over 1.2% represents an explosion hazard (Section 3.1.5 of the SHERP).

c. Any combustible gas concentration above 0.3% is cause to suspect the readings on the HNu photoionization meters [Section 5.5.4 (g)].

8.6 STORAGE

8.6.1 Active Storage

Between uses during the day, the HPK must be kept as listed below. The HPK is in "active storage" when you drive it between locations on a monitoring circuit.

a. Turn the HPK off before storing it.

b. You may leave the water trap, aspirator bulb, the sampling hose and the probe in place when storing, or remove them.

c. The HPK may be kept in the passenger space of a car, truck, or van. It must be restrained against rolling when the vehicle is in motion.

d. If the HPK is kept in the cargo space of a truck, it must kept in a box (like the HPK Gas Kit case) that protects it from rain, mud, and direct sun.

8.6.2 Inactive Storage

When the HPK is stored overnight, or during a day on which it will not be used, it must be kept as listed below.

a. Turn the HPK off before storing it.

b. Carefully clean the HPK with a damp disposable towel to remove any visible dirt.

c. The HPK should be stored in the equipment trailer when it is not in use.

d. Place the HPK on charge (Section 8.7.2.1) for sixteen hours after each day of use.

8.7 PREVENTIVE MAINTENANCE, TROUBLE-SHOOTING AND SERVICING

8.7.1 Indicators of Instrument Malfunction

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
4% range meter needle rises up-scale violently.	Active filament defective.	Replace active filament (Section 8.7.7).
4% range meter cannot be set to zero.	Active filament defective.	Replace active filament (Section 8.7.7).
100% range meter needle drops down-scale violently.	Thermal filament defective.	Replace thermal filament (Section 8.7.7).
100% range meter can't be set to zero.	Thermal filament defective.	Replace thermal filament (Section 8.7.7).
Calibration screw can't set meter to 100% (or 4%)	Dirty combustion chamber.	Clean combustion chamber (Section 8.7.5).
Volt Adjust knob can't set needle on green arrow.	Batteries undercharged.	Recharge batteries (Section 8.7.2.1).

Batteries will not hold a charge.	Batteries inserted improperly.	Test battery circuit. (Section 8.7.2.2).
	Batteries defective.	Replace batteries (Section 8.7.2.3).
	Charger Defective.	Test charger circuit (Section 8.7.3).
		Replace the charger (Section 8.8).
	Pump motor defective.	Replace the pump motor (Section 8.8).
Oxygen meter cannot be set to "CALIBRATE".	Oxygen cell electrolyte spent.	Reactivate oxygen cell (Section 8.7.6).
Oxygen reading above 1% with inert gas.	Oxygen cell electrolyte spent.	Reactivate oxygen cell (Section 8.7.6).
Oxygen meter cannot be set to "CALIBRATE" **And** O_2 cell tests discontinuous [Section 8.7.6 (d)].	Oxygen cell defective.	Replace oxygen cell.
Oxygen **reading above 1%** with inert **gas.**	Oxygen cell defective.	
Combustibles meter doesn't respond during start-up or calibration.	Faulty meter.	**Send to Bacharach for repair (Section 8.8).**
Range Valve leaks, plugs, or turns stiffly.	**Dirty valve body.**	**Clean valve (Section 8.7.4).**

8.7.2 Normal Battery Maintenance

8.7.2.1 Battery Charging

a. Set Function Control knob to OFF.

b. Don't charge the batteries unless the instrument panel is firmly in place.

c. Insert charger plug into the charging jacks on the side of the instrument case below the combustibles meter. Be certain the plug marked with red goes into the jack marked with red, and the black plug enters the black hole.

d. Plug the charger line cord into a 115V AC outlet.

e. Touch the side of the charger after it is has been operating for 30 minutes. If it does not feel warm, perform the charger circuit tests (Section 8.7.3).

f. The batteries should charge for 16 to 20 hours. If the HPK will not be used on the weekend, arrange for the security personnel to disconnect the charger on Saturday morning.

g. At the end of the charge period, unplug the charger power cord. Then remove the charger plug from the charging jacks on the HPK.

h. Re-calibrate the HPK (Section 8.4.2 or 8.4.3).

8.7.2.2 Battery Circuit Tests

a. Set the range selector of a multimeter to the 10 volt scale. Place probes in the multimeter jacks as indicated on the multimeter.

b. Set the Function Control knob to OFF.

c. Insert the multimeter probes in the instrument charging jacks on the side of the instrument case under the combustibles meter.

d. The multimeter should indicate 5 volts.

e. Set the Function Control knob to ON.

f. The voltage reading on the multimeter should drop to 2.5 - 2.6 volts.

g. Failure to obtain these readings indicates depleted batteries, a short circuit, or open electrical connection. Most "battery problems" are traceable to charger malfunction or contact problems.

h. Once a month, inspect the batteries for deterioration by removing them from the storage compartment. Be careful to return the batteries to the battery holder as shown on the side of the battery case.

8.7.2.3 Battery Replacement

a. Set Function Control knob to OFF.

b. Loosen the captive hold-down screws on the meter panel.

c. Remove the meter panel from the instrument case. The batteries will be visible inside the case.

d. Remove the batteries.

e. Clean the silver battery contacts on the meter panel and in the instrument case with a rough cloth or fine sandpaper.

f. Insert the new batteries in the case.

g. When replacing batteries, be certain to reinstall them in the position indicated on the side of the battery compartment.

h. Charge the batteries (Section 8.7.2.1)

i. While Bacharach puts D-sized nickel cadmium batteries in the HPK, Alkaline type D-cell batteries may also be used.

8.7.3 Charger Circuit Tests

a. Perform battery circuit tests (Section 8.7.2.2).

b. Plug charger power cord into 115V AC outlet. Place multimeter probes on the charger pins (red on red, black on black). The multimeter should indicate approximately 5.5 volts (unloaded voltage).

c. Set the HPK Function Control Knob to OFF.

d. Insert charger plug into the charging jacks on the side of the instrument case below the combustibles meter. Be certain the plug marked with red goes into the jack marked with red, and the black plug enters the black hole.

e. Place the multimeter range selector to 500 milliamp (ma).

f. Connect the the negative (- black) multimeter probe to the red (+) charging jack of the HPK and the positive (+ red) multimeter probe to the remaining exposed pin on the charger. With Charger connected to 115V AC, the multimeter should indicate a charge rate of 120 to 150 ma. If the multimeter indicates no current, replace the charger.

g. Set the Function Control knob to ON. (Never charge the batteries with the HPK on. The power consumption is greater than the charger delivery rate).

h. Multimeter should indicate approximately 250 ma. If the multimeter indicates 300 ma or more, send the HPK to Bacharach for repair.

8.7.4 Range Valve Cleaning

a. Loosen the captive hold-down screws on the meter panel.

b. Remove the meter panel from the instrument case. The batteries will be visible inside the case.

c. Slide the "C" washer off of the bottom of the range valve stem.

d. Pull the range valve stem out of the valve body.

e. Clean the valve stem with a clean laboratory tissue.

f. Clean the valve body with cotton swabs.

g. Do not apply lubricant to the range valve.

8.7.5 Combustion Chamber Cleaning

a. Fill a tedlar bag with a freon gas (like chlorofluoromethane).

b. Vent the HPK outdoors. Step (f) below generates small quantities of hydrogen chloride gas.

c. Set the Function Control knob to ON.

d. Twist the Voltage Adjust knob as far clockwise as it will go.

e. Attach the tedlar bag to the HPK probe with a short piece of 1/4" Tygon^R tubing. Note: This length of tubing must be used for no other purpose.

f. Allow the HPK to draw the freon from the tedlar bag for 10 seconds.

g. Detach the bag from the probe. Flush the HPK with air for 30 seconds.

h. Set the HPK aside for twelve hours.

i. Perform start-up (Section 8.3) and calibration (Section 8.4.2 or 8.4.3) before using.

8.7.6 Oxygen Cell Reactivation

Reactivation Kit 514-001 is all that is required to completely reactivate the oxygen cell. The Kit contains a cap gasket with Teflon membrane, zinc electrode with O-ring, nylon screw with seal, KCl solution, nylon pad and brush. To reactivate the cell, proceed as follows:

a. Loosen the captive hold-down screws on the meter panel.

b. Remove the meter panel from the instrument case. The batteries will be visible inside the case.

c. Unplug oxygen cell from the printed circuit board and disconnect the plastic tubing from the cell inlet and outlet nipples.

d. Check for electrical continuity between the gold electrode and the banana plug. If the cell shows a resistance higher than 200 ohms, replace the cell completely.

e. Remove the nylon screw and seal ring on the electrical plug side of the cell.

f Unscrew the zinc electrode (banana plug nearest the blue dot on the side of cell). Remove it together with its O-Ring seal. Discard the zinc electrode, the screw, the O-ring and the seal.

g. Drain all the solution from the cell and completely fill with fresh

KCl solution through either opening.

h. Remove cap and gasket with membrane by removing the six screws which hold the cap in place. Discard the gasket with membrane.

i. Wash the cell thoroughly with cold, clean water. Use the brush to remove any white substance that may remain on the gold electrode. DO NOT USE ANY SOAP OR DETERGENT.

j. Any white substance that remains after brushing can be removed with the abrasive nylon pad. The gold electrode should be handled very carefully and only slight pressure applied in cleaning with the nylon pad.

k. Wash again with the brush and water.

l. Put one drop of KCl solution on top of the gold electrode and put new gasket with membrane in place. The side of the gasket with the Teflon membrane should face the gold electrode.

m. Replace the cap, observing the direction of the sampling nipples. Nipples should point away from the label on the cell body.

n. Tighten all screws until the cap shoulder is flush with the cell body. The cell is now dry charged, and can be stored as long as desirable.

o. Fill the cell with KCl solution, through the opening for the nylon screw.

p. If the old O-ring is still in the zinc electrode opening, remove it.

q. Place the new O-ring on the zinc electrode, screw the zinc electrode into the cell, and tighten it with a small wrench.

r. Plug the fill hole with nylon screw and new seal ring (310-035).

The cell is now fully activated.

s. Re-calibrate (Section 8.4.2 or 8.4.3).

8.7.7 Filament Replacement

8.7.7.1 Replacing the Combustion Filament

If the HPK has been in use for a considerable period of time, or in moist or dusty conditions, it is frequently desirable to replace the filament flame arrestor assembly in combination.

a. Loosen the captive hold-down screws on the meter panel.

b. Remove the meter panel from the instrument case. The batteries will be visible inside the case.

c. Unplug oxygen cell from the printed circuit board and disconnect the plastic tubing from the cell inlet and outlet nipples.

d. Remove the five screws holding the brass plate to the underside of the panel.

e. Remove the filament leads from the subpanel terminals.

f. Remove the flame arrestor assembly from the subpanel.

g. When replacing the filaments only, and re-using the flame arrestor:

- Remove and inspect the flame arrestor
- Check for dust, corrosion or other damage
- Replace gasket if it has deteriorated
- Install a new filament in place of the old one, by screwing the

new filament into the flame arrestor plate to compress the O-ring gasket as tightly as possible using the thumb and finger

- When inserting filament be very careful not to touch or distort the platinum coil

h. Place flame arrestor / filament assembly on to the subpanel.

i. Cross tighten the five retention screws to apply even pressure to the flame arrestor gasket.

j. Perform start-up (Section 8.3)

k. Re-calibrate (Section 8.4.2 or 8.4.3)

8.7.7.2 Replacing the Reference Filament

a. First un-solder the black wire at subpanel.

b. Unplug the oxygen cell.

c. Then unscrew the knurled reference filament base from its cavity, using a pair of pliers.

d. Install the new filament in the same position as the old one.

e. Tighten with pliers, and solder wire to subpanel.

f. Perform start-up (Section 8.3).

g. Re-calibrate (Section 8.4.2 or 8.4.3).

8.7.8 Leaks in the Sampling Line

a. Remove the short probe and sampling hose. Place a rubber cork over the water trap inlet.

b. If the motor almost stops, fix the leak in the line or probe. Do not perform the rest of this procedure if the leak is fixed.

c. Remove the water trap. Block the instrument inlet with the cork.

d. If the motor almost stops, fix the leak in the water trap or its connection. Do not perform the rest of this procedure if the leak is fixed.

e. Loosen the captive hold-down screws on the meter panel.

f. Remove the meter panel from the instrument case. Disconnect the gas line from the pump.

g. If the motor almost stops, fix the leak in the gas line. If the pump continues unimpeded, replace the pump (Section 8.8).

h. Perform start-up (Section 8.3).

i. Re-calibrate (Section 8.4.2 or 8.4.3)

8.7.9 Oxygen Cell Contamination by Foreign Liquids

If any liquid has been accidentally introduced into the sampling line and thus into the sampling chamber of the cell, it will be necessary to flush the system out with distilled water as soon as possible. To do this, use the following procedure:

a. Loosen the captive hold-down screws on the meter panel.

b. Remove the meter panel from the instrument case. The batteries will be visible inside the case.

c. Unplug oxygen cell from the printed circuit board and disconnect the plastic tubing from the cell inlet and outlet nipples.

d. Drain the liquid out.

e. Pour distilled water into one sampling nipple until it comes out of the other.

f. Drain water out.

g. Flush the cell with distilled water several times.

h. Insert the cell into the printed circuit board, observing plug color coding (the blue dot on the cell should align with the blue dot on the board).

i. Connect one end of the cell to the inlet and the other directly to the sample pump with the tubing from step (c). Bypass the combustibles reaction chamber.

j. Set the Function Control knob to ON. Flush the sampling chamber with air for five minutes.

k. The cell should now register normal output and is ready for use.

l. Reconnect sample tubing so that outlet oxygen cell goes to reaction chamber, and outlet of reaction chamber goes to pump inlet (or aspirator bulb).

8.8 Other Types of Service

All other types of repair may be performed only by the CDM or Bacharach authorized service personnel. The HPK must receive a preventive maintenance check from one of these authorized service personnel at least once a month.

Standard Measurement Operating Procedure for:

OVA FLAME IONIZATION DETECTOR

6.0 INTRODUCTION

This document describes procedures that field personnel should perform when using the Foxboro Century 128 OVA flame ionization detector. The procedures that should be observed by the CDM service technicians will be documented in the CDM Field Equipment Operation, Maintenance and Calibration Manual.

6.1 PURPOSE OF MEASUREMENT

At the OII site the OVA Flame Ionization Detector is used to:

1. Analyze gas samples from the North and South parcel gas monitoring wells;
2. Measure the vapor exposure of site personnel;
3. Detect surface emissions from landfill cracks and fissures to aid in determining need for landfill cover repair;
4. Screen off-site soils for suitability as landfill cover material (contaminated soils are rejected); and
5. Detect leaks from landfill gas transport systems.

OII site personnel do not use the OVA as a portable gas chromatograph. GC use will not be discussed in this procedure.

6.2 SUPPLIES AND EQUIPMENT

6.2.1 Equipment needed

- Foxboro Century Model 128 Organic Vapor Analyzer
- Carrying case and straps
- OVA Charger
- Maintenance and tool kit
- Hydrogen filling hose
- Hex key (supplied with instrument)
- 3/16" flat screw driver
- Nickel or quarter
- Stiff wire (about 12" of coat hanger, cleaned)
- 12" adjustable crescent wrench
- Open end box wrenches: 3/8", 7/16", 1/2" and 15/16"
- Channel-lock pliers
- Small wire brush

6.2.2 Supplies needed

- 3/16" Tygon^R tubing
- Teflon tape dope
- Spare glow plug

- Spare dust filters
- Calibration gas: 80 ± 20ppm methane in air
- Calibration gas: 500 ± 100 ppm methane in air
- Cylinder of hydrogen gas
- Cylinder brace
- Detergent / water solution
- Methyl alcohol
- Paper towels
- Cotton tipped swab

6.3 START UP PROCEDURE

a. Set the OVA on a flat surface.
b. Remove the lid by releasing the latch and pulling the lid up along its hinges.
c. Attach the probe to the main instrument package by aligning the plug and screwing the hose on. Align the spring clamp on the readout jack with the notch in the plug on the sidepack. Install the sample line L-connector parallel to the electronic connector.
d. Insert the close-area sampler firmly against the red gasket at the base of its socket in the probe body. Use the telescoping tubular sampler to test spaces you want to avoid.
e. Tighten the probe compression fitting on the sampler.
f. Pull up on the Instrument Switch and move it to BATT. If the needle on the meter deflects past the BATTERY OK white line on the probe, the OVA can operate at least four hours before it needs recharging. If it does not, charge the instrument before using it (Section 6.7.2.).
g. Pull up on the Instrument Switch and move it to ON.
h. Allow the OVA to warm up for five minutes.
i. Pull up on the Pump Switch and move it to ON. Place the main package in a vertical position, so that the Sample Flow Rate Rotameter ball floats. The rotameter should read between 1.5 and 2.25. If flow is less than 1.5, check for flow blockages (Section 6.7.4)
j. Cover the inlet of the probe with your thumb. The pump should almost stop and the rotameter float should drop to zero. If flow continues, investigate for leak (Section 6.7.5.2).
k. Set the Range Switch (in the "CALIBRATION" box) to the X10 position.
l. Use the Adjust Knob to set the needle just below 0. Set the Alarm Volume Knob so that you can hear the Flame out alarm. If you can't, see Section 6.7.1.
m. Use the Adjust Knob to set the needle to the 5 position.
n. Turn the Alarm Level Knob (on the probe) until the audible alarm just comes on.
o. Open the H_2 TANK Valve and the H_2 SUPPLY Valve slowly three turns. The H_2 SUPPLY Gauge should read between 9 and 10.5 psi. For eight hours of operation, the H_2 TANK Gauge should read at least 1500 psi. If hydrogen pressure falls below 500 psi, recharge the hydrogen tank (Section 6.7.3).
p. Wait approximately one minute.

q. Set the needle back to 0 with the Adjust Knob. You should hear the flame out alarm.
r. Depress the igniter button for 3 seconds. You should hear a soft popping sound or see a sudden sharp positive deflection of the needle when the detector lights. **Do not depress the igniter button for more than five seconds.** If the detector does not light, wait for one minute before attempting to light it again.
s. Allow the OVA to warm up at least 5 minutes before taking measurements.
t. To avoid a false flame-out alarm, set the meter to 1 ppm with the Adjust knob and make differential readings from there.
u. Test whether the OVA responds to organic solvent by holding a solvent-based marking pen in front of the probe inlet. A positive deflection of the meter indicates the flame is on.
v. Calibrate the OVA (Section 6.4.2)

6.4 INSTRUMENT CALIBRATION

6.4.1 Frequency of Calibration and Maintenance

Test	SOP Number	Calibration Standard	Frequency
Calibrate	6.4.2, 6.4.3	Methane in air	1 / day
Alarm function	6.3 (l-n)	Internal	Every power-up
Operational Check	6.3 (u)	Marking Pen	Every power-up
Leak check	6.3 (j)	Flow blockage	1 / day
Analytical zero	6.4.4	High-purity air	1 / month
Sampling Probes	6.7.5	Cleaning	2 / month
Flame arrestor filter	6.7.6	Cleaning	1 / month

6.4.2 Field Calibration

a. Perform the start up procedure (Section 6.3).
b. Set range switch on X10.
c. Set the needle to zero with the adjust knob. Note: this step is an operational zero. It should not be performed in air that yields a positive reading on the OVA (see Section 6.4.4).
d. Fill a tedlar bag with a gas standard (e.g. 100 ppm methane in air) that is National Institute of Standards and Technology (NIST) traceable. Use this tedlar bag only for calibration.
e. Attach clean 3/16" Tygon^{R} tubing from bag to probe. Don't use this tubing for any other purpose.
f. Open the valve on the tedlar bag.
g. Unlock the Gas Select knob by sliding the lock control lever to the twelve o'clock position on the knob.
h. Set the Gas Select knob to the position that places the needle in the proper position (e.g. over the 7.8 for 78 ppm calibration gas).
i. Lock the Gas Select knob.
j. Record the calibration gas, its concentration, and the Gas Select setting in the site safety log book or on the data sheet.

6.4.3 Calibration To A Gas Other Than Methane

The OVA may be calibrated to any certified hydrocarbon calibration gas. This procedure is provided special applications such as vinyl chloride monitoring.

a. Perform the start up procedure (Section 6.3).
b. Set range switch on X10.
c. Set the needle to zero with the adjust knob. Note: this step is an operational zero. It should not be performed in air that yields a positive reading on the OVA (see Section 6.4.4)
d. Fill and flush a tedlar bag with a gas standard (e.g. 10 ppm vinyl chloride in air) that is National Institute of Standards and Technology (NIST) traceable. Fill it and flush it again. Use this tedlar bag only for this gas standard.
e. Fill the bag with two to three liters of the gas. **If the gas is toxic, these steps must be done in a fume hood.**
*. It is safer to use a flow-regulated gas cylinder with a traceable calibration gas to calibrate the OVA, **especially if the gas is toxic** (e.g., vinyl chloride).
f. Attach clean 3/16" Tygon^R tubing from the bag (or cylinder) to the OVA probe. Don't use this tubing for any other purpose.
g. Open the valve on the tedlar bag (or cylinder).
h. Unlock the Gas Select Knob by sliding the Lock Control Lever to the twelve o'clock position on the knob.
i. Set the Gas Select Knob to the position that places the needle in the proper position (e.g. over the 7.8 for a 78 ppm gas standard).
j. Lock the Gas Select knob.
k. Record the calibration gas, its concentration, and the Gas Select setting in the site safety log book or on the data sheet.
l. Attach a new calibration sticker to the OVA. Make certain that the instrument is clearly marked as to the gas for which it is calibrated. All subsequent instrument readings must be expressed as ppm of the gas used (e.g., 20 ppm benzene equivalent).

6.5 FIELD MEASUREMENTS

6.5.1 Health and Safety Measurement

a. Perform the start up procedure (Section 6.3).
b. Perform the calibration procedure (6.4.2).
c. Set the needle to 1 with the Adjust Knob.
d. Start investigations of ambient air with the Range Switch in the X1 position. Switch the range setting as needed to the lowest range that yields a reading below full scale.
e. Monitor employee exposure in the breathing zone. Hold the probe about 4'-5' from the ground. Monitor enclosed areas with the probe before you enter them.
f. Perform the operational check [Section 6.3 (u)] with a marking pen whenever you are unsure the OVA is working.
g. Do not allow the OVA to contact contaminated surfaces.

h. With the exception of the the probe inlet and the exhaust, the OVA may be wrapped in clear plastic during field monitoring to protect it from contaminants or moisture (in the event of precipitation). During storage (Section 6.6.3), remove the plastic covering to minimize condensation.
i. Perform the shut down procedure (Section 6.6.1) when finished.

6.5.2 Gas Bag Sampling

a. Perform the start-up procedure (Section 6.3).
b. Perform the calibration procedure (Section 6.4.2), using a 100 ppm methane standard.
c. Carry the OVA on your shoulder, or place it on a surface known to be clean (such as the tabletops in the equipment trailer).
d. Allow the instrument to stabilize for a minute after calibration.
e. Set the needle to zero. Gas bag testing may be done with the alarm volume turned off.
f. Set the Range Switch to X100.
g. You may pre-test the gas bag for methane with the HPK as described in Section 1.6.9.
h. Methane levels above 0.2% will surely swamp the OVA's detector.
i. Attach the OVA probe to the vapor source or gas sample bag with a short piece of Tygon^R tubing. Do not attach the HNu to a source that varies from atmospheric pressure by more than 5" of water pressure.
j. Open the valve on the bag.
k. Change the range setting to the lowest range that yields a reading below full scale.
l. Record the gas concentration on the data sheet.
m. Close the valve on the bag.
n. Disconnect the tubing from the bag.
o. When you are finished with the measurements, follow the shut down procedure (Section 6.6.1).

6.5.3 "Clean" Soil Fill - Off-Site Analysis

a. Transport the OVA to the fill location.
b. If there are no holes in the fill, dig some. Allow vapor to accumulate in the holes for ten minutes before testing them.
c. Perform the start-up procedure (Section 6.3).
d. Perform the calibration procedure (Section 6.4.2) using a 500 ppm methane standard.
e. Observe and record background concentration.
f. Use the probe to test the air near the soil surface and in existing trenches or test holes at various locations in the fill dirt pile. Record the readings.
g. Reject the fill if any reading exceeds 500 ppm methane.
h. Perform the shut down procedure (Section 6.6.1) when you are finished taking measurements.

6.5.4 Leak Detection

a. Perform the start-up procedure (Section 6.3).
b. Perform the calibration procedure (Section 6.4.2) using a 100 ppm methane standard.
c. Set the alarm to 2 ppm [Section 6.3 (l-n)].
d. In the area of the leak, set the needle to 1 ppm with the Adjust Knob.
e. Place the probe near the lines, flanges, and fittings where leaks are suspected. Move the probe slowly over suspected leak points.
f. If the alarm goes off, decrease its volume. Move the probe slowly back and forth in the area to find the peak concentration, which should correspond to the source of the leak.
g. When you are finished taking measurements, perform the shut down procedure (Section 6.6.1)

6.5.5 Environmental Factors that Affect Measurements

a. The OVA is designed to sample air or vapors only. Do not allow any liquids or solids to get into the probe or meter assembly.
b. Temperature can effect the efficiency of the detector. Record the temperature at which you are working.
c. The OVA responds to methane. Because the OVA can not distinguish toxic vapors from methane, using an OVA to determine toxicity exposure on landfills often causes a false perception of hazard.

6.6 STORAGE AND CLEANING

6.6.1 Shut Down Procedure

a. Close the H_2 TANK Valve.
b. Close the H2 SUPPLY Valve.
c. Move the Instrument Switch to OFF.
d. Wait 5 seconds.
e. Move Pump Switch to OFF.
f. Carefully clean the outside of the OVA with a damp (not dripping wet) paper towel to remove any visible dirt.

6.6.2 Active Storage

Between uses during the day, the OVA must be kept as listed below. The OVA is in "active storage" when you drive it between locations on a monitoring circuit.

a. Perform the shut down procedure (Section 6.6.1) before storing it.
b. The OVA may be kept in the passenger space of a car, truck, or van. It must be restrained against rolling when the vehicle is in motion.
c. If the OVA is kept in the cargo space of a truck, the probe must be removed from the sidepack, and the OVA must kept in a box (like the case) that protects it from rain, mud, and direct sun.

6.6.3 Inactive Storage

When the OVA is stored overnight, or during a day on which it will not be used, it must be kept as listed below.

a. Perform the shut down procedure (Section 6.6.1).
b. The OVA should be stored in the equipment trailer when it is not in use.
c. Place the OVA on charge (Section 6.7.2.1) for sixteen hours after each day of use.
d. Periodically observe the hydrogen tank pressure gauge. A decrease of more than 150 psi/hour indicates a significant leak in the hydrogen supply system.

6.7 TROUBLE-SHOOTING AND SERVICING

6.7.1 Indicators of Instrument Malfunction

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Low sample flow rate	Plugged probe tube	Clean tube (Section 6.7.6)
	Clogged dust filters	Replace or clean filters (Section 6.7.4).
	Clogged flame arrestor	Replace or clean filters (Section 6.7.4).
	Broken pump	Send OVA to Foxboro (Section 6.8).
	Problems in sidepack	Send OVA to Foxboro (Section 6.8).
Flame will not light	Sample flow too low	See above
	Glow plug defective	Send OVA to Foxboro (Section 6.8).
	Hydrogen line frozen	Warm unit. Use dry hydrogen gas in cold temperatures.
	Fuel jet is misaligned	Remove flame arrestor. Re-insert it. Screw Mixer/Burner Assembly in or out.
Flame-out alarm does not sound when flame dies.	Volume too low	Turn Volume Knob clockwise.

	OVA out of calibration	Re-calibrate (Section 6.4.2, 6.4.3
	Dirty flame chamber	Clean chamber using a swab and methyl alcohol (6.7.6)
	Defective electronics	Send OVA to Foxboro (Section 6.8).
False flame-out alarm	Instrument "zeroed" to high ambient level	In X1 range, adjust meter to 1 ppm Zero to "lowest expected ambient level".
Meter responds slowly or doesn't respond	Leaks in sample line	Check for leaks (Section 6.7.5)
	Mechanical or electrical problems	Send OVA to Foxboro (Section 6.8).
Meter recovers slowly in clean air	Dirty sample lines	Clean sample lines by blowing out with clean air from SCBA (Section 6.7.7)
	Dirty Particle filters	Flushing with high purity air from SCBA or bake at 250°F.
	Dirty Flame Arrestor	Flushing with high purity air from SC or bake at 250°F.
	Dirty flame chamber	Clean chamber using a swab and methyl alcohol (6.7.6)
False high background reading	Dirty hydrogen	Use hydrocarbon-free hydrogen. Check for contaminated fittings on filling hose assembly. Remove the exhaust port and clean sample inlet filter with a small wire brush or a knife blade.
	Dirty sample input lines	Flush with clean air from SCBA.

	Dirty particle filters	Flush with clean air from SCBA or bake at 250°F.
	Dirty flame arrestor	Flush with clean air from SCBA or bake at 250°F.
	Dirty flame chamber	Clean chamber using a swab and methyl alcohol (6.7.6)
Pump runs without Pump Switch on	Short circuit in pump	Send OVA to Foxboro (Section 6.8)
No power to pump or electronics	Weak battery	Recharge battery pack. Replace battery pack.
Hydrogen pressure drops when valves are shut	Leaky H_2 valve stems	Tighten packing nuts
	Other problems	Send OVA to Foxboro (Section 6.8)
H_2 SUPPLY Gauge reads too low or too high	mis-set pressure reducers	Send OVA to Foxboro (Section 6.8)
Can't Calibrate OVA with GAS SELECT Knob	mis-set internal reducers	Send OVA to Foxboro (Section 6.8)

6.7.2 Battery Charging

Perform the following procedure in the equipment trailer.

a. Remove RECHARGER Connector cap by pressing down and twisting counter-clockwise.
b. Set battery charger switch to Off.
c. Attach the connector from the charger to the RECHARGER Connector on the BATTERY PACK cover.
d. Insert the charger's AC plug into a standard 115 v AC wall outlet.
e. Move the battery charger switch to the On position. The light above the switch should light.
f. The needle on the charger's meter indicates current flow when it is fully deflected to the left. When the meter pointer is over the charged marker, the battery has a full charge.
g. The OVA needs at least one hour of charging for every hour of operation. Overnight charging is recommended. The batteries cannot be damaged by charging for long periods.
h. When the OVA is needed, turn the battery charger switch to OFF and disconnect the charger from the battery assembly.
i. Once every 6 months, the instrument should be allowed to completely run down, and then fully recharged.

6.7.3 Hydrogen Refilling

If the H2 TANK pressure falls below 500 psi, recharge the hydrogen tank from the cylinder of zero grade hydrogen in the support zone. Do not perform this procedure while there are ignition sources, such as lighted cigarettes in the area.

a. Lift and move the Instrument Switch to OFF.
b. Attach the hydrogen filling hose securely to the cylinder of zero grade hydrogen with the 15/16" wrench.
c. Remove the OVA fill cap cover (below the H_2 REFILL Valve).
d. Attach the filling hose to the instrument fill connection with the 3/8" box wrench.
e. Check to ensure that all of the valves on the instrument are closed.
f. Open the supply valve on the hydrogen cylinder.
g. Check for hydrogen leaks in the hose and fittings. Tighten the connections if necessary.
h. Turn the FILL/BLEED Valve on the hose to BLEED for five seconds.
i. Turn the FILL/BLEED Valve to OFF.
j. Open the H_2 REFILL Valve on the instrument slightly.
k. Check for hydrogen leaks. Tighten the connections if necessary.
l. Open the H_2 TANK Valve on the instrument panel.
m. Turn the FILL/BLEED Valve to FILL.
n. It takes about two minutes to fill the hydrogen tank.
o. After the hydrogen tank is filled, close the cylinder and OVA valves.
p. Set the filling hose to BLEED.
q. Disconnect the hose from the instrument using the 3/8" box wrench.
r. Disconnect the hose from the hydrogen cylinder.

6.7.4 Particle Filter Cleaning

6.7.4.1 Probe Inlet Filter Cleaning

a. Twist the compression nut on the close area sampler clockwise and remove the sampler from its socket in the probe.
b. Unscrew the joint in the sampler body that is marked with Teflon tape.
c. Drop the filter out on your hand.
d. Look at a light source through the sampler tube. If the tube is clogged, clean it (Section 6.7.6)
e. Tap the filter, hollow side down, on a clean tabletop.
f. Scrub the surface of the filter with the wire brush from the OVA tool kit.
g. If the filter is contaminated with organics, you may soak them off with methyl alcohol, or bake them off at 250°F.
h. If you use solvent on the filter, blow it out with clean air from a compressed air cylinder. Dry the filter completely before placing it back in the sampler.
i. Place the spring in the fat part of the sampler.
j. Place the filter in the fat part of the sampler. The hollow side must face out, so that air flows into the filter cup.

k. Screw the sampler body back together. If the Teflon tape dope is worn, replace it.
l. Perform the start-up (Section 6.3) and calibration procedures (Section 6.4.2).

6.7.4.2 Sidepack Inlet Filter Cleaning

a. Remove the probe's electronic and sample line connections from the sidepack.
b. Unscrew the sample line coupling from the sidepack with a 7/16" wrench.
c. Remove the filter and spring by tilting the sidepack.
d. Clean the filter as described in Section 6.7.4.1 (e-h).
e. Reinsert the filter; spring first and cup side out.
f. Check that the O-ring on the coupling is intact. If it is not, replace with a spare from the OVA tool kit.
g. Screw the coupling back in.
h. Re-calibrate (Section 6.4.2).

6.7.4.3 Combustion Chamber Flame Arrestor Cleaning

a. Turn the OVA off (Section 6.6.1).
b. Remove the black safety cover from the exhaust port at the bottom of the OVA with a hex key.
c. Unscrew the flame arrestor in a counter-clockwise direction. Use channel-locks only if you can't remove the flame arrestor by hand.
d. Clean the filter as described in Section 6.7.4.1 (e-h).
e. Screw the flame arrestor back into its socket. Do not use tools to tighten the flame arrestor.
f. Replace the safety cover. The hex screws on the cover should barely feel tight.

6.7.4.4 Combustion Chamber Inlet Filter Cleaning

a. Turn the OVA off (Section 6.6.1).
b. Remove the flame arrestor [Section 6.7.4.3 (b-c)]
c. Locate the final filter, a porous metal surface deep in the combustion chamber.
d. Scrub the final filter in place with the wire brush from the OVA tool kit.
e. Replace the flame arrestor and safety cap [Section 6.7.4.3 (e-f)]

6.7.5 Repair Gas and Air Leaks

6.7.5.1 Hydrogen System Leaks

a. With the OVA turned off (Section 6.6.1), and the H_2 TANK Valve open, observe the level on the H_2 TANK Gauge. If the reading the next morning is significantly lower (drops more than 350 psi), there is a leak in the hydrogen system.
b. With the pump off and the H_2 valves open, listen for leaking gas.
c. Apply a soap bubble solution to the hydrogen valve stems, the GC

fittings, and the hydrogen refill cap. Bubbling solution indicates leaking gas.

d. Tighten the valve packing nuts or compression fittings at which bubbling occurs. Because you can permanently damage the OVA by over-tightening, tighten these fittings a little bit a time.

e. If the above procedures do not locate the leak, send the OVA to Foxboro for factory servicing (Section 6.8).

6.7.5.2 Air System Leaks

a. Perform a leak check [Section 6.3 (j)].

b. After each of the following steps, perform a leak check. If the pump stops, or rotameter drops to zero, no further steps are needed.

c. Moisten your thumb and repeat the leak check.

d. Twist the compression nut on the close area sampler clockwise and remove the sampler from its socket in the probe.

e. Hold the base of the close-area sampler firmly against the red gasket at the base of its socket. Tighten the compression nut.

f. If the system still leaks, remove the sample line at the sidepack coupling.

g. Place your thumb over the coupling. If the leak does not stop, tighten the coupling with a 7/16" wrench.

h. If the above steps do not correct the leak, send the unit to Foxboro for repair (Section 6.8).

6.7.6 Clean Plugged Sampling Probes

a. Dismantle the close area sampler [Section 6.7.4.1 (a-d)].

b. Push visible blockages out of the sampler tube with a length of stiff wire.

c. Blow loose particles out with clean compressed air.

d. Clean the outside of the probe with a detergent solution and a paper towel.

e. Wash the probe with organic solvent only if it has heavy organic contamination.

f. If solvent is used, wash the probe with detergent and water, then bake it in the sun for an hour to eliminate residual hydrocarbons before reassembly.

g. Reassemble the sampler [Section 6.7.4.1 (i-k)].

h. Perform the start-up (Section 6.3) and calibration procedures (Section 6.4.2).

6.7.7 Replace Charcoal Filter

a. Loosen the end caps on the charcoal filter holder, a silver cylinder on the face of the OVA, with a set of channel lock pliers.

. Withdraw the charcoal cartridge from the holder and dispose of the charcoal.

. Refill the cartridge with fresh charcoal Foxboro P/N CSC004 or equivalent. Fill the cartridge completely.

. Insert the cartridge back into the holder.

. Replace the end caps on the holder. Tighten the end caps just past

finger tight with the channel lock pliers.
- Check the tightness of the end caps with detergent water [Section 6.5.1 (c-d)].

6.7.8 Replace Igniter Plug

- Perform the shut down procedure (Section 6.6.1)
- Turn the four screws on the face of the OVA 1/4 turn counterclockwise to release it from the case.
- Remove the igniter button shield by rotating it clockwise.
- Remove the OVA from its case by lifting the face plate while pulling the plastic case out to allow the igniter button to pass.
- Perform the start-up procedure [Section 6.3 (a-p)]. You may omit the leak check and alarm volume steps.
- Look for glow on plug when the Ignite button is depressed.
- If plug does not glow, unscrew it with the 5/16" open end wrench only Do not use a crescent wrench, since stripped threads require major repair.
- Screw a new glow plug in the socket - **tighten slightly snug only,** to avoid stripping threads.
- Check for glow on new plug. Look for evidence of ignition [Section 6.3 (p)]. If the plug glows, but the flame does not ignite, see Section 6.7.1.
- Perform the shut down procedure (Section 6.6.1)
- Place the OVA back in its case.
- Tighten the four case screws.

6.7.9 Clean Combustion Chamber

a. Perform the shut down procedure (Section 6.6.1).
b. Remove the flame arrestor [Section 6.7.4.3 (b-c)].
c. Moisten a cotton swab with one or two drops of water only.
d. Swab around the electrode and the chamber to remove visible particles.
e. Run the OVA pump for 5 - 10 minutes to dry the chamber.
f. Replace the flame arrestor [Section 6.7.4.3 (e-f)].

6.8 OTHER TYPES OF SERVICE

While the OVA often requires types of service not addressed in this manual, the procedures needed should not be conducted by personnel who have not been trained by Foxboro. When the methods listed in this manual fail to make the OVA operate satisfactorily, send the OVA for repair to:

Foxboro Company
P.O. Box 5449
151 Woodward Avenue
South Norwalk, CT 06856

Call Foxboro ahead of time for a return authorization at (203) 853 -1616 or (800) 321 0322.

APPENDIX F

LABORATORY QUALITY ASSURANCE MANUALS

APPENDIX F - CONTENTS

- Agriculture and Priority Pollutants Laboratories (APPL)
- Coast to Coast Analytical Services
- Tracer Research

AGRICULTURE
&
PRIORITY
POLLUTANTS
LABORATORIES
INC.

QUALITY
ASSURANCE
MANUAL

MARCH 1990

QUALITY ASSURANCE MANUAL

1990

Agriculture & Priority Pollutants Laboratories, Inc

APPL, Inc.
4203 W. Swift Ave.
Fresno, California 93722
(209) 275-2175

TABLE OF CONTENTS

QUALITY POLICY

The object of Agriculture & Priority Pollutants Laboratories, Inc. (APPL, Inc.) is to provide high-quality data that is accurate, reliable and adequate for the intended purposes.

SCOPE

The purpose of a Quality Control program is to monitor the analytical process. This manual is designed to inform all employees working at Agriculture and Priority Pollutants Laboratories, Inc. (APPL, Inc.) what is required for consistently precise and accurate data. By following the guidelines presented here, the quality of all work can be maintained at the highest possible levels.

The complex nature and pitfalls of the analytical procedures require a set of built-in controls to prevent or detect incorrect results. In a legal action it is not unusual that the testimony of the analyst is evaluated on the strength or weakness of the operating quality control program.

LABORATORY

APPL, Inc. is located in Fresno, California and is housed in an 8,000 square foot building. The facility was designed and built for the specific needs of a analytical laboratory. The services offered include GCMS, LCMS, GC, ICAP and Volatile analysis.

APPL, Inc. is certified by the State of California Department of Health Services Hazardous Waste Testing Laboratory, Department of Public Health Laboratories Services Sanitation and Radiation Laboratory-Approved Water Laboratory and the California Department of Food and Agriculture pesticide residue analysis.

The laboratory is broken down into 7 areas. Each of these areas are on their own separate positive air flow systems from one another. The areas are as follows: Sample Receiving, Organic Extraction, Inorganic Extraction, Organic Instrumentation, Inorganic Instrumentation, Volatile Organic Analysis and GC/MS.

Sample receiving is located for easy access from the entrance of the laboratory. This room has the capacity of storing large numbers of samples. The sample tracking is started at the time samples are received. Three full time employees are on hand to receive, store and dispose of samples. All employees are trained for the sample tracking system, MacIntosh Plus System, Omnis III software.

The organic extraction laboratory is next to the sample receiving. All organic extraction takes place in this laboratory. The equipment used include soxhlet extraction units, mechanical shakers, and various types of specific glassware suited to the matrix needs. Seven employees work in this section, four full time and three part part time, with one full time supervisor.

The inorganic extraction laboratory houses all the equipment for inorganic analysis; hot plates, analytical balances, pH meters, ion chromatograph and specific glassware for inorganic needs. Five employees work in this section two full time, three part time and one full time inorganic section supervisor.

The volatile laboratory has gas chromatographs equipped with purge and trap units all with auto samples. All sample analyses performed in this section are performed by a laboratory automation system. Two full time employees work in this section.

The organic instrumentation laboratory has nine gas chromatographs equipped with 10 ECDs, 4 NPDs and 4 FIDs. This room also houses the LCMS which is run by two full time employees fully trained for LCMS analysis. Four full time employees also work in this section, three full time and one part time.

The inorganic instrumentation laboratory has an ICAP and atomic absorption spectrophotometer. These instruments are run by one full time section supervisor.

The GC/MS room houses 2 mass spectrometers, one dedicated to volatile analysis and one dedicated to semi-volatile analysis. They are operated by two full time employees.

The reception area, offices, file room and lounge take up the rest of the laboratory square footage.

STAFF

Laboratory Directory - Authorizes final reports, monitors project status, coordinates sample logistics between laboratory and client, consults with client on analytical procedures, overall supervision of personnel. Director sees that the day to day operation of the laboratory is smooth and efficient.

Quality Control Director - Reviews all organic and inorganic analysis to insure compliance with QC guide lines, analytical data validation and reduction, monitors EPA perfomance programs, performs in-house audits. Also is assistant project manager for specific clients.

Health and Safety Officer - Institutes and monitors programs and training, tracks all hazardous/potentially hazardous samples and wastes, performs laboratory safety audits.

Sample Custodian - Supervises sample receiving personnel, monitors distribution and disposition of samples and Chain of Custody, maintains records for samples tracking and storage integrity, coordinates

TRAINING

Training of new personnel is the responsibility of the supervisor or senior analyst in that section. Summaries of on the job training and outside education and technical experience information are kept in the personnel files. These files are maintained by the manager.

Annual reviews are done on all employees. These reviews are done by the supervisors or the laboratory director which ever is more appropriate. Goals are set and discussed at the time of the review. The employee and reviewer sign the review form. Each year the old review is discussed to see if goals have been met or changed.

When an employee attends special training or education seminars a brief summary is written by the employee and filed in their personnel file.

shipping of all samples.

Organic Supervisor - Oversees all operation of organic section; extraction procedures, instrumentation, and personnel. Trouble shooter for section and the Laboratory Automation System manager.

Inorganic Supervisor - Oversees all inorganic operations. ICAP and AA analyst. Coordinates sample flow and employee work load.

EQUIPMENT AND CALIBRATION PROCEDURES

Major instrumentation used at APPL, Inc. include 2 Hewlett-Packard Gas Chromatograph/Mass spectrometers, one dedicated to volatile analysis and the second dedicated to semi-volatile analysis. The first GC/MS was installed in October 1985 and ran both volatile and semi-volatile analysis. A Tekmar auto sampler was added in December 1986. The second GC/MS was installed in April 1987.

Calibration is done daily in accordance with EPA approved methodology and instrument manufactures instructions prior to any analysis.

Initial calibration consists of injecting all TCL compounds at 5 concentrations. Concentration of standards used are listed in the CLP. Average response factors are generated using the internal standards specified in the CLP. Relative standard deviation in the response factors for all TCL compounds must be less than or equal to 30%.

Once the initial calibration criteria is met, a daily calibration check is performed every 12 hours or once per day. All TCL compounds are injected and the response factors are calculated. The response factors are compared to the %RSD of the initial check and must be within plus or minus 10%. The response of the internal standards and the surrogate compounds are plotted daily on Shewart Control Charts and must remain within 95% confidence levels.

The mass spectrometers are tuned every 12 hours or once per day. The tuning parameters have been specified by the EPA using 1-bromo-4-fluorobenzene (BFB) for volatiles and Decafluorotriphenylphosphine (DFTPP) for semi-volatiles. The criteria for tuning parameters is presented in Table 1.

The 2 GC/MS instruments have full maintenance and service agreements. In house maintenance and servicing records are kept in a bound lab book found next to each instrument. Spare parts are keep on hand in case of equipment failure. Downtime will be minimized by proper use and maintenance of the equipment.

Located in the organic instrumentation labortory are 9 gas chromatographs equipped with 10 electron capture detectors, 4 nitrogen-phosphorus detectors and 4 flame ionization detectors. 8 GCs are Hewlett-Packard 5890A gas chromatographs and 1 is a Hewlett-Packard 5880 gas chromatograph. The 5880 GC was installed in February 1983. The 5890 GCs were installed from December 1984 through June 1989. Two 5890A GCs are dedicated to organochlorinated pesticide analysis, two are dedicated to organophosphorus pesticide analysis, one is dedicated to phenoxy herbicide analysis, one is dedicated to EDB/DBCP analysis, one is dedicated to 8015 analysis, one is used for total hydrocarbons analysis and phenol analysis, the 5880 GC is dedicated to special projects. All instruments have maintenance agreements. In house maintenance is logged in bound log books kept beside each of the instruments. These in house maintenance procedures are explained in detail in several APPL standard operating procedures.

Organochlorinated pesticide calibration is done using a stock calibration standard consisting of aldrin, dieldrin, DDT and a surrogate standard, Deca PCB. It is prepared at 3 concentration levels. To each calibration standard concentration a known amount of internal standard, Tetrachloro-m-xylene, is added. The response factors are calculated according to CLP and the present relative standard deviation must be less than or equal to 20% for aldrin, dieldrin, DDT and Deca-PCB. This calibration is done every 72 hours. If the %RSD is greater than 10% a fresh calibration standard is made and the calibration is repeated according to APPL standard operating procedures. Two standard mixes containing the TRCL pesticides are injected every 15 samples alternating between the 2 mixes.

Organophosphorus pesticides calibration is done using stock calibration standard consisting of trifluralin, methyl parathion, DEF and a surrogate standard, Terbuthylazine. It is prepared at 3 concentration levels. To each calibration standard a known amount of internal standard, Barban, is added. The response factors are calculated and the percent relative standard deviation must be equal to or less than 25% for trifluralin, methyl parathion, DEF and terbuthylazine. This calibration is done every 72 hours. If the %RSD is greater than 25% a fresh calibration standard is made and the calibration is repeated according to APPL standard operating procedures.

Herbicide, total hydrocarbons, DBCP and EDB calibration is done using a minimum of 3 concentration levels. The calibration mix for herbicides consists of silvex, 2,4-D, 2,4,5-T and dacthal (surrogate). The calibration and standard mix for total hydrocarbons consists of gasoline, kerosene and diesel. The calibration and standard mixes for DBCP/EDB analysis consists of DBCP and EDB. The response factors are calculated and must be less than or equal to 25%.

Also located in the organic instrumentation laboratory is a Hewlett-Packard 5988A Thermospray LC/MS. Prior to the determination of each set of samples the mass spectrometer is tuned to optimize performance, sensitivity, and mass spectral resolution. Tuning involves the introduction of a chemical known as a tuning compound into the mass spectrometer. Various parameters are adjusted until the mass spectrometer's performance is optimized over the expected mass range of the samples.

Located in the Volatile organic analysis (VOA) laboratory are 3 Hewlett-Packard 5890 gas chromographs. One GC is equipped with a Tekmar LSC 2 purge and trap and a Tekmar ALS 10 stage autosampler. The second GC is equipped with a Tekmar 4000 purge and trap and a Tekmar ALS 10 stage autosampler. The third GC is equipped with a Tekmar LSC 200 purge and trap and a Tekmar ALS 2016 16 stage autosampler. The first VOA instrument was installed in April 1984. The VOA instrument was installed in November 1986. The third VOA instrument was installed in July 1988. All VOA instruments have service agreements. In house maintenance is logged in bound log books located beside each of the 3 instruments. This maintenance log book is referenced in APPL standard operating procedures.

Initial calibration for external standard is done by preparing a minimum of 3 concentration levels for each parameter of interest by adding 20 µL of one or more secondary dilution standards to 100 mL of reagent water. Each calibration standard is analyzed and area response versus the concentration is tabulated. The ratio of response to concentration (calibration factor) is a constant over the working range, less than or equal to 10% relative standard deviation.

The inorganic instrumentation includes a Thermo Jarrel Ash inductively coupled argon plasma simultaneous spectrophotometer (ICAP) and a Varian 1475 atomic absorption spectrophotometer (AA). The AA was installed in September 1983 and the ICAP was installed in December 1987.

The instruments are calibrated according to CLP standards are prepared by diluting stock solutions. They are prepared fresh each time an analysis is to be made. At least 3 concentrations are prepared in an appropriate range. After initial calibration a continuing calibration verification is analyzed at least 10% frequency or every 2 hours. The same continuing calibration standard is used throughout the analysis run. Control limits for initial and continuing calibration verification and listed in Table 2.

To verify linearity an ICAP standard at least 2 times the detection limit is analyzed at the beginning and at the end of each sample analysis run.

A calibration blank is analyzed at each wavelength after every initial and continuing calibration verification, at a frequency of 10% or every 2 hours during a run.

TEST METHODS

APPL is capable of analyzing a wide variety of matrices for various pesticides, herbicides and inorganic parameters. Several test methods are used. They are found in the following references:

"Test Methods for Evaluating Solid Waste" (SW-846), 2nd edition, Update I (1984), Update II (1985), 3rd edition (1986), USEPA

"Guidelined Established Test Procedures for Analysis of Pollutants Under the Clean Water Act" 40 CFR, Part 136, (1984).

"Methods for the Determination of Organic Compounds in Drinking Water" EPA/600/4-88/39 (1988), USEPA.

"Standard Methods for the Examination of Water and Wastewater", 16th edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation, Washington D.C. (1985).

"Recommended Methods of Analysis for the Organic Compounds Requested for AB 1803", 5th edition (1986).

All procedures that take place at APPL are covered by the above mentioned references or by APPL standard operating procedures. Standard operating procedures (SOP) cover quality control, shipping & receiving, organic and inorganic training, methods, special projects and office management. All SOPs are written in three parts. Introduction - contains a brief summary of what the SOP is all about. Instructions - contains detailed instructions on how to do the specific task so that a qualified person could do that procedure by following the SOP. Salutation - describes persons qualified to perform the SOP procedures. All SOPs contain a minimum of 2 signatures. A copy of every SOP is kept on the main bookshelf in the laboratory and are available to any employee at any time. A copy of section specific SOPs are kept in that section and are maintained by the section head.

PERFORMANCE & SYSTEM AUDITS

External audits include the two EPA sponsored programs; Water Supply Study (WS) from Cincinnati and the Water Pollution Laboratory Performance Evaluation Study (WP) from Cincinnati. The first one provides water samples for organochlorine and organophophorus pesticides along with herbicides, carbamates, volatiles, and inorganic parameters. The analysis is performed using the EPA 500 series methods for drinking water. The second provides water samples for organochlorine pesticides, volatile halocarbons, volatile aromatics, herbicides and inorganic parameters. The analysis is performed using the EPA 600 series methods. Both programs are biannual.

It is the QC Directors responsibility to see that samples are handled on a timely basis. After the results have been turned in to the agencies and a report has been issued to APPL, Inc. it is the QC Directors responsibility to notify each analyst of his or her performance. If the results are not within the specified limits, the QC data run at that time is extensively reviewed.

Internal performance evaluations audits include split samples, field duplicates and field blanks which are run on every 10th sample. The identities of these audits will be know after the analysis has been completed and reported. EPA QC checks are also used as internal performance audits and are run on a quarterly basis.

Internal audit checks are done once per month or at intervals adequate to assure the integrity of the project. These audits will show the data of the audit, who performed the audit, the project audited, type of analysis, findings and problems, corrective action taken and the anticipated date for re-inspection. A sample is chosen at random. This sample can be at any point of completion. The QC director will perform these internal audits. If the QC director is unavailable the project manager will perform the audits.

STATISTICAL ASSESSMENT OF DATA QUALITY

Routine procedures taken from EPA methodology will be used to assess all data generated in terms of accuracy, precision and completeness.

Accuracy is the nearness of a result or the mean of a set of results to the true value. Accuracy is expressed in terms of percent recovery for a spiked sample. Percent recovery equals the concentration found divided by the true concentration times 100.

Shewhart Control Charts are initially plotted using at least 5 spike recoveries. The mean percent recovery (X) and the standard deviation (s) is calculated. Upper and lower control limits (UCL, LCL) are established by adding and subtracting 3 times the standard deviation from the mean. Spike analysis are performed on 10% of samples received or at least once per batch of samples.

Precision refers to the agreement or reproducibility of a set of replicate matrix spike results. Precision is usually expressed as the relative percent difference.

$$\% \text{ difference} = \frac{2(A-B)}{(A+B)} \times 100$$

Since the least difference between a pair of duplicates can be zero, that value forms the baseline of the control chart. The control limit will be 3 times the standard deviation.

Completeness is the ratio of acceptable laboratory results to the total number of analysis performed.

$$C = \frac{(1-\text{ number of defective results})}{\text{total number of requested analysis}} \times 100$$

Completeness value will be at least 95%.

CORRECTIVE ACTION

Corrective action will be initiated when the following problems arise:

1) Any data point beyond the UCL or LCL on a control chart.
2) 7 successive points on the same side of the mean on a control chart.
3) Less than 50% of the data points fall within plus or minus one relative standard deviation of the mean.
4) Unacceptable results on performance evaluation audits
5) Unacceptable results on inter/intralaboratory comparision studies

The first step is to repeat the analysis on the spike/spike duplicate which failed, if this set of data doesn't fail then the analysis may be treated as a random error and disregarded. If the repeated analysis continues to show error a laboratory control spike/spike duplicate is analyzed. If this analysis is in control then the out of control matrix/matrix spike duplicate can be attributed to matrix interference. If the laboratory control spike/spike duplicate is out of control the following measurements are to be taken:

a) Stop analysis

b) Check calculations

c) Check instruments for proper performance through accuracy and precision

d) Verify standards

e) Assure the purity of reagent water

f) Identify and resolve the problem

g) Increase frequency of quality assurance checks to ensure analysis is back in control

h) Document the problem and solution

i) Discard all analysis since the last in-control data point.

QUALITY ASSURANCE REPORT TO MANAGEMENT

Monthly reports will be submitted in writing to the Laboratory Director from the Quality Control Director. The monthly report will contain an assesment of the data accuracy, precision and completeness. Significant quality assurance problems and recommendations will be reported verbally as they arise.

SOURCES AND PREPARATION OF STANDARDS

The reagents, standards and reference material required for the methods used at APPL are kept in specific locations for each section. All orgainc standards are located in a refrigerator that contain only standards. A standard refrigerator log is used to record when a standard is removed from the refrigerator for use and when it is replaced and who the user was. The section head is responsible for the standards, to make sure they do not go past an expiration date and to make sure that there is enough standard.

All VOA standards are stored in a VOA specific refrigerator located in the VOA room. A log is kept of which standards are on hand.

All GC/MS standards are stored in a refrigerator located in the mass spectrometer room. A log is kept of which standards are on hand and their use.

All inorganic standards and reagents are stored in the inorganic extraction room. Shelf life is recorded to show when reordering is necessary. The inorganic supervisor is responsible for the standards and reagents.

All standards that are received at the laboratory are recorded in a bound lab book located at the quality control director's desk. An SOP outlines the steps to take when recording a standard. The QC director distributes the standards to the appropriate section head.

Preparation of working standards is done by the section head. The procedure for preparing and documenting standards is covered in APPL SOPs.

SAMPLE CUSTODY PROCEDURES

Upon arrival, all samples are inspected for damage. Any sample container found leaking, broken or damaged in any way is immediately reported to the sample custodian. Samples in containers not appropriately preserved or in containers other than those recommended by the EPA will be noted on receiving documentation. The client will be informed by the laboratory.

All samples, after inspection are issued a unique APPL, Inc. number. The numbers are numeric and are logged in the "Sample Receiving Book". The lab number is affixed to the sample container. A sample analysis sheet is then filled out for each set of samples. See Appendix 1. The information contained on the analysis sheet is entered into the laboratory tracking system, MacIntosh Plus System, Omnis III software. A daily printout is used in all sections to keep track of the sample load. Each section head is responsible to follow the sample tracking in their section. This information is also entered into the "Sample Analysis Required" log book. The information contained in this book is a simplified version of the analysis sheet in a bound volume. Client reference, analysis required, APPL number and analysis sheet number are then readily available during computer down time. A copy of each analysis sheet is distributed to all pertinent sections. Once the sample has been properly received it is cooled to 4°C.

Insuring the integrity of the chain-of-custody for a sample is of the utmost importance. The number of individuals handling the sample must be kept to a minimum. When samples arrive with a chain-of-custody form, see Appendix 2, the form is signed by the receiving officer, dated, time noted, copied and returned to the client. A copy of the chain-of-custody is filed in chronological order in a chain-of-custody file. A copy is also attached to the sample analysis sheet to be cross checked for reporting purposes.

When the sample is being analyzed, every piece of glassware is labeled with its unique laboratory number. The final vial containing the prepared sample is labeled with the same number and the instrument analyzing the sample is programmed with the laboratory number to insure proper reporting for each sample.

All samples are logged into and out of the refrigerators. The date, time and the persons initials are recorded in this log book located in the sample receiving area. The only exception to this procedure is that volatile samples are stored separately from all other samples. All refrigerators are on a temperature monitoring system which is checked daily.

All samples are kept up to a maximum of 60 days after the final reports are sent to the client. Samples will be returned to the client when ever possible. Samples that are not returned will be disposed of properly, to the correct waste disposal site as determined by the maximum contaminant levels found.

All procedures in sample receiving, handling and shipping are covered in APPL SOPs for that section. A sample flow chart in shown in Table 2.

DATA VALIDATION

Validity of all data generated will be determined based on the precision and accuracy accessment. All data calculations will be checked and rechecked a second time by the analyst. All raw data will be clearly marked for proper identification. The validation consist of data generation, reduction and two levels of review. The data reduction and validation process is documented and initialed by the analyst. The following points are reviewed: Sample preparation, analysis information, QC samples are within the correct limits and documentation is complete. If the QC data doesn't meet the criteria the sample is re-analyzed. Professional judgement and experience to evaluate the validity of the reported results is used. Reports submitted will have sufficient back-up QC data available for review. Laboratory reports will be checked and signed by the analyst who performed the work and will also be signed by the laboratory director or the QC director.

A laboratory automation system is used to analyze volatile samples, organochlorinated pesticides, organophosphorus pesticides and herbicides. To make sure the LAS is working properly, calibration of the instruments as specified in the methods is done every 72 hours. The laboratory automation system manager runs checks to make sure the system is functioning properly.

INTERNAL QUALITY CONTROL CHECKS & FREQUENCY

Minimum laboratory quality control checks will include: blanks, spikes, spike duplicates, standards, internal standards, QC Check samples, reagent checks, surrogate standards as specified by methodology and control charts.

Method blanks will consist of laboratory pure deionized water. For volatile analysis the deionized water will be boiled 15 minutes. The method blanks will be carried through the entire analytical scheme. The method volume will be approximately equal to the sample volume. Method blanks will be run every 10th sample or once with every batch of samples.

Matrix spikes and matrix spike duplicates will be run every 10th sample or once with every batch of samples. This data will be documented as precision on control charts. If spikes exceed control limits increased precision data is produced until analysis is back in control. If matrix spike and spike duplicates fail QC requirments a laboratory control spike/spike duplicate will be analyzed. This is to check the extraction procedure and the instrumentation.

Control charts are maintained daily on each instrument for standards used. Standards which do not fall within 2 standard deviations of the mean will not be used for analysis.

Internal standards are used during GC and GC/MS analysis whenever they are compatible with the analysis and methodology used.

Quality control samples from the EPA are analyzed quarterly. Along with EPA check samples APPL, Inc participates in two EPA sponsored programs; Water Supply Study, EMSL-Cincinnati and the Water Pollution Laboratory Performance Evaluation, EMSL-Cincinnati. Both the above programs are twice yearly.

All incoming reagents are logged into a bound lab book. Lot numbers are recorded along with a space to log date opened to insure the shelf life isn't exceeded. Reagents are tested periodically to insure against laboratory interference.

Surrogate standards will be spiked into each blank, sample and matrix spike according to EPA methodology.

QC documentation following the Shewhart Control Chart format will be maintained for precision and accuracy.

TABLE 1

BFB KEY ABUNDANCE CRITERIA

Mass	Abundance Criteria
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	Base peak, 100% relative abundance
96	5 to 9% of mass 95
173	<2% of mass 174
174	>50% of mass 95
175	5 to 9% of mass 174
176	>95% but < 101% of mass 174
177	5 to 9% of mass 176

DFTPP KEY MASSES AND ABUNDANCE CRITERIA

Mass	Abundance Criteria
51	30 to 60% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	40 to 60% of mass 198
197	<1% of mass 198
198	Base peak, 100% relative abundance
199	5 to 9% of mass 198
275	10 to 30% of mass 198
365	>1% of mass 198
441	Present but less than mass 433
442	>40% of mass 198
443	17 to 43% of mass 442

<u>TABLE 2</u>

SAMPLE FLOW CHART

Sample Receiving	- Check and document physical condition of sample upon receipt - Verify sample documentation - Log into sample information system - Distribute pertinent information to analytical sections
Sample Storage	- Sample is stored in accordance to standard EPA guidelines or specific client instructions - Monitor all storage areas - Maintain documentation for sample distribution/sample return
Analytical Sections	- Requested analysis are verified and performed with all work documented - Unused sample is returned to sample receiving
Sample Archiving	- Sample is archived 60 days from finalized report date, then returned to client or arranged for disposal

TABLE 3

Compound	Container	Preservative	Holding Time
Volatile conc. waste samples	Widemouth glass with Teflon liner 8-oz.	None	14 days
Volatile water samples	2-40mL vials with Teflon lined septum caps	4 drops conc HCl Cool, 4°C	14 days
Volatile sludge, soil samples	Widemouth glass with Teflon liner 4-oz.	Cool, 4°C	14 days
Semivolatile conc. waste samples	Widemouth glass with Teflon liner 8-oz.	None	14 days
Semivolatile water samples	1 gal amber glass with Teflon liner	Cool, 4°C	Extracted within 7 days and analyzed within 40 days
Semivolatile sludge, soil	Widemouth glass with Teflon liner 8-oz.	Cool, 4°C	14 days

Received By: ____________________

Appendix 1

SAMPLE ANALYSIS SHEET

R-

Client: ____________________

Address: ____________________

City: ____________ Zip: ________

Attention: ____________________

Phone#: ____________________

Client Job, Project#,
or Location: ____________________

PO# (If available): ____________________

Sample Date: ____________________

Date Received: ____________ Time: ________

Delivered By: ____________________

DUE DATE: ____________________
(In RED Ink)

EXTRACT NO LATER: ____________________

Time In/Color: ____________________

Chain of Custody: yes____ no____

Client ID	APPL ID	Analysis Requested

Samples remained chilled in shipping containers until
received & placed in refrigerator/freezer: yes____ no____

Additional copies or comments: ____________________

Charges:

Invoice#:

# of Samples to whom:

Appendix 2

CHAIN OF CUSTODY RECORD

SAMPLERS: *(Signature)*

Phone:

SHIP TO:

ATTENTION:

Phone No.

SHIPPING INFORMATION

Shipper

Address

Date Shipped

Shipment Service

Airbill No.

Cooler No.

Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date/Time
Relinquished by: *(Signature)*	Receive for laboratory by*: *(Signature)*	Date/Time

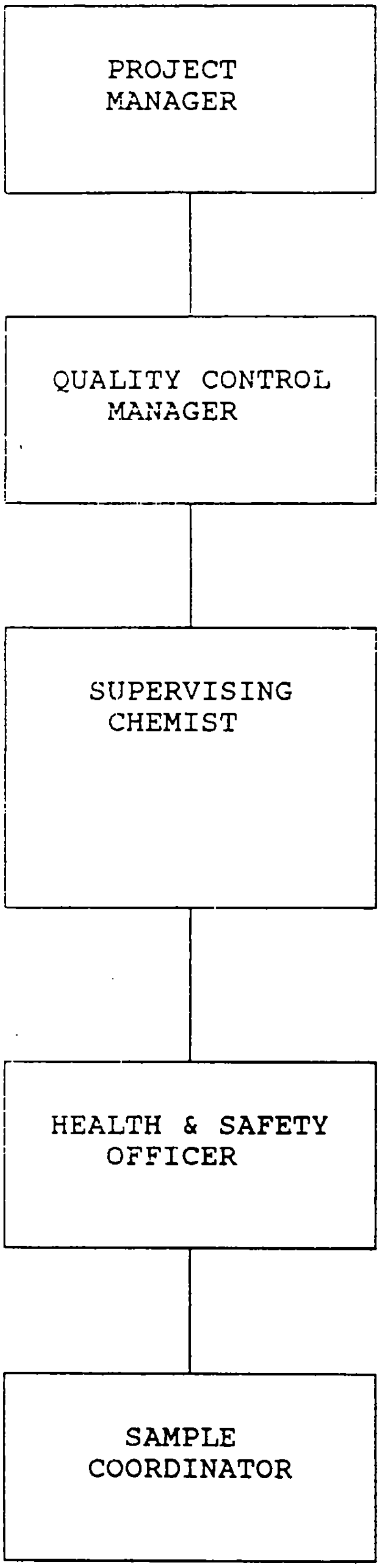
*Analysis laboratory should complete, "sample condition upon receipt", section below, sign and return top copy to
A P P L, INC. 4203 WEST SWIFT, FRESNO, CALIFORNIA 93722

Sample Number	Site Identification	Date Sampled	Analysis Requested	Sample Condition Upon Receipt

Form A-382 (Rev. 7/82)

APPENDIX 3

ORGANIZATION CHART



PROJECT MANAGER

0) Authorizes final report after quality control supervisor approval
0) Monitors project status
0) Coordinates sample logistics between lab and client
0) Consults with client on analytical procedures
0) Check daily GC/MS calibration reports

QUALITY CONTROL MANAGER

0) Reviews all organic analysis to insure compliance with quality control guidelines
0) Implements quality control check programs
0) Analytical data validation and reduction
0) Prepares and circulate in-house blind spikes
0) Updates certifications with various goverment agencies

SUPERVISING CHEMIST

0) Supervise sectional chemists and technicians
0) Initiate and monitor quality control programs
0) Insure sectional instrumentation maintenance programs
0) Generate instrument calibration reports
0) Monitor analysis of field and quality control samples, matrix spikes, and duplicates

HEALTH & SAFETY OFFICER

0) Institutes and monitors safety programs and training
0) Tracks all hazardous/potentially hazardous samples and wastes
0) Performs laboratory safety audits

SAMPLE COORDINATOR

0) Supervises sample-receiving personnel
0) Monitor distribution and disposition of samples and chain-of-custodies
0) Maintaines records for sample tracking and storage integrity
0) Coordinates shipping of all samples

Coast-to-Coast Analytical Services, Inc.

QUALITY ASSURANCE MANUAL
and
QUALITY CONTROL PROGRAMS

REVISION DATE:

August 1990

Laurence R. Hilpert, Ph.D.
Vice President/QA Officer

COAST-TO-COAST ANALYTICAL SERVICES

QUALITY ASSURANCE PROGRAM

TABLE OF CONTENTS

SECTION 1.0 - PROJECT DESCRIPTION

Coast-to-Coast Analytical Services, Inc. (CCAS) proposes to supply analytical support for projects dealing with environmental sampling and analysis of air, water, soil, wastewater, and petroleum products. Projects which CCAS is capable of supporting may include, but are not limited to the following general descriptions:

1. Buried Tank Investigations
2. California AB 2588 Air Studies
3. Wastewater Pilot Studies
4. Toxicity Bioassay Studies
5. Groundwater Monitoring
6. Hazardous Waste Investigations
7. Soil Gas Studies
8. BTU Value of Gas Determination
9. Compliance Monitoring
10. Expert Testimony

EPA-style or other project-specific data reporting formats can be developed in support of your individual work orders. However, it is our experience that these are generally not necessary.

SECTION 2.0 - PROJECT ORGANIZATION & RESPONSIBILITY

CCAS employs a Project Manager system to assure that all work performed by the laboratory is properly managed and otherwise attended to. Qualified Project Managers are selected from among the senior technical officers of the company according to the nature of the job itself. The Project Manager is responsible for the review of the initial work requests, the assignment of resources and the review of both the quality assurance data and the data used to generate the reports.

For example, when a typical request to provide analytical services is delivered to the laboratory, the Sample Control Officer selects a Project Manager. Large clients are often served by preselected Project Managers such as Dr. Mary Havlicek, Dr. Stephen Havlicek or Dr. Laurence Hilpert. A copy of the work order developed from the chain of custody document is sent to the Project Manager for his/her immediate review. Any changes noted as a result of this review are sent back to both the Sample Control Officer and the departments within which the analyses are to be performed. If questions arise, the client is called. An acknowledgement that describes the work to be performed is returned to the client. The Project Manager is responsible for polling the Laboratory Information Management System (LIMS) in order to verify that the work is being executed in timely fashion. The Group Leaders and Department Heads are responsible for notifying the Project Managers regarding any difficulties which may be complicating the analyses themselves (i.e.. a special matrix problem) or which might delay the delivery of the results. The analysts are responsible for performing the analysis, performing the necessary quality assurance work and maintaining the "paper trail" which serves to verify that all procedures were in control while a set of samples were being analyzed. The analyst is also required to inform his/her Group Leader if problems or delays are likely. Thus it can be seen that project performance is a team effort at CCAS. This system provides for quality review at the following four levels.

1. The Analyst - first level review
2. The Group Leader/Department Head - second level review
3. The Project Manager - third level review
4. Signature Review - fourth line review

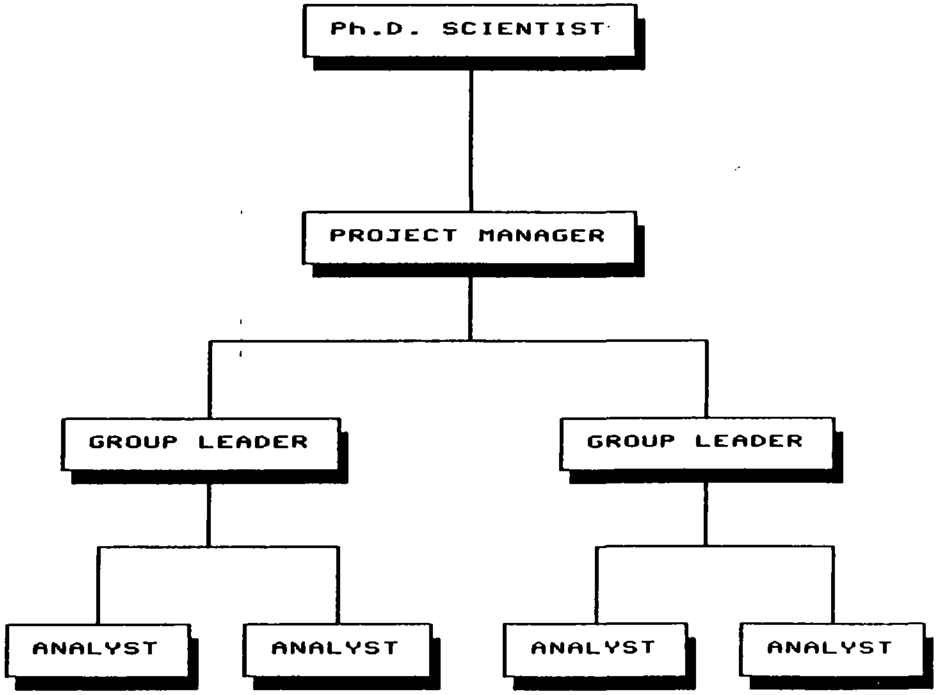
A diagram showing each of these levels, the typical CCAS project organization and the levels of responsibility within a typical project is provided as Exhibit 1.

SECTION 3.0 - QUALITY ASSURANCE OBJECTIVES

The first objective of the Quality Assurance Program at CCAS is to provide data of known quality. The second objective is to provide data of the highest quality permitted by the intended use to which the data will be put. The third objective is to improve the quality of all data leaving the laboratory, regardless of intended use. The methods and organizational structures designed to achieve these worthy objectives are discussed in the sections which follow.

Quality as used to describe the analytical services provided by CCAS means the production of results which are accurate, valid and precise. This is reflected in the commitment CCAS'technical resources to the Quality Assurance Program. For example, Dr. Laurence R. Hilpert who serves as the CCAS Quality Assurance Officer holds the rank of Vice President and is therefore fully authorized to direct Quality Assurance measures within all departments at all branches of the Company. Prior to joining CCAS three years ago, Dr. Hilpert was employed by the National Bureau of Standards, now known as the National Institute for Science and Technology (NIST), for 11 years where he was responsible for the certification of Standard Reference Materials for the Organic Analytical Research Division. Aspects of QA/QC programs utilized

EXHIBIT 1


Ph.D. SCIENTIST
PROJECT MANAGER
GROUP LEADER
GROUP LEADER
ANALYST
ANALYST
ANALYST
ANALYST

at NBS are now being applied at CCAS. In many cases, these criteria exceed those specified by EPA.

While the level of Quality Assurance automatically supplied at Coast-to-Coast is more than sufficient for most intended uses, additional documentation or special report formats can be provided upon request. Charges for additional documentation range from nominal for such records as injection records, chromatograms and calibration curves to considerable for presentation of results in full EPA CLP-style format. Quality assurance data already supplied at no additional charge include:

1. Blanks

2. Duplicates

3. Spikes

4. Surrogate Recoveries (when appropriate)

SECTION 4.0 - SAMPLING PROCEDURES

CCAS employs certified sampling technicians and uses approved sampling methods and guidelines as described in SW-846, third edition, second revision (December 1988); in the Handbook for Analytical Quality Control in Water and Wastewater Laboratories; in Standard Methods for the Examination of Water and Wastewater, 17th edition; in the NIOSH manual and in such individual methods as are separately provided by EPA (i.e. the TO series of air methods).

CCAS is able to provide both direct sampling assistance and free over-the-phone sampling consultation whichever best meets the client's needs. Our field sampling crew includes six OSHA-certified personnel with considerable experience in the collection of samples of a diverse nature. Sampling equipment such as bailers, pumps, SUMMA electropolished stainless steel canisters, and even a meterological station are available for rental to those clients who wish to conduct their own sampling.

In cases in which one is needed, CCAS is able to develop a representative sampling plan which might include such provisions as:

1. The selection of appropriate sampling locations

2. The use of field screening protocols

3. The measurement of important supporting data

4. A statistically sound estimation of the number of samples required.

5. A listing of acceptable conditions for sampling

6. The selection of matrices/media to be sampled
7. The selection of appropriate sample containers
8. The selection of safe, effective preservatives
9. The determination of the appropriate sampling frequency and/or duration
10. Chain of custody documentation
11. Composite vs grab sampling
12. The selection of which parameters are to be measured & where
13. The use of field filtration

CCAS has been able to develop special sampling and analytical protocols for parameters not yet described in an official publication. This capability is becoming more significant in the light of recent legislation such as Proposition 65 and AB 2588 regulating parameters for which no methods presently exist.

SECTION 5.0 - SAMPLE CUSTODY

Sample Control is the department which documents the receipt of incoming samples and initiates all paperwork regarding samples. CCAS is presently operating a computerized LIMS system in parallel with a manual logbook system. The present schedule anticipates complete computerization by April 1990.

Upon arrival to the lab the priority of the sample is determined for order of processing. Samples with short holding times take first priority. Next in line are samples with longer holding times, but which were brought in to the lab late and are quickly approaching that holding time. Then the RUSH samples are processed, then any other sample received.

Samples awaiting processing are held in a refrigerator used only for that purpose. The refrigerator is kept locked at all times to maintain security and to keep the samples from being mistaken for samples already processed. An exception to this is when the samples are received in sealed coolers in which case they are not unsealed until they are processed. Samples with short holding times do not usually come to the lab this way and those that do are from certain clients, so CCAS asks to be advised in advance to open these and process them first.

Documentation received with the sample is then reviewed for accuracy and completeness of information regarding the client, the sampler, the description of the samples, the date sampled, and any special request, such as turnaround time, detection limits required, etc. If the samples come to the lab with a chain of custody, as is recommended, the chain of custody document is signed by the Sample Control Officer after it is determined that all samples listed on that chain of custody have arrived. Notes regarding the condition of the samples, such as seals being intact, or bottles not received, or bottles received broken, are made by the Sample Control Officer on the chain-of-custody document. Inconsistencies require an immediate call to the client.

The samples are then organized to determine what, and how many containers of each sample are received. The samples are then logged into the LIMS system and/or the sample logbook. Each sample is given a unique log number, with a description (for example, some analyses require three bottles for one sample, which would be numbered nnnn-1, nnnn-2, nnnn-3). Information entered into the LIMS logbook includes the date and time received by the lab, the client's name, the sampler's name, the description of the sample, the date and time sampled, the sample destination, each analysis requested, the initials of the person logging in the sample, each type of container the sample is in, and any additional notes regarding that sample, such as a turnaround time. "RUSH" samples are highlighted and/or specially designated so as to be conspicuous.

Once the sample is logged in, the sample containers are clearly marked with the correlating sample number. The sample log numbers are also recorded on the chain of custody for future reference. In the near future, bar coding will be brought on line as a part of the LIMS system.

A billing sheet is generated by the Sample Control Officer which is used for several purposes. The accounting department uses it for invoicing, the project manager receives a copy for tracking purposes and the client immediately receives a copy which serves as confirmation that his request has been properly understood. Later the office personnel mark off the results which have been completed and reported. Any paperwork regarding the samples is attached to the billing sheet, including the original chain of custody, any Work Notification Notices, any Task Request Forms, any completed original worksheets, all the computer-generated results, and a copy of the invoice.

Worksheets are then prepared by Sample Control to notify various groups within the lab of the required analyses. The worksheet includes information such as the client's name, the sampler's name, the sample number, the date and time collected, the date and time received, the turnaround time required, and the sample location. If a sample is a RUSH, the turnaround time is highlighted to make sure it is noticed by lab personnel. The analysis requested, the holding time for that analysis, the EPA Method number, and the detection limit are also listed as the work is completed, both on the work order and by direct entry into the LIMS system. The analyst initials the work order, dates it, and records the results obtained by entering the information into the LIMS system.

Following log-in, but prior to analysis, a proper location for the storage of the sample is then determined by the Sample Control Officer. Similar sample types are stored in the same locked refrigerators. When the samples are placed in the refrigerator, the sample numbers are logged into the refrigerator log book. This logbook includes information regarding the subsample number, the location, the container type, the analysis needed, the initials of the person logging them in, and the date logged in. Once the sample is stored, the worksheets are distributed to the proper departments, and key personnel are notified of any unusual or important information such as rushes, unusual matrices, unusual analyses, samples approaching their holding times, or especially hazardous samples. When an analyst needs a sample, he/she refers to the log book and enters the date the sample is checked out and his/her initials. Upon returning the sample to the refrigerator, he/she records the date returned. Again, this function will be computerized and incorporated into the LIMS system.

Samples known to be extremely hazardous are identified by placing fluorescent red "dots" on the sample container, on the worksheets, on the billing sheet, on the chain of custody, and in the log book. All received samples are thoroughly scanned by a radiation meter to detect possible levels of radioactivity.

The proper sampling containers, with preservatives where appropriate, are provided to the client free of charge. This is to promote the use of the proper containers and preservatives which provide more accurate results.

The sample containers and preservatives which are provided include:

Bacteria - Disposable sterilized bag with a tablet of Sodium Thiosulfate or reusable sterilized plastic jar with some Sodium Thiosulfate.

Wet Lab work - A plastic bottle without preservative.

COD, NH_3,TKN - An 8 oz. plastic bottle with Sulfuric Acid (2ml).

Oil & Grease - A 1-L amber glass bottle with Sulfuric Acid (5 ml).

Phenols - An amber liter glass bottle with Phosphoric Acid.

MBAS - 8 oz. plastic bottle with KH_2PO_4 solution.

Silver (High level) - A 4 oz. glass amber bottle with Sodium Hydroxide and Sodium Thiosulfate.

Any Metals - A 500 ml amber bottle with Nitric Acid (5 ml).
- A 4 oz plastic bottle with Nitric Acid (2 ml).

Chlorinated Water for VOA - Two glass vials with septum seal & sodium thiosulfate.

Volatile Organics - Two glass vials with septum seal.

inc. 602s for non-sterile samples - Two glass vials with septum seal and sodium sulfate (ASTM - recommended, cleared with DOHS for use by CCAS, safer than HCl suggested by EPA).

plus - Two plastic "guard bottles" with charcoal inside which the glass vials are placed inside to prevent cross-contamination.

TOC - A 40 ml glass vial with a septum seal and no preservative.

TOX - A 250 ml amber glass bottle with a septum seal and no preservative.

Extractables - A 1-L liter amber glass bottle with Teflon-lined cap.

Variety Soils - A glass "widemouth" jar with Teflon-lined lid; or a 40 ml glass vial with Teflon-lined septum sealed cap; or a Shelby tube of brass ring-capped with snug plastic caps which have been underwrapped with Teflon tape.

Cyanide - A 1-L plastic bottle with Sodium Hydroxide (5 ml 50%).

Sulfides - A 1-L plastic bottle with Zinc Acetate (5 ml 10%.).

Once the sample is two months past the holding time, it is disposed of, returned to the client, or stored indefinitely. This practice allows the client ample time to review the data and request further analyses, if desired.

See Exhibit 2 for holding times, preservatives and recommended container types.

Exhibit 2

TABLE 2-16. REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Name	Container[1]	Preservation	Maximum holding time
Bacterial Tests:			
Coliform, fecal and total	P, G	Cool, 4°C, 0.008% $Na_2S_2O_3$	6 hours
Fecal streptococci	P, G	Cool, 4°C, 0.008% $Na_2S_2O_3$	6 hours
Inorganic Tests:			
Acidity	P, G	Cool, 4°C	14 days
Alkalinity	P, G	Cool, 4°C	14 days
Ammonia	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Biochemical oxygen demand	P, G	Cool, 4°C	48 hours
Bromide	P, G	None required	28 days
Biochemical oxygen demand, carbonaceous	P, G	Cool, 4°C	48 hours
Chemical oxygen demand	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Chloride	P, G	None required	28 days
Chlorine, total residual	P, G	None required	Analyze immediately
Color	P, G	Cool, 4°C	48 hours
Cyanide, total and amenable to chlorination	P, G	Cool, 4°C, NaOH to pH>12, 0.6g ascorbic acid	14 days
Fluoride	P	None required	28 days
Hardness	P, G	HNO_3 to pH<2, H_2SO_4 to pH<2	6 months
Hydrogen ion (pH)	P, G	None required	Analyze immediately
Kjeldahl and organic nitrogen	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Metals:			
Chromium VI	P, G	Cool, 4°C	24 hours
Mercury	P, G	HNO_3 to pH<2	28 days
Metals, except chromium VI and mercury	P, G	HNO_3 to pH<2	6 months
Nitrate	P, G	Cool, 4°C	48 hours
Nitrate-nitrite	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Nitrite	P, G	Cool, 4°C	48 hours
Oil and grease	G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Organic carbon	P, G	Cool, 4°C, HCl or H_2SO_4 to pH<2	28 days
Orthophosphate	P, G	Filter immediately, cool, 4°C	48 hours
Oxygen, Dissolved Probe	G Bottle and top	None required	Analyze immediately
Winkler	do	Fix on site and store in dark	8 hours
Phenols	G only	Cool, 4°C, H_2SO_4 to pH<2	28 days
Phosphorus (elemental)	G	Cool, 4°C	48 hours
Phosphorus, total	P, G	Cool, 4°C, H_2SO_4 to pH<2	28 days
Residue, total	P, G	Cool, 4°C	7 days
Residue, Filterable	P, G	Cool, 4°C	7 days
Residue, Nonfilterable (TSS)	P, G	Cool, 4°C	7 days
Residue, Settleable	P, G	Cool, 4°C	48 hours
Residue, volatile	P, G	Cool, 4°C	7 days
Silica	P	Cool, 4°C	28 days
Specific conductance	P, G	Cool, 4°C	28 days

Revision 0
Date September 1986
From SW-846
Includes Revision 1
December 1987

Exhibit 2

TABLE 2-16. REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES (CONTINUED)

Name	Container[1]	Preservation	Maximum holding time
Sulfate	P, G	Cool, 4°C	28 days
Sulfide	P, G	Cool, 4°C, add zinc acetate plus sodium hydroxide to pH>9	7 days
Sulfite	P, G	None required	Analyze immediately
Surfactants	P, G	Cool, 4°C	48 hours
Temperature	P, G	None required	Analyze
Turbidity	P, G	Cool, 4°C	48 hours
Organic Tests:			
Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4°C, 0.008% $Na_2S_2O_3$	14 days
Purgeable aromatic hydrocarbons	G, Teflon-lined septum	Cool, 4°C, 0.008% $Na_2S_2O_3$, HCl to pH2	14 days
Acrolein and acrylonitrile	G, Teflon-lined septum	Cool, 4°C, 0.008% $Na_2S_2O_3$, Adjust pH to 4-5	14 days
Phenols	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction
Benzidines	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$	7 days until extraction
Phthalate esters	G, Teflon-lined cap	Cool, 4°C	7 days until extraction 40 days after extraction
Nitrosamines	G, Teflon-lined cap	Cool, 4°C, store in dark, 0.008% $Na_2S_2O_3$	40 days after extraction
PCBs, acrylonitrile	G, Teflon-lined cap	Cool, 4°C	40 days after extraction
Nitroaromatics and isophorone	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$ store in dark	40 days after extraction
Polynuclear aromatic hydrocarbons	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$ store in dark	40 days after extraction
Haloethers	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$	40 days after extraction
Chlorinated hydrocarbons	G, Teflon-lined cap	Cool, 4°C	40 days after extraction
TCDD	G, Teflon-lined cap	Cool, 4°C, 0.008% $Na_2S_2O_3$	40 days after extraction
Total organic halogens	G, Teflon-lined cap	Cool, 4°C, H_2SO_4 to pH<2	7 days
Pesticides Tests:			
Pesticides	G, Teflon-lined cap	Cool, 4°C, pH 5-9	40 days after extraction
Radiological Tests:			
Alpha, beta and radium	P, G	HNO_3 to pH<2	6 months

[1] Polyethylene (P) or Glass (G)

SECTION 6.0 - CALIBRATION PROCEDURES & FREQUENCY

The calibration of laboratory instruments is performed at the specified frequency and within acceptance limits published by EPA (i.e. the response factors and relative percent deviations for EPA methods 8240 & 8270). In cases in which specific guidelines are not available, CCAS applies either the manufacturer's recommended guidelines or in-house guidelines. Where calibration frequencies are not specified by the method itself, verification is generally established at least once daily following the initial development of a multipoint calibration curve.

Where available, calibrations are carried out using certified reference materials. Although these can be very expensive as is the case for certified National Bureau of Standards traceable specialty gas standards, the additional accuracy and credibility are well worth the cost. More importantly, CCAS analysts are trained to detect calibration problems at the bench and realize that these must be corrected before carrying on with any additional analyses. Guidelines have been developed and affixed to such equipment as GC/MS systems specifically to assist the analysts in detecting problems in cases in which data are typically processed by persons other than those operating the equipment.

A selection of representative calibration curves and reports is provided as Appendix A.

SECTION 7.0 - ANALYTICAL PROCEDURES

CCAS employs analytical methods described in the following references:

1. SW-846, third edition, second revision, December 1987
2. Standard Methods for the Examination of Water and Wastewater, 17th edition, 1989
3. Methods for the Chemical Analysis of Water and Wastes, EPA-600/4-79/020, 1983
4. Annual Book of ASTM Standards
5. EPA Compendium Series Methods for the Analysis of Air, 1988
6. AOAC Official Methods of Analysis, 15th edition, 1990
7. NIOSH Manual of Analytical Methods , third edition, 1987
8. Code of Federal Regulations 40, Revised 1985

If special protocols such as may be required by regulation in the absence of well-established methods (i.e. Proposition 65 and AB 2588) are desired, CCAS is uniquely well-qualified to develop them.

For example, CCAS is presently under contract to the State Air Resources Board to develop methods needed to quantitatively determine ethylene oxide at global background levels. As is typical in such cases, CCAS begins, if possible, with the modification of an existing EPA method. This step ensures a more acceptable reception when the documentation of the method is presented to the regulators. As a member of EPA's Technical Assistance Team and EPA's Air Toxics Workgroup, CCAS has added credibility even when there are no related EPA protocols to modify.

Dr. Hilpert, CCAS' Quality Assurance Officer, is responsible for maintaining the company's Manual of Standard Operating Procedures (SOP). This manual is a collection of published analytical protocols, plus comments, cautions and equipment-specific instructions. Trainees are required to read and understand specific SOPs before being internally certified to perform a given analysis. Analysts are regularly given updates of those SOPs relating to the analyses they are certified to perform. Department heads maintain copies of all SOPs applying to their departments while the Laboratory Directors and higher ranking officers have complete copies of all SOPs. The SOP system ensures that all analyses are performed to the same high standards throughout the Company. More importantly, no analyst is allowed to deviate from the approved SOP without the prior approval of the Quality Assurance Officer. Failure to follow a SOP can be cause for dismissal.

Procedures applied are always identified by reference to an EPA method or by reference to some other specific source on all CCAS analytical reports. Senior CCAS technical staff are always available to assist clients by discussing the merits of all methods performed by the laboratory. By guiding the client in the selection of an appropriate method, CCAS believes that we will be able to provide a more complete and valuable service.

SECTION 8.0 - DATA REDUCTION, VALIDATION & REPORTING

The lines of responsibility for data reduction, validation, and reporting are clearly delineated - everyone is responsible for generating valid data. An elaborate system of internal recordkeeping has been designed which allows the Quality Assurance Officer (Dr. Hilpert) to determine when the sample came in, how it came in, who collected it, who received it, who prepared the work order, where and how the sample was stored, who had each sample, when he had it, how much he used and what he did with it. Sample preparation records are kept which show both the date of preparation and the person who prepared it. Volumes of reagents added, concentration factors and comments are written in the preparation logbooks. Sample analysis logbooks are kept for each instrument which show the date analyzed and who ran the equipment. If data are transcribed or calculations are made, the time of transcription or calculation and the analyst's initials are written on a hard copy of the calculation or transcription which is maintained as a permanent record. Standard preparation records are similarly documented in special departmental logbooks created for this purpose.

Thus, it is clear that everyone is responsible for quality at CCAS. Their various roles have already been explained in Section 2. Documentation of this responsibility is what makes the QA/QC system particularly effective. In addition to the workstation and instrument logbook documentation, those providing second and third level data review (group leaders/department heads and Project Managers) must sign and date their work. Similarly, data reduction staff such as the GC/MS data processing group led by Dr. Rafael Espinosa (formerly of the National Bureau of Standards) must initial their work in order to maintain accountability. Even the word processing technician who prepares the report must put his initials on the final report! Ultimately the senior scientist signing the report has final responsibility. The documentation of these responsibilities is also being incorporated into the LIMS system which will collect the records all in one place, thereby facilitating retrieval.

Data collected from several different departments are separately evaluated first by the analyst, second by the department head, then collectively by the Project Manager, and finally by the signer of the reports. The collective review may include a check of the ion balance, examination for compatible constituents and whether or not the results make sense. The latter part of the evaluation process, which might be described as certification, includes the review of the quality assurance data. Among the questions considered are:

1. Is the full method blank acceptable?
2. Is the duplicate sufficiently precise?
3. Is the calibration validated?
4. Is an acceptable spike recovery obtained?
5. Do the number of significant figures reflect the precision of the method?
6. Is the method of analysis correctly stated?
7. Is the method of sample preparation correctly stated?
8. Are correct holding times observed?
9. Are the units correct?
10. Are the practical quantitation limits correct?
11. Is an acceptable value obtained for the Certified Reference Material?
12. Are surrogate recoveries acceptable?

Only after all questions have been satisfactorily answered are the data considered to be validated. At that point, the report is signed and transmitted to the client. For those elements of the evaluation involving the LIMS system, password protection further prevents the release of improperly reviewed data.

Written acceptance criteria for blanks, the CCAS spikes, duplicates, and reference samples make it easier for our analysts to identify and correct suspect data. Multiple person review increases the opportunity to eliminate data of suspect quality. Ph.D./Senior Scientist review applies experience regarding sensibility to detect suspect data.

SECTION 9.0 - INTERNAL QUALITY CONTROL CHECKS

Internal quality control checks include, but are not limited to those items which are discussed separately in the paragraphs which follow. It should be further noted that these are documented as part of the Company's record keeping practices and are therefore available for use in validating the quality of all results generated by CCAS laboratory facilities. Furthermore, many of these quality control checks incorporate numerical acceptance criteria which require corrective action if exceeded.

9.1 **Instrument Performance Criteria** - Where available, published instrument performance criteria such as those developed by EPA for use in connection with the methods for volatile and semivolatile organics analysis are employed to verify that instruments are performing according to specifications. These method-specific criteria are provided as Exhibits 3 and 4 respectively. In-house criteria, serving the same purpose have been developed for other instrumentation and are generally based on the manufacturer's specifications.

9.2 **Reasonableness** - This highly significant criteria is often overlooked by regulatory documents - presumably because it is subjective rather than quantitative in nature. Furthermore, since the assessment of reasonableness requires experience, not all laboratories are equally qualified to provide this form of internal quality assurance. Reasonableness considers such things as the relationship to other samples from a given site, comparison of the current data with historical data, a knowledge of environmental degradation processes, a knowledge of the composition of commercial products such as fuels, solvents and pesticides which may be released to the environment. The key ingredient in CCAS' ability to provide this element of internal quality control is experience. For this reason, all CCAS-released reports are reviewed by an experienced Ph.D. scientist before signing. The experience-based criterion applied may best be summed up as follows: "If it doesn't make sense, it is probably WRONG!"

Exhibit 3

TABLE 3. BFB KEY ION ABUNDANCE CRITERIA

Mass	Ion Abundance Criteria
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	base peak, 100% relative abundance
96	5 to 9% of mass 95
173	less than 2% of mass 174
174	greater than 50% of mass 95
175	5 to 9% of mass 174
176	greater than 95% but less than 101% of mass 174
177	5 to 9% of mass 176

Exhibit 4

TABLE 3. DFTPP KEY IONS AND ION ABUNDANCE CRITERIA[a]

Mass	Ion Abundance Criteria
51	30-60% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	40-60% of mass 198
197	<1% of mass 198
198	Base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	>1% of mass 198
441	Present but less than mass 443
442	>40% of mass 198
443	17-23% of mass 442

---

[a] J.W. Eichelberger, L.E. Harris, and W.L. Budde. "Reference Compound to Calibrate Ion Abundance Measurement in Gas Chromatography-Mass Spectrometry", Analytical Chemistry, 47, 995 (1975).

9.3 **Control Charts** - Method-specific matrix-specific quality control charts have been developed by each of our laboratories for each of the parameters they determine. These are updated on a monthly basis and released to the analysts, group leaders, department heads, project managers, technical officers of the company and to the Quality Assurance Officer. These graphical representations allow analysts at the bench to immediately determine if an analysis is out of control so that corrective action will not be delayed. At higher levels of review, they serve to validate the data as it is being reviewed. A large number of example control charts may be found in Appendix B.

9.4 **Surrogate Spikes** - Wherever possible, compounds closely related to the analytes but not having commercial use are added to every sample prior to sample preparation. The recovery of these materials demonstrate that losses have not occurred during sample preparation and that analytes of a similar nature could have been recovered from that sample. Acceptance criteria are posted on each instrument thereby promoting early problem detection.

9.5 **Replicate Samples** - Results from replicate sample analyses are a measure of precision. One sample in ten is split for duplicate analysis in order to verify that acceptable precision is achieved. If more than one sample matrix is involved, the above criteria apply to each sample matrix. If acceptable precision is not verified, further analyses are halted until a cause has been identified and corrective action taken. If samples are expected to be clean, duplicate water spikes are performed in order to evaluate precision.

9.6 **Spiked Samples** - Results from spiked sample analyses are a measure of accuracy. One sample in ten is spiked with several of the Priority Pollutants in the compound class or classes under investigation. If more than one sample matrix is involved, the above criteria apply to each sample matrix. Spike recoveries are calculated by the method detailed in ASTM Method D 3856, Section 11.5.4, Annual Book of ASTM Standards, Volume 11.01, Water, (1986). CCAS usually selects the same sample used for the replicate analysis. In this way, CCAS can base the percent recovery upon the amount added and the mean of the duplicate determinations and thereby minimize the effect of precision upon the determination of accuracy. Again, if acceptable recoveries are not obtained, further analyses are halted until a cause has been identified and corrective action taken.

9.7 **Certified Reference Standards** - CCAS analyzes US EPA and NBS certified reference materials along with the samples in order to certify the accuracy of results. In order to establish CA state certification for drinking water analysis, CCAS analyzed performance evaluation samples from the California Department of Health Services. CCAS achieved a perfect score for all of the parameters included in the test. Such standards are sometimes also submitted to us by our clients. Since the expected results for standards of this type generated in-house are known, problems may be detected and corrected at a very early stage. Results not within the acceptance range are investigated, and corrective action taken to insure that results are within the acceptable range prior to the analysis of further samples.

9.8 **Internal Standards** - Known amounts of internal standards are added to every sample or sample extract for organics analysis. This technique permits CCAS to compensate for minor changes in instrument performance by relating analyte concentrations to the response of the internal standards. Values for the internal standard response outside the acceptance range established for each instrument constitute grounds for rejecting the data. Since these ranges are posted right on the instrument, immediate problem detection is possible. The analyst is then required to determine the cause of the problem and correct it before reanalyzing the samples.

9.9 **Daily Standard and Blank Runs** - Each day's runs are preceded by instrument tuning, initialization of analytical parameters, standard runs containing all of the analytes to be determined plus the internal standards, surrogates, and blank runs. Hard copies and computerized records of all such runs are maintained. The blank run is compared with acceptance criteria established for the laboratory. If an acceptable blank is not obtained, the problem must be corrected before samples are processed.

9.10 **Verification of Results with an Alternative Method** - The range of capabilities available at CCAS often makes it possible to determine a given parameter by one or more alternate methods. For example, calcium may be determined by atomic absorption, EDTA titration, ion chromatography, or inductively-coupled-plasma spectroscopy. Fuel-related materials may be determined by gas chromatography using either flame ionization detection or selective ion mass spectrometry. Purgeable organics in soil may be extracted by headspace or purge-and-trap techniques. Polychlorinated biphenyls may be determined by gas chromatography followed by electron capture detection or by selective ion mass spectrometric detection. When results are in question or are known to be the subject of legal action, they are verified with another method.

9.11 **Logbooks** - Logbooks documenting the preparation of standard and surrogate solutions are maintained. Information regarding the source of the standard, lot number, weight or volume of standard used, date prepared and name of preparer are included. Solvents used to prepare standard and surrogate solutions are checked for purity prior to use. Logbooks documenting the use of each analytical instrument are maintained; a description of every sample (including standards, duplicates, spikes and blanks) is recorded in the log book as the samples are analyzed. Likewise, logbooks documenting periodic maintenance and repairs to each instrument are maintained.

SECTION 10.0 PERFORMANCE & SYSTEM AUDITS

The Quality Assurance Officer and/or other corporate executives conduct both performance and systems audits of the laboratory in order to ensure that data of a defensible quality are produced at all times. As part of its laboratory certification program, the State of California also conducts both performance and systems audits. In addition, an independent accreditation service, the American Association for Laboratory Accreditation visited CCAS in the Fall of 1989 and conducted a comprehensive systems audit prior to issuing accreditation.

Performance audits are quantitative in nature and are designed to evaluate specific analytical measurement systems. They may be open or blind and may originate with the laboratory, with the client or with a regulatory agency. Samples of a known composition are obtained from EPA, the National Institute of Science and Technology (NIST, formerly the National Bureau of Standards), or from a commercial source such as ERA. These are analyzed along with our regular sample workload. Results are compared with acceptance limits and communicated to the analysts following the completion of the work. Correct results are acknowledged publicly within the laboratory to promote a general appreciation for quality while incorrect results are addressed by a formal notice with a request for corrective action. An example report generated by a "blind" performance audit is provided as Exhibit 5.

Systems audits are qualitative reviews of the laboratory quality control measurement system designed to verify that these systems are being used appropriately. A partial systems audit might be as simple as a short question and answer session with a group or department. These might reveal procedural misunderstandings which could be corrected on the spot and/or by rewriting the Standard Operating Procedure (SOP) with improved clarity.

Systems audits may be carried out at any stage of an analytical program. For example, CCAS certifies analysts for proficiency in the procedures which they are to perform before allowing them to perform them. This activity represents a kind of one-on-one systems audit. Analyst certifications are reviewed annually, as individual procedures are revised, or as new procedures are added. These are all examples of systems audits.

Items addressed in a typical systems audit include a comparison between actual laboratory practice and the protocol as written in the standard operating procedure. While most such audits serve only to verify that laboratory procedures are in control, they are the best way to discover evolutionary variations from the SOP that need to be incorporated formally into the SOP or eliminated. These reviews also provide analysts with an opportunity to communicate problems associated with the existing SOPs.

Exhibit 5
Example Report
Blind Performance Audit

AIR, WATER and HAZARDOUS WASTE LABORATORY CERTIFIED by CALIFORNIA DEPT of HEALTH SERVICES

Central
Coast
Analytical
Services

Central Coast
Analytical Services
141 Suburban Road , Suite C-4
San Luis Obispo, California 93401
(805) 543-2553

Lab Number: F-11135dup
Collected: 08/24/89
Received: 08/24/89
Tested: 09/07/89
Collected by: Unknown

EPA METHOD 508/608/8080 - PESTICIDES AND PCB'S

General Auto Supply

SAMPLE DESCRIPTION:
ERA Check Sample, Lot #522,
Water, Submitted Blind as
General Auto Supply

Duplicate Analysis

Compound Analyzed	Detection Limit (PQL*) (ug/L)	Conc. (ug/L)	True Value (ug/L)	Acceptance Range (ug/L)	Percent Recovery
Heptachlor	0.01	0.13	0.17	0.061-0.18	76.
Aldrin	0.01	0.17	0.24	0.10-0.29	71.
p,p'DDE	0.01	0.22	0.23	0.071-0.32	96.
p,p'DDT	0.01	0.47	0.47	0.17-0.68	100.

* Practical Quantitation Limit

Compounds listed as "not found" would have been reported if present at or above the listed detection limits. Sample was extracted 08/28/89 by EPA Method 3510.

Respectfully submitted,

Mary Havlicek

Mary Havlicek, Ph.D.
President

ECD#1
09/18/89
F11135du.wr1/74
MH/ss/ss/ss

SECTION 11.0 - PREVENTATIVE MAINTENANCE

Coast-to-Coast Analytical Services, Inc. has opted to purchase service contracts on selected major instrumentation to ensure the availability of regularly-scheduled and periodic maintenance. Since even the typical 72-hour guaranteed response time is not sufficient for the modern laboratory, CCAS has begun to rely to a greater extent on expanded in-house supplies of spare parts, on improved in-house repair capabilities and on the availability of backup instrument instrumentation from the same manufacturer. For example, when one of the GC/MS systems develops a problem, CCAS is generally able to quickly isolate the problem by swapping boards with one of the operating instruments. The malfunctioning part is then ordered by overnight delivery service, thus often suffering only one day of downtime.

In-house preventative maintenance such as filter changes, pump-oil replacement, cleaning of optics, etc. is documented in instrument-specific maintenance logbooks kept with each instrument. Scheduled preventative maintenance is similarly recorded as are in-house and commercial repairs.

SECTION 12.0
PROCEDURES USED TO ASSESS PRECISION, ACCURACY & COMPLETENESS

12.1 Precision - Measures the dispersion of repeated measurements of the same parameter in the same sample from one another. The tools employed to routinely assess precision at CCAS include:

a. Duplicate Analyses
b. Duplicate Matrix Spikes (also measure accuracy)
c. Duplicate Samples
d. Calibration Curves
e. Quality Control Charts (also measure accuracy)

12.2 Accuracy - Measures the deviation of the reported value from the true value. The tools employed to routinely assess accuracy at CCAS include:

a. Certified Reference Materials
b. Commercial Performance Evaluation Samples
c. Laboratory Control Samples
d. Spikes
e. Matrix Spike Duplicates (also measure precision)
f. Sensibility
g. Confirmation by an Independent Method
h. Quality Control Charts (also measure precision)

12.3 Completeness -The QA definition of completeness refers to the degree to which valid data are produced under a particular QA program. Appropriately enough, expressed as a percentage, the job is

never done. Since the QA objectives discussed within and generally adopted by EPA are based on the 95 percent confidence level, about 5 percent of the tests fail EVEN WHEN THE SITUATION IS FUNCTIONING PROPERLY. Thus the QA target for completeness is 95 percent. The actual percent of samples reported vs. samples received, of course will be closer to 100 percent since the statistical 5 percent, plus the real "out-of-control" results will be repeated, if possible, and matched with acceptable QA data.
The measurements used to describe completeness may be calculated according to one of the two formulas presented below:

A. Results provided divided by samples submitted expressed as a percent.

B. Accepted results generated divided by number of analyses performed.

Typically CCAS'customers are concerned only with the first definition.

SECTION 13.0 - CORRECTIVE ACTIONS

The detection of a Quality Assurance problem at CCAS, as explained above, may arise at the bench, during review by the Group Leader/ Department Head, by the Project Manager or by the Ph.D. chemist who signs the reports. It is the responsibility of the detecting party to initiate corrective action by completing an "Analysis Out of Control" form. In use for more than a year, these forms have developed the positive acceptance required to make the system a success. Forms are now generated routinely by bench analysts, middle managers and senior technical staff. They are sent upward through the ranks as well as downward and are generally recognized as a form of communication designed to improve quality. A blank form is presented as Exhibit 6. It should be noted that because a written response is required, the CCAS system documents not only problems but also solutions. The following are among the items which must be inspected and, if a problem is discovered, for which corrective action is required.

13.1 Calibrations/Instrument Responses - Analysts must initiate retests and take corrective actions anytime these are out of limits. Since valid data cannot be generated in the absence of a proper instrument response, detection of problems must be immediate and corrective action is absolutely required before analyses can be resumed. For these reasons, acceptance criteria of this type are posted right on the instrument. Detection of a problem is most often achieved by the analyst him/herself.

13.2 Instrument Blanks - Results provided for all analytes must be below the reported practical quantitation limits. Analytes for which a signal is noted but for which the signal is too weak to provide a value above the practical quantitation limit may be reported either as "not found" or with a calculated value and a footnote explaining that such levels are reported only in the blank. CCAS prefers the latter format since it is provides more information, but allows the client to express a preference. Required actions typically begin with a rerun under the same conditions. If the rerun is acceptable, it is concluded that carryover was the cause and no further action is required. If the rerun is also unacceptable, it is concluded that the analytical system is contaminated. More serious corrective actions such as cleaning the system, replacing sample contact parts, etc. must then be undertaken before analyses can be resumed. Here again, detection of a problem is most often achieved by the analyst.

13.3 **Method Blanks** - Method blanks differ from instrument blanks in that they are brought through all sample preparation steps prior to being introduced to the instrument. They therefore describe contamination which may originate in the laboratory as well as within the instrument. The reporting options are the same as have already been described in the previous subsection. Values at or above the practical quantitation limit require corrective action. In this case, a comparison with the corresponding instrument blank may permit the problem to be isolated. If the instrument is implicated, the corrective actions described in the previous subsection apply. If the sample preparation is suspect, an immediate systems audit may pinpoint the source of the problem. If not, further isolation may be necessary. This is accomplished by the use of reagent blanks and sample preparation step blanks.

13.4 **Travel Blanks** - Travel blanks are containers of analyte-free water supplied to the client by the laboratory and sent back to the laboratory unopened. They serve to detect incidental contamination arising from shipment and storage prior to analysis. If a comparison to the instrument and method blank indicate that the problem is indeed due to shipment and storage, corrective actions might include the replacement of shipping containers, the cleaning of refrigerators, etc.

13.5 **Field Blanks** - These are employed to detect contamination arising from contact with sampling equipment, during shipment or during storage. Since they also detect contamination originating during sample preparation and analysis, an unacceptable result requires isolation by comparison with the method blank, the travel blank and the instrument blank. If these are clean, the client is advised that a sampling problem may exist. Appropriate corrective actions include the use of properly cleaned samplers, pumps, bailers, etc.

13.6 **Spikes** - Unacceptable spike data include all points beyond the upper or lower control limits on the Quality Control Charts or three points in a row above or below the mean when at least one is near the warning limit. Potential corrective actions include a systems review between the analyst, the data processor, the person preparing the spike and the group leader. If a surrogate of the same class as the analyte for which a poor recovery was noted is present, it may serve as an indicator of a matrix problem. When such is the case and a duplicate spike provides a low recovery, the likely cause is a matrix effect and analyses may be resumed. Otherwise, analyses are suspended while the issue is resolved.

13.7 **Duplicates** - Unacceptable precision may indicate a non-homogeneous sample, a dirty instrument, or an instrument malfunction that compromises reproducibility. Corrective actions again include a systems review with the analyst and group leader plus the physical reexamination of the sample. The signal-to-noise ratio of the instrument should be examined as its deterioration indicates that cleaning may be needed or troubleshooting procedures undertaken. Analyses are to be suspended until the source of the problem has been identified and corrected.

13.8 **Sensibility** - Unusual results are generally detected by the Project Manager or signing Ph.D. chemist since a higher level of experience is needed to make observations of this type. Because these senior staff have access to all of the analytical data which relate to a project, they are also able to develop an overview of the situation that allows them to spot potential inconsistencies between separate analytical tests involving the same analytes. Examples of data which don't make sense would include groundwater thought to be contaminated with gasoline but having a suspiciously low BTX (a possible indication of diesel), or a narrow range petroleum distillate described as diesel (probably Stoddard solvent). Corrective actions usually involve reruns, discussions with the client, performing additional tests, etc. If otherwise sensible results are of a sensational nature, the above actions may be supplemented by resampling, reanalysis or even splitting samples with another laboratory. In this case, the concern is that any results which had the potential to require costly remediative actions by the client should not be released without extremely thorough documentation.

13.9 **Other Corrective Actions** - Instruments suffering from high problem rates or failing to meet performance criteria may be sent back to the manufacturer. Trainees failing to achieve proficiency may be dismissed and analysts repeatedly found to be the source of "out of control" situations are retrained or dismissed. Methods which are the subject of frequent "out of control" notices may be revised, replaced or abandoned.

SECTION 14 - QA REPORTS TO MANAGEMENT

Within CCAS, QA doesn't just report to management, QA IS **management.** Dr. Hilpert is an Officer of the Company, holds the rank of Vice President and reports only to the President. He is authorized to enter into contracts for the company and as such is one of the only three persons to be empowered. He becomes heavily involved in major project management as well as in the upgrading of staff through in-house training.

Exhibit 6

COAST - TO - COAST ANALYTICAL SERVICES

Air, Water & Hazardous Waste Sampling, Analysis & Consultation
Certified Hazardous Waste, Chemistry, Bacteriology & Bioassay Laboratories

141 Suburban Road • San Luis Obispo, CA 93401 • (805) 543-2553 • Fax (805) 543-2685
751 S. Kellogg, Suite A • Goleta, CA 93117 • (805) 964-7838 • Fax (805) 967-4386
1885 North Kelly Road • Napa, CA 94558 • (707) 257-7211 • Fax (707) 226-1001
9333 Tech Center Dr., Ste. 800 • Sacramento, CA 95826 • (916) 368-1333 • Fax (916) 362-2484
2400 Cumberland Dr. • Valparaiso, Indiana 46383 • (219) 464-2389 • Fax (219) 462-2953

ANALYSIS OUT OF CONTROL FORM

Department: ____________________

Date: ____________________

Technician: ____________________

Symptoms/Problems:

Samples Affected:

Corrective Actions Taken: Date: __________ By:

In addition to reporting to our management, CCAS' Quality Assurance Program is prepared to report to YOUR management. With every batch of reports you will receive:

1. Blank Report (minimum one, cost zero)
2. Spike Report (minimum one, cost zero)
3. Full Duplicate Analysis (minimum one, cost zero)
4. Travel Blank Report (if appropriate, cost 1/2)

In addition, at nominal cost based on time and materials a client can elect to receive an overall monthly quality assurance report summarizing his quality assurance results for the month and including relevant instrument performance documentation, copies of the chain of custody documents, task-specific case narratives and a discussion of any conclusions CCAS may be able to draw from the data such as depth relationships, source relationships, area would be confined to the data and its interpretation since CCAS staff members are analysts and would not wish to include legal, medical or engineering conclusions.

SECTION 15 - ANALYST CERTIFICATION

All analysts at CCAS are certified by their supervisor for proficiency in the analytical procedures which they perform. Copies of all current analyst certifications are maintained by department managers as well as in the employee's personnel folder. CCAS requires that analysts know and adhere to all aspects of the analytical methods as well as EPA recommended holding times and preservatives for constituents. Analysts are notified immediately of any changes in analytical procedures. Certifications are reviewed annually or whenever modifications or changes to procedures are implemented. CCAS reports the date of analysis and the analysts' initials as well as the extraction procedure and analytical methods used on all analytical reports. An example of the Analyst Certification form is provided as Exhibit 7.

EXHIBIT 7

ANALYST QUALIFICATION FORM

NAME ______________________ ______________ DATE

List EPA or SM Number or Description of Test or Job Below

____

____

____

Attach photocopy of work done or else describe it here. (Calibration curves and raw data for procedures as well as results and QA/QC data must be included.)

Analyst knows: __sample prep ___holding time ___preservation ___interferences

____hazardous properties of reagents & samples ____proper disposal methods

____safety procedures ____calculations _____startup ____shutdown __repair

Instrument/Equipment Used______________________________

____

____

Note any restrictions__________________________________

____

____

______________________________ ______________

Signature of Supervisor Date

Copy must be given to: lab manager, lab director, department supervisor, analyst.
Original must be placed in analyst's personnel file.

TRACER RESEARCH CORPORATION'S
SAMPLING PROCEDURES
AND
QA/QC PROCEDURES

PREPARED BY:

TRACER RESEARCH CORPORATION

SOIL GAS SAMPLING PROCEDURE

I. Probe Placement

A) A clean probe (pipe) is removed from the "clean" storage tube on top of the van.

B) The soil gas probe is placed in the jaws of hydraulic pusher/puller mechanism.

C) A sampling point is put on the bottom of the probe.

D) The hydraulic pushing mechanism is used to push the probe into the ground.

E) If the pusher mechanism will not push the probe into the ground a sufficient depth for sampling, the hydraulic hammer is used to pound the probe into the ground.

II. Sample Extraction

A) An adaptor (Figure 1) is put onto the top of the soil gas probe.

B) The vacuum pump is hooked onto the adaptor.

C) The vacuum pump is turned on and used to evacuate soil gas.

D) Evacuation will be at least 30 seconds but never more than 5 minutes for samples having evacuation pressures less than 15 inches of mercury. Evacuation times will be at least 1 minute, but no more than 5 minutes for probes reading greater than 15 inches of mercury.

E) Gauges on the vacuum pump are checked for inches of mercury.

1. Gauge must read at least 2 inches of mercury less than maximum vacuum to be extracting sufficient soil gas to collect a valid sample.

III. Sample Collection

A) With vacuum pump running, a hypodermic syringe needle is inserted through the silicone rubber and down into the metal tubing of adaptor

(Figure 1).

B) Gas samples should only contact metal surfaces and never contact potentially sorbing materials (i.e., tubing, hose, pump diaphragm).

C) The syringe is purged with soil gas then, without removing syringe needle from adaptor, a 2-10 mL soil gas sample is collected.

D) The syringe and needle are removed from the adaptor and the end of the needle is capped.

E) If necessary, a second 10 mL sample is collected using the same procedure.

IV. Deactivation of Sampling Apparatus

A) The vacuum pump is turned off and unhooked from the adaptor.
B) The adaptor is removed and stored with equipment to be cleaned.
C) Using the hydraulic puller mechanism, the probe is removed from the ground.
D) The probe is stored in the "dirty" probe tube on top of the van.
E) The probe hole is backfilled, if required.

V. Log Book and U.S. EPA Field Sheet Notations For Sampling (Figures 2A-2D)

A) Time (military notation)
B) Sample number (use client's numbering system)
C) Location (approximate description - i.e., street names)
D) Sampling depth
E) Evacuation time before sampling
F) Inches of mercury on vacuum pump gauge
G) Probe and adaptor numbers
H) Number of sampling points used

I) Observations (i.e., ground conditions, concrete, asphalt, soil appearance, surface water, odors, vegetation, etc.)

J) Backfill procedure and materials, if used.

VI. Other Recordkeeping

A) Client-provided data sheets are filled out, if required

B) Sample location is marked on the site map

VII. Determination of Sampling Locations

A) Initial sample locations will be determined by client (perhaps after consultation with TRC personnel) prior to start of job.

B) Remaining sample locations may be determined by:

- 1) Client
  - a) Entire job sampling locations set up on grid system.
  - b) Client decides location of remaining sample locations based on results of initial study, or
- 2) Client and TRC Personnel
  - a) Client and TRC personnel decide location of remaining sample locations based on results of initial sample locations.

ANALYTICAL PROCEDURES

I. Varian 3300 Gas Chromatograph

A) Equipped with Electron Capture Detectors (ECD), Flame Ionization Detectors (FID), Photo Ionization Detectors (PID) and/or Thermal Conductivity (TC) Detectors.

B) The chromatographic column used by TRC for the analysis of halocarbons is a 1/8" diameter packed column containing Alltech OV-101. This nicely separates most of the tri-chloro and tetra-chloro compounds that are encountered in soil gas investigations. The di-chloro compounds tend to elute ahead of the tri-chloro and tetra-chloro compounds, thus creating no interference. In the event that assurance of the identity of a compound in any particular sample is needed, it will be analyzed on a SP-1000 column after the OV-101 analysis.

II. Two Spectra Physics SP4270 Computing Integrators.

The integrators are used to plot the chromatogram and measure the size of the chromatographic peaks. The integrators compute and record the area of each peak. The peak areas are used directly in calculation of contaminant concentration.

III. Chemical Standards From ChemServices, Inc. of Westchester, Pennsylvania.

A) TRC uses analytical standards that are preanalyzed, of certified purities and lot numbered for quality control assurance. Each vial is marked with an expiration date. All analytical standards are the highest grade available. Certified purities are typically 99%.

B) The Quality Assurance procedures used by ChemService were described by the Laboratory Supervisor, Dr. Lyle Phipher:

1) The primary measurement equipment at ChemServices, the analytical balance, is serviced by the Mettler Balance Company on an annual basis and recalibrated with NBS traceable weights.
2) All chemicals purchased for use in making the standards are checked for purity by means of gas chromatography using a thermal conductivity detector. Their chemicals are purified as needed.
3) The information on the purification and analysis of the standards is made available upon request for any item they ship when the item is identified by lot number. All standards and chemicals are shipped with their lot numbers printed on them. The standards used by TRC are made up in a two step dilution of the pure chemical furnished by ChemServices.

IV. Analytical Supplies

1. Sufficient 2 and 10 cc glass and Hamilton syringes so that none have to be reused without first being cleaned.
2. Disposable lab supplies, where appropriate.
3. Glassware to prepare aqueous standards.
4. Miscellaneous laboratory supplies.

QA/QC PROCEDURES

I. Standards

A) A fresh standard is prepared each day. The standards are made by serial dilution.

1) First, a stock solution containing the standard in methanol is prepared at TRC offices in Tucson. The stock solution is prepared by pipetting the pure chemical into 250 mL of methanol in a volumetric flask at room temperature. The absolute mass is determined from the product of volume and density calculated at room temperature. Hamilton microliter syringes, with a manufacturer's stated accuracy of + or - 1%, are used for pipetting. Information on density is obtained from the CRC Handbook of Physics and Chemistry. Once the stock solution is prepared, typically in concentration range of 50-1000 mg/L, a working standard is prepared in water each day. The solute in the stock solution has a strong affinity to remain in methanol so there is no need to refrigerate the stock solution. Additionally, the solute tends not to biodegrade or volatilize out of the stock solution.

2) The working standards are prepared in 40 mL VOA septum vials by diluting the appropriate ug/L quantity of the standard solution into 40 mL of water.

B) The standard water is analyzed for contamination before making the aqueous standard each day.

C) The aqueous standard is prepared in a clean vial using the same syringe each day. The syringe should only be used for that standard.

D) Final dilution of the calibration standards are made in water in a VOA vial having a Teflon coated septum cap instead of in a volumetric flask in order to have the standard in a container with no air exposure. The VOA bottle permits mixing of the standard solution and subsequent syringe sampling all day long without opening the bottle or exposing it to air. The measurement uncertainty inherent in the use of a VOA bottle instead of a volumetric flask is approximately + or - 1%.

E) The aqueous standard will contain the compounds of interest in the range of 5 to 100 ug/L depending on the detectability of the individual components. The standard will be analyzed at least three times at the beginning of each day to determine the mean response factor (RF) for each component (Figure 3). The standard will be injected again after every fifth sample to check detector response and chromatographic performance of the instrument throughout the day.

F) The RF allows conversion of peak areas into concentrations for the contaminants of interest. The RF used is changed if the standard response varies 25%. If the standard injections vary by more than 25% the standard injections are repeated. If the mean of the two standard injections represents greater than 25% difference then a third standard is injected and a new RF is calculated from the three standard injections. A new data sheet is started with the new RF's and calibration data.

$$\%\ \text{difference} = \frac{\text{A area} - \text{B area}}{\text{A area}}$$

Where ; A = mean peak area of standard injection from first calibration
B = peak area of subsequent standard injection

G) The low ug/L aqueous standards that are made fresh daily need not be refrigerated during the day because they do not change significantly in a 24 hour period. On numerous occasions the unrefrigerated 24 hour old standards have been compared with fresh standards and no difference has been measurable. If the standards were made at high ppm levels in water, the problem of volatilization would probably be more pronounced in the absence of refrigeration.

H) Primary standards are kept in the hotel room when on a project.

I) A client may provide analytical standards for additional calibration and verification.

II. Syringe Blanks

A) Each uL syringe is blanked before use.

B) 2 cc (glass) syringes will each be blanked if ambient air concentrations are elevated (greater than or equal to 0.01 ug/L) for components of interest.

C) If ambient air concentrations are <0.01 ug/L for components of interest, a representative sample of at least two syringes are blanked at the beginning of each day. If representative syringes have no detectable contamination remaining syringes need not be blanked. If any of representative syringes show contamination, all 2 cc syringes must be blanked prior to use.

D) Syringe blanks are run with air or nitrogen.

E) If it is necessary for any syringe to be used again before cleaning, it is blanked prior to its second use.

III. System Blanks

A) System blanks are ambient air drawn through the probe and complete sampling apparatus (probe adaptor and 10 cc syringe) and analyzed by the same procedure as a soil gas sample. The probe is above the ground.

B) One system blank is run at the beginning of each day and compared to a concurrently sampled air analyses.

C) A system blank is run before reusing any sampling system component.

IV. Ambient Air Samples

A) Ambient air samples are collected and analyzed a minimum of two times daily to monitor safety of the work environment and to establish site background concentrations, if any, for contaminants of interest.

B) All ambient air samples shall be documented (Figure 3).

V. Samples

A) All unknown samples will be analyzed at least twice.

B) More unknown samples will be run until reproducibility is within 25%, computed as follows:

$$\text{Difference} = \frac{A - B}{(A + B)/2}$$

Where; A is first measurement result

B is second measurement result

If the difference is greater than .25, a subsequent sample will be run until two measurements are made that have a difference of .25 or less. Those two measurements will be used in the final calculation for that sample.

C) The injection volume should be adjusted so that mass of analyte is as near as possible to that which is contained in the standard, at least within a factor of ten.

D) Whenever possible the attenuation for unknown samples is kept constant through the day (so as to provide a visual check of integrations).

E) A water plug is used as a gas seal in uL syringes

F) A seal is established between syringes when subsampling

G) At very high concentrations air dilutions are acceptable once concentration of contaminants in air have been established.

H) All sample analysis are documented (Figure 3).

I) Separate data sheets are used if chromatographic conditions change

J) Everything is labeled in ug/L, mg/L, etc. PPM and PPB notations are to be avoided.

VI. Daily System Preparation (Figure 4).

A) Integrators parameters are initialized

1. Pt. evaluation
2. Attenuation
3. Peak markers
4. Auto zero
5. Baseline offset (min. 10% of full scale)

B) The baseline is checked for drift, noise, etc.

C) System parameters are set.

1. Gas flows (Note: N_2, air, H_2 tank pressure on Page 1 of chromatograms).
2. Temperatures
    - a) Injector
    - b) Column
    - c) Detector

D) After last analysis of the day conditioned septa are rotated into injection ports used during the day and replaced with fresh septa.

E) Column and injector temperatures are run up to bake out residual contamination.

F) Syringes are cleaned each day

1. 2 and 10 cc syringes are cleaned with Alconox or equivalent detergent and brush

2. uL syringes are cleaned daily with IPA or MeOH and purged with N_2. Syringe Kleen is used to remove metal deposits in the barrel.
3. Syringes are baked out overnight in the oven of the gas chromatograph at a minimum temperature of 60°C.

VII. Sample Splits

If desired, TRC's clients or any party, with the approval of TRC's client, may use sample splits to verify TRC's soil gas or groundwater sampling results.

A) Sample splits may be collected in two valve, flow through-type all-glass or internally electroplated stainless steel containers for analysis within 10 days of collection.

1. Flow through sample collection bottles should be cleaned by purging with nitrogen at 100°C for at least 30 minutes. Once clean, the bottles should be stored filled with nitrogen at ambient pressure.
2. Sample bottles are filled by placing them in the sample stream between the probe and the vacuum pump. Five sample bottle volumes should be drawn through the container before the final sample is collected. The sample should be at ambient pressure.

B) Sample splits can be provided in 10 cc glass syringes for immediate analysis in the field by the party requesting the sample splits.

C) Splits of the aqueous standards or the methanol standards used by TRC for instrument calibration may be analyzed by the party requesting sample splits.

Figures 1 through 4

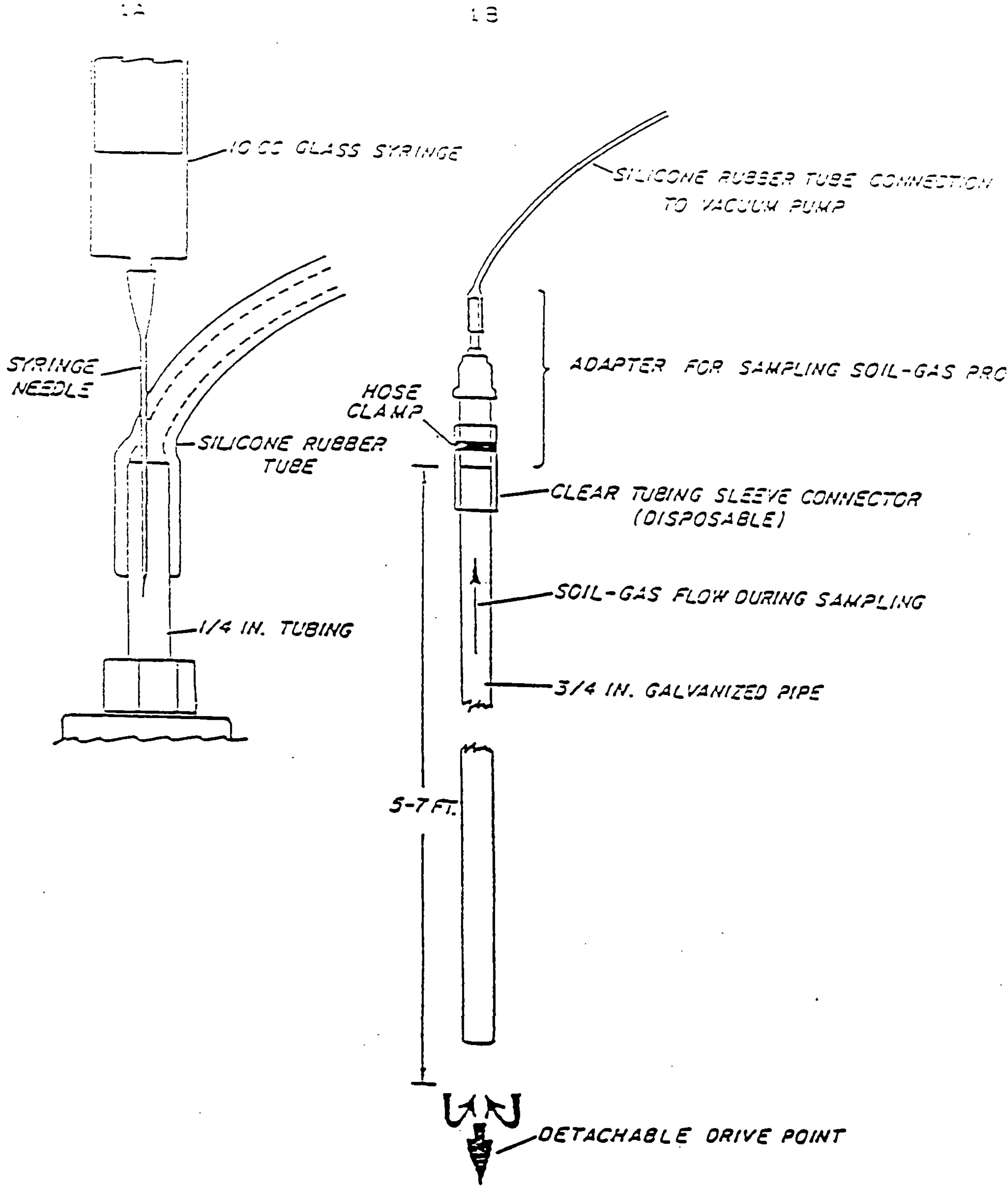
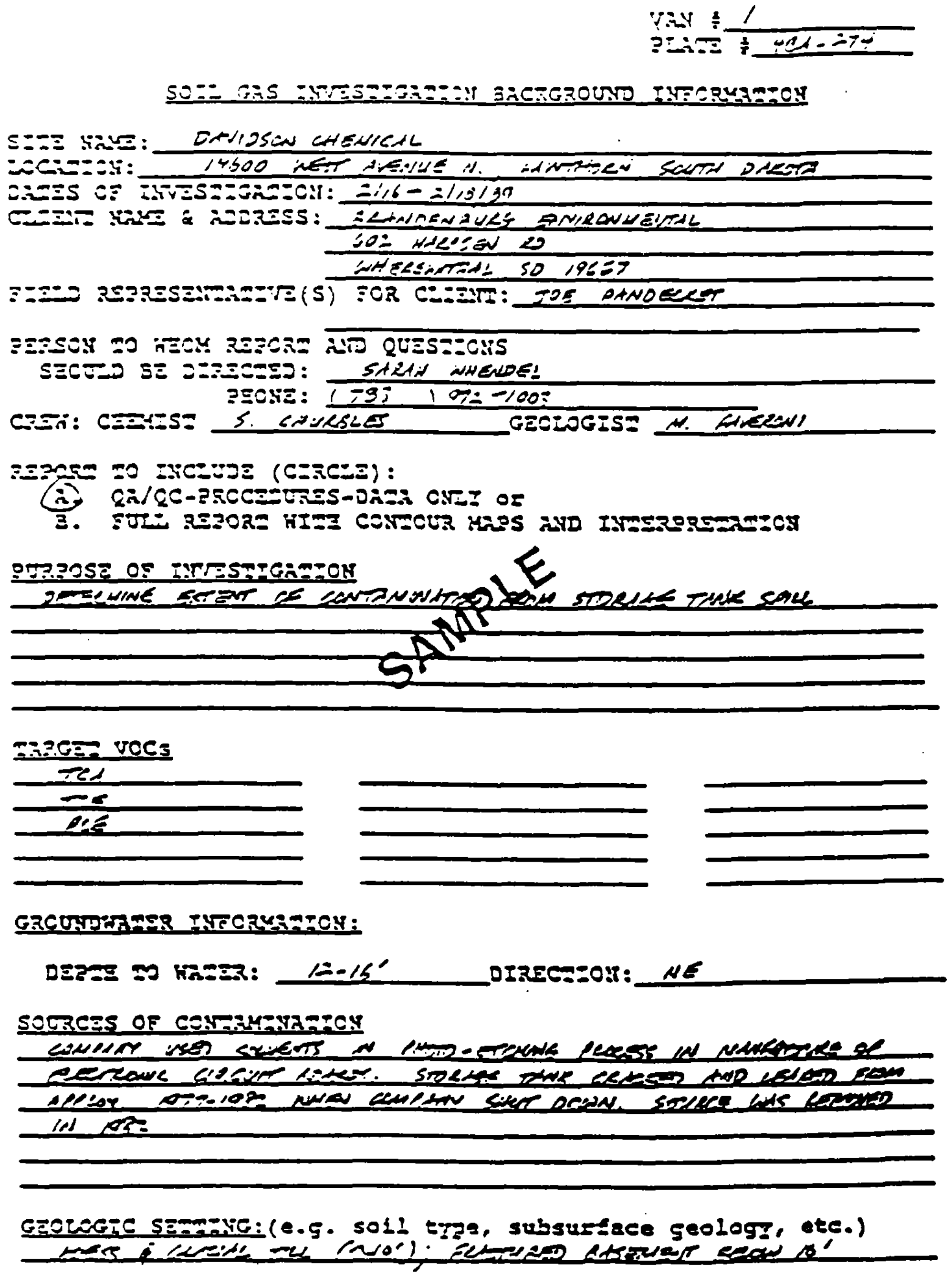


FIGURE 1. SAMPLING APPARATUS

1A. CLOSE-UP OF SYRINGE SOIL GAS SAMPLING THROUGH EVACUATION LINE
1B. DIAGRAM OF SOIL GAS SAMPLING PROBE WITH ADAPTOR FOR SAMPLING AND EVACUATION OF THE PROBE AFTER IT IS DRIVEN INTO THE GROUND



VAN # 1

PLATE # 401-274

SOIL GAS INVESTIGATION BACKGROUND INFORMATION

SITE NAME: DAVIDSON CHEMICAL

LOCATION: 14500 WEST AVENUE N. HAWTHORN SOUTH DAKOTA

DATES OF INVESTIGATION: 2/16 - 2/18/90

CLIENT NAME & ADDRESS: BRANDENBURG ENVIRONMENTAL
502 HALSEN RD
WHEELENTHAL SD 19657

FIELD REPRESENTATIVE(S) FOR CLIENT: JOE PANDECKET

PERSON TO WHOM REPORT AND QUESTIONS SHOULD BE DIRECTED: SARAH WHENDEL

PHONE: (793) 972-1003

CREW: CHEMIST S. CHURBLES GEOLOGIST M. FAVERONI

REPORT TO INCLUDE (CIRCLE):

[✓ A. QA/QC-PROCEDURES-DATA ONLY] or

B. FULL REPORT WITH CONTOUR MAPS AND INTERPRETATION

PURPOSE OF INVESTIGATION

DETERMINE EXTENT OF CONTAMINATION FROM STORAGE TANK SPILL

TARGET VOCs

TCA
TCE
PCE

GROUNDWATER INFORMATION:

DEPTH TO WATER: 12-15' DIRECTION: NE

SOURCES OF CONTAMINATION

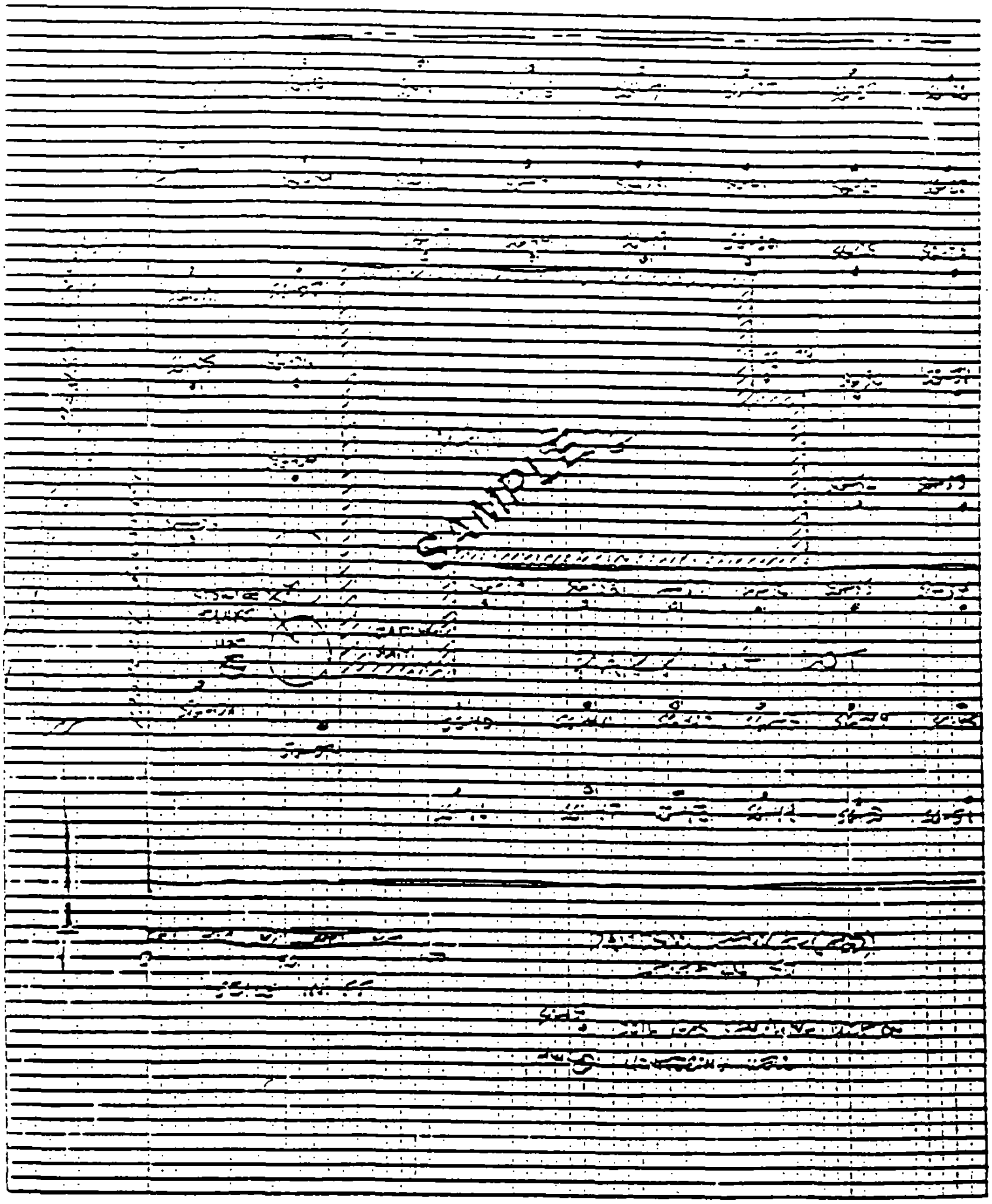
COMPANY USED SOLVENTS IN PHOTO-ETCHING PROCESS IN MANUFACTURE OF ELECTRONIC CIRCUIT BOARDS. STORAGE TANK CRACKED AND LEAKED FROM APPROX 1977-1982 WHEN COMPANY SHUT DOWN. STORAGE WAS REMOVED IN 1982.

GEOLOGIC SETTING: (e.g. soil type, subsurface geology, etc.)

LOESS & GLACIAL TILL (~10'); FRACTURED BASEMENT FROM 15'

FIGURE 2A
FIELD LOGBOOK - BACKGROUND INFORMATION

SITE MAP



SITE MAPS TO INCLUDE: SITE NAME, SCALE, NORTH ARROW, SOIL GAS LOCATIONS & NUMBERS, CULTURAL AND NATURAL FEATURES TO IDENTIFY

FIGURE 2B
FIELD LOGBOOK - SITE MAP