AP - 001

STAGE 1 & 2 WORKPLANS

DATE:

MAY 6, 1994

SAMPLING, ANALYSIS AND QUALITY ASSURANCE PLAN FOR REMEDIAL INVESTIGATION AT THE FORMER BRICKLAND REFINERY

Prepared for:

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May 6, 1994

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Sampling, Analysis and Quality Assurance Plan for Remedial Investigation at the Former Brickland Refinery

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May 6, 1994

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1.0 Project Description

The former Brickland Refinery site is located in Sunland Park, New Mexico near the city of El Paso, Texas. The 35-acre site operated as a petroleum refinery from 1933 to 1958. Virtually all of the processing equipment and buildings associated with refinery operations have been removed from the site. Disposal and leakage of petroleum products and waste refinery-related chemicals have resulted in soil and groundwater contamination at the site.

This sampling, analysis and quality assurance plan describes the subsurface soil and groundwater investigation program to be conducted at the former Brickland Refinery site currently owned by the Rexene Corporation (Rexene). The primary objective of this investigation is to characterize free product and soil contamination at the site, and to collect data to determine the appropriate soil remediation requirements. A secondary objective is to obtain additional groundwater information to help determine if groundwater remediation is necessary.

The purpose for performing a remedial investigation at the former Brickland Refinery site is to generate data that will aid in the selection and design of the appropriate remedial technology for treatment of petroleum contaminated soil at the site. In addition, the investigation is designed to provide data for developing the appropriate site clean-up standards for petroleum contaminated soils. The impact of the contaminated soils on groundwater will be evaluated, and the groundwater sampling in this proposed investigation will be used to gather information to assess the need for additional groundwater investigations and remediation. If the need for groundwater remediation is confirmed, then additional work may be required to complete the design and implementation of a groundwater treatment system. Whenever possible, monitor well design and locations will be selected so that they may be converted to recovery wells at a later date in order to save time and cost, should a groundwater clean-up prove to be necessary.

2.0 Quality Assurance Objectives

According to EPA (EPA 1991) quality assurance guidelines should ensure the following:

- Intended measurements are appropriate for achieving project objectives;
- Quality control procedures are sufficient for obtaining data of known and adequate quality; and
- Such data will be defensible if challenged technically or legally.

Quality assurance objectives are specifications that measurements must meet in order achieve project objectives. There are both quantitative and qualitative objectives against which data measurements will be evaluated to determine if project objectives have been achieved.

2.1 Quantitative Objectives

Quantitative objectives include parameters such as precision, accuracy, detection limits and completeness of data. The definitions for these parameters according to EPA (EPA, 1987) are presented below.

- Precision - a measurement of mutual agreement among individual measurements of the same parameter, usually under prescribed similar conditions.
- Accuracy - the degree of agreement of a measurement (or an average measurement of the same parameter) with an accepted reference or true value.
- Completeness - a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions.

2.2 Qualitative Data Objectives

Qualitative objectives include the comparability and representativeness of data and are defined below:

- Comparability - The confidence with which one data set can be compared to another. Comparability is assessed by comparing both sampling and analytical methods and units of repeated data.

- Representativeness - The degree to which data accurately and precisely represent characteristics of a population, sampling point parameter variations, process conditions or environmental conditions.

The purpose for QA/QC procedures is to provide guidelines that should be followed to ensure that the data collected during implementation of field work is of sufficient quality to satisfy project requirements.

3.0 Field Methods and Sampling Procedures

Potential soil remediation technologies applicable to the Brickland site have been identified by GCL. The following applicable technologies for soil treatment were identified:

- Solidification/Stabilization
- Soil Washing
- Bioremediation
- Capping
- Long-Term Monitoring

In order to determine the site-specific applicability of each technology, specific analyses of selected samples of site soils will be required.

To accomplish these objectives, soil borings will be augured, test trenches will be excavated, monitor wells will be installed and soil and groundwater samples will be collected for analysis. Section 3.1 elaborates on the investigative methods, and sections 3.2 through 3.6 on the sampling and analytical methods that will be used to meet these data objectives.

3.1 Investigation Methods for Site Soils and Groundwater

Test trenches, soil borings, well points, monitoring wells and specific analysis of soil and groundwater samples to characterize physical and chemical subsurface properties are all components of this investigation plan. Plate A identifies the proposed locations for these components. These locations were selected in the areas of the site that are believed to have the most significant contamination and/or will provide the most significant data for site characterization. These areas also represent the most likely locations for any potential active soil and/or groundwater remediation that would be implemented.

3.1.1 Test Trenches

Five test trenches are planned; however, one additional trench may be included as an option if field conditions warrant its excavation. These test trenches will provide access for sample collection and will also provide for a better visual observation of the relationship between subsurface soils, groundwater, lithology and the distribution and extent of subsurface contamination.

Test trenches will be excavated using a backhoe fitted with a 3-foot bucket. Trench dimensions will be approximately 4 feet wide, 6 to 8 feet long and approximately 12 feet deep, depending on groundwater level. The trenches will be excavated and sloped to prevent side-wall cave in. Trench excavations will proceed at approximately 2-foot intervals to allow for visual observation of the subsurface and the collection of samples as specified in this document. Upon completion of the investigation, the trenches will be backfilled and compacted.

3.1.2 Soil Borings

It is proposed that 14 soil borings be drilled in order to characterize the subsurface lithology, and to collect the samples necessary to meet the data objectives of this investigation plan.

A drill rig with all-terrain capability (or provisions for all terrain access) equipped with a 6.125 inch OD X 2.75 inch ID continuous-flight hollow-stem auger will be used to drill the boreholes. At locations where monitor wells or well points are proposed, auger flights appropriate for a 4-inch ID monitor well casing and 2-inch ID well point casing will be used. Core samples will be collected using a 5-foot continuous core barrel sampler. The auger will be advanced at intervals of 5 feet to facilitate removal of the continuous core sampling tube for lithologic logging and sample collection.

The total depth of the soil borings will be determined in the field, but are not expected to exceed 15 feet for soil borings and 30 feet for monitor wells. In some borings the total depth could be as shallow as 5 or 6 feet. If auger refusal conditions are encountered, drilling will be stopped. Auger refusal conditions will be verified by the American Society of Testing and Materials (ASTM) Method D-1586. This method specifies that refusal is met when a standard 2-inch OD split barrel sampler driven by a 140- pound weight dropped 2.5 feet will not penetrate 6 inches in 50 impacts.

Some of the borings will be completed as monitor wells and/or well points; the remainder will be properly plugged and abandoned according to the following procedure.

- Fill bottom third of borehole with pelleted bentonite.
- Activate bentonite with 1-gallon of distilled water.
- Fill borehole with soil boring cuttings until borehole is approximately half filled.

- Fill borehole with pelleted bentonite until borehole is approximately two-thirds filled.

- Activate bentonite with 1-gallon of distilled water.

- Fill remainder of borehole with soil boring cuttings to the surface.

3.1.3 Well Points

During recent investigations, GCL installed well points in zones of suspected soil contamination in order to define the nature and extent of the contamination and the occurrence of free-phase floating product. These well points were installed at varying depths, with well screens placed either across the air-water interface or several feet beneath the water table. The screened interval of several well points installed below the water table will be elevated to allow measurement of the air-water interface and to aid in location of free-phase product. Each well screen will be elevated using the drill rig by raising the well point casing up through the ground until the desired elevation is reached. Also, a few well points will be driven deeper to provide more information on groundwater movement in deeper portions of the shallow aquifer. The well points to be adjusted are shown on plate A.

Three soil borings will be converted to well points upon completion of sampling and lithologic description activities. These well points will also serve to provide information on groundwater movement and free-phase product in the shallow aquifer. In addition, two new well points will be installed in the southern portion of the site adjacent to soil borings B-12 and B-13 to investigate the theory that free-phase product has collected in this area. All of these new well point locations are identified on plate A.

3.1.4 Monitoring Wells

Conversion of four soil borings to monitoring wells is planned to enhance the monitoring capability of the existing network. One monitor well will be placed toward the center section of the site and another will be placed near MW-6S to investigate for free-phase and dissolved phase contaminants. In addition, two monitoring wells will be installed in soil borings B-12 and B-13 at the southwestern end of the site to investigate the theory that free-phase product has collected in this area. Monitoring well installations will be designed so that they may be easily converted to recovery wells if groundwater remediation is determined to be necessary. Soil borings planned for conversion to monitoring wells are identified on plate A.

3.1.4.1 Monitoring Well Installation

The proper emplacement of monitor wells is critical for the collection of valid and representative groundwater samples. Drilling equipment must be decontaminated properly, screens must be set at the appropriate depth, and wells must be properly developed.

Installation of monitor wells in the shallow zone will be initiated using a hollow-stem auger drilling technique. Prior to starting each well, personnel will steam-clean the rig and all the drilling tools in the decontamination area. A decontamination area will be established on one of the concrete foundations remaining at the site. Water used for decontamination will be contained and analyzed prior to disposal to determine if it is hazardous. If it is hazardous, it will be shipped off-site for disposal at a regulated disposal facility.

The well casings for the wells will be composed of 4-inch, flush joint, polyvinyl chloride (PVC) pipe, precleaned and prepackaged by the manufacturer. The screen, a 10-foot riser pipe, and a 5-foot capped tailpipe will be composed of stainless steel. The well screen shall be a 4-inch wire-wrap 0.02-inch slot regular strength stainless steel screen. This screen was selected because of the potential future use of the monitoring wells for recovery purposes. The casing will be installed by connecting individual sections while they are lowered into the borehole through the hollow center of the auger column. For shallow monitor wells (less than 40 feet) a 10-foot screen will be placed at the air/water interface, with 3 feet above the static water level and 7 feet below.

After the well casing has been installed, the auger flights will be retrieved in 5-foot intervals. Precleaned and prepackaged 8/12 or 10/20 silica sand will be poured down the auger annulus to fill the void left as each 5-foot flight is removed. This sand, along with a small volume of formation sand that may slough into the borehole during retraction of the auger column, will provide the filter pack for the well screen. The sand will be placed to a level of 2 to 5 feet above the top of the screen. A 1- to 2-foot thickness of less permeable 20/40 sand will be placed directly above the gravel pack to protect it from bentonite and cement slurry intrusion.

A 5-foot bentonite pellet seal will be placed on top of the filter pack in well sections below the water table, and a bentonite powder hydrated with 10 gallons of water will be used for well sections above the water table, to form an impervious barrier and prevent downward migration of moisture. The remainder of the well annulus up to the ground surface will be grouted with a cement/bentonite slurry. The grout will be inserted from the surface after all remaining auger flights have been removed. The well head will be completed with the installation of a flush-to-grade concrete slab and waterproof steel vault. The locations and elevations of the monitor wells will be surveyed by a certified land surveyor.

3.1.4.2 Well Development

Monitor well and well point development will be conducted in one or two phases: bailing and pumping. In the first phase, water will be bailed from the well in order to remove gross amounts of clay and silt. Bailing will also serve as a verification of proper well alignment. During the second phase of well development, a 4-inch submersible pump will be installed in the well and operated from several different levels within the screened interval. If low well yields are encountered in a well, then an air-driven ejector pump may be used to develop the wells. The well will be determined to be fully developed when the indicator parameters of pH, temperature, and electrical conductance of water sampled from the well have stabilized over three consecutive measurements. Stability of parameters will be allowed to vary ± 0.2 units for the pH, ± 50 µmhos for the conductivity, and ± 1°C for the temperature. Wells which do not stabilize within a reasonable amount of development, (within three well casing volumes of water) will be examined on a case by case basis. On-site GCL personnel will determine the cause of the problem, such as pump rate variation or particular aquifer characteristics, and document the problem and solution in the field notebook. All produced water will be contained in clean drums. Cuttings and fluid will be disposed in accordance with applicable regulations.

An electronic sounding oil-water interface probe will be used to measure depth to water and, if present, immiscible product thickness. The top-of-casing elevation for each well will be the point from which all measurements are referenced. Fluid level measurements will be conducted for the new monitoring wells and all well points to provide additional groundwater flow and floating product data, including depth to water, depth to product, and product thickness.

Upon recovery of the well, samples should be collected in accordance with the sampling plan for each individual well. The procedures for collecting each sample according to method of analysis to be performed are discussed below.

3.2 Soil Sampling Methods

The data collected during the remedial investigation will include a variety of chemical analyses of soil and groundwater, and fluid level measurements, as well as biological and geotechnical data from soils. Approximately 30 different analysis or measurement methods of chemical, physical or biological characteristics will be used to investigate, evaluate and characterize the site for remediation. The following procedures will be utilized to sample the soil samples retrieved from trenches and boreholes. A sampling and analysis summary for soil borings and test trenches is presented in table 1. In addition, table 2 presents the appropriate containers, preservative and holding times for each sample by location.

3.2.1 Test Trench Sampling

When the total depth of the test trench is reached, the exposed subsurface will be logged for lithology, as well as visually scanned to determine the most appropriate depth and stratigraphic layer from which samples should be obtained. Sample depths will be determined by selecting the interval exhibiting the greatest amount of visual staining.

Test trench samples designated for chemical analyses include poly aromatic hydrocarbons (PAHs), benzene, toluene, ethylbenzene, and xylene (BTEX) and RCRA metals. Selection of PAH and BTEX samples will be based on the sampling schedule of table 1, visual observation and photoionization detector (PID) screening. Those samples that have the highest PID readings will be collected for analysis. Collection of RCRA metal samples will be based on the criteria of table 1.

Once samples have been identified for collection, 6-inch long, 2-inch diameter open tube stainless steel samplers will be used to collect samples from the trench. Personnel entry into the trench for sampling will be avoided by using extension tools (such as a hand auger) for sample collection. Upon collection of the samples via the stainless steel tubes the soil will be removed via a plunger device (as needed) and placed into appropriate sample containers (see table 2) and immediately placed into an ice-filled cooler.

3.2.2 Borehole Sampling

A continuous core, clear Lexan sampling tube (minimum 2-inch ID) will be used to collect samples while drilling with the hollow-stem auger. Upon reaching the desired sampling depth (approximately every 4 or 5 feet) drilling will stop and the sampling tube will be retrieved. The core will be photographed and described as to lithologic character. The depth and type of samples to be collected will vary by borehole location and will be in accordance with table 1.

Table 1
Former Brickland Refinery-Remedial Investigation
Sampling Analysis Summary for Soil Borings and Test Trenches

Hole/ Trench I.D.	Target Depth (ft)	Sample Interval (ft)	Analytical Strategy *																					
			1	2[a]	3[a]	4	5	6	7	8	9	10	11	12	13[b]	14	15	16	17	18	19	20	21	22
B-1	15	0																						
		2								1														
		4																						
		6		1	1	1	1			1	1	1	1	1	1							1		
		8																				1		
		10																						
		12																						
B-2	15	0																						
		2																						
		4																						
		6												1	1						1	1		
		8						1	1													1		
		10																						
		12																						
B-3	15	0																						
		2																						
		4	1																					
		6	1											1	1									
		8	1			1	1				1	1	1	1										
		10	1																					
		12	1																					
B-4	15	0																						
		2								1						1								
		4														1								
		6								1				1	1	1							1	
		8														1								
		10														1								
		12														1	1	1						
B-5	15	0																						
		2																						
		4																						
		6		2D	1									1	1							1		
		8																	1	1		1		
		10																						
		12																						
B-6	15	0																						
		2																						
		4																						
		6												1	1						1	1		
		8																	1	1				
		10																						
		12																						
B-7	15	0																						
		2	1																					
		4	1																					
		6	1											1	1									
		8	1								1	1	1	1										
		10	1																					
		12	1																					
B-8	15	0																						1
		2																						
		4																						
		6				1	1	1	1					1	1							1		
		8																						
		10																						
		12																						
B-9	15	0																						
		2	1																					
		4	1																					
		6	1											1	1									
		8	2D				1															1		
		10	1																					
		12	1																					
B-10	15	0																						
		2																						
		4																						
		6		1	1					1				1	1									
		8																	1	1		1		
		10																						
		12																						

Table 1
Former Brickland Refinery-Remedial Investigation
Sampling Analysis Summary for Soil Borings and Test Trenches

Hole/ Trench I.D.	Target Depth (ft)	Sample Interval (ft)	Analytical Strategy * 1	2[a]	3[a]	4	5	6	7	8	9	10	11	12	13[b]	14	15	16	17	18	19	20	21	22
B-11	15	0																						1
		2	1													1								
		4	1													1								
		6	1	1	2D									1	1	1							1	
		8	1			1	1			2D	1	1	1	1		1								
		10	1													1								
		12	1													1								
B-12	15	0																						
		2																						
		4																						
		6												1	1									
		8						1	1											1	1			
		10																						
		12																						
B-13	15	0																						
		2																						
		4																						
		6												1	1									
		8								1												1		
		10																						
		12															1	1						
B-14	15	0																						
		2																						
		4																						
		6																						
		8	1	1	1			1	1					1	1							1		
		10																						
		12																						
TR-1	12																							
									1															
				1	2D								1	1										
									2D															
TR-2	12	0																						
		2																						
		4																						
		6		1	1								1	1										
		8																						
		10																						
		12																						
TR-3	12	0																						
		2								1														
		4																						
		6		2D	1					1			1	1										
		8																						
		10																						
		12																						
TR-4	12	0																						
		2								1														
		4																						
		6		1	1					1				1	1									
		8																						
		10																						
		12																						
TR-5	12	0																						1
		2								1														
		4																						
		6		1	1					1				1	1									
		8																						
		10																						
		12																						
Trip Blanks					4																			
Field Blanks				3	3																			
Rinsate Samples				3	3																			
Total Samples			26	18	22	4	5	4	4	17	4	4	4	19	19	12	2	2	3	3	3	13	2	2

Table 1
Former Brickland Refinery-Remedial Investigation
Sampling Analysis Summary for Soil Borings and Test Trenches

***Analytical Strategy Codes:**

(1) TPH (EPA 418.1)
(2) PAH (EPA 8270A)
(3) BTEX (EPA 8020)
(4) TOC (EPA 415.1)
(5) Soil pH (EPA 9045)
(6) TCLP-Benzene (EPA 1311)
(7) TCLP-Metals (EPA 1311)
(8) RCRA Metals
(9) Background Heterotrophic Bacteria (Sect. 9215)[c]
(10) Volatile Hydrocarbon Utilizers (Sect. 9215)[c]
(11) Non-Volatile Hydrocarbon Utilizers (Sect. 9215)[c]
(12) Macronutrient Analysis (Hach Field Kit)
(13) Lithology (USCS)
(14) Particle Size Distribution (Laser)
(15) Saturated Horizontal Hydraulic Conductivity (ASTM -D-2434)
(16) Saturated Vertical Hydraulic Conductivity (ASTM-D-2434)
(17) CEC (Absorbed Water)
(18) Clay Type (X-Ray Diffraction)
(19) Humic Content (ASTM-D-2974)
(20) Moisture Content (ASTM-D-2216-80)
(21) Capillary Moisture Relationship (ASTM-D-2325)
(22) Dry Bulk Density (API RP-40)

[a] Field screen all intervals with PID and submit samples with highest concentration for laboratory analysis.

[b] Record lithologic description for entire depth of hole or trench.

[c] Method Reference: Standard Method for the Examinations of Water and Wastewater, 17th Edition, 1989.

[D] Include duplicate sample

Table 2

Sample Analysis, Containers, Preservative and Holding Time Requirements by Sample Location

Sample Location	Container Requirements	Analysis per Container	Preservative	Holding Time	Laboratory
B-1	1-250 mL GWM, TFE Lid	EPA 8270A, 415.1, 9045, RCRA Metals	Cool ≤4°C	14 days to extraction for EPA 8270A	Core-Aurora
	2-125 mL GWM, TFE Lid	EPA 8020 RCRA Metals		14 days 6 months	
	1-125 mL GWM, TFE Lid	Back. Hetero. Bact. Non-Vol. HC Util. Vol. HC Util.			GTEL
	2-6 in x 2 in ID Lexan Sleeve	ASTM-D-2216-80			Core-Bakersfield
B-2	1-250 mL GWM, TFE Lid	EPA 1311-Benzene EPA 1311-Metals	Cool ≤4°C	14 days to extraction 6 months to extraction	Core-Aurora
	2-6 in x 2 in ID Lexan Sleeve	ASTM-D-2216-80 ASTM-D-2974			Core-Bakersfield
B-3	6-250 mL GWM, TFE Lid	EPA 418.1	Cool ≤4°C	28 days	Core-Aurora
	1-250 mL GWM, TFE Lid	EPA 415.1, 9045			
	1-125 mL GWM, TFE Lid	Back. Hetero. Bact. Non-Vol. HC Util. Vol. HC Util.			GTEL

Table 2 (cont'd)

Sample Analysis, Containers, Preservative and Holding Time Requirements by Sample Location

Sample Location	Container Requirements	Analysis per Container	Preservative	Holding Time	Laboratory
B-4	2-125 mL GWM, TFE Lid	RCRA Metals	Cool ≤4°C	6 months	Core-Aurora
	6-6 in x 2 in ID Lexan Sleeve	Particle size distribution ASTM-D-2434-Vertical ASTM-D-2434-Horizontal ASTM-D-2325			Core-Bakersfield
B-5	2-250 mL GWM, TFE Lid	EPA 8270A	Cool ≤4°C	14 days to extraction	Core-Aurora
	1-6 in x 2 in ID Lexan Sleeve	CEC Clay Type			Core-Bakersfield
	2-6 in x 2 in ID Lexan Sleeve	ASTM-D-2216-80			
B-6	1-6 in x 2 in ID Lexan Sleeve	ASTM-D-2216-80 ASTM-D-2974	Cool ≤4°C		Core-Bakersfield
	1-6 in x 2 in ID Lexan Sleeve	CEC, Clay Type			
B-7	6-250 mL GWM, TFE Lid	EPA 418.1	Cool ≤4°C		Core-Aurora
	1-125 mL GWM, TFE Lid	Back. Hetero. Bact. Non-Vol. HC Util. Vol. HC Util.			GTEL

Table 2 (cont'd)

Sample Analysis, Containers, Preservative and Holding Time Requirements by Sample Location

Sample Location	Container Requirements	Analysis per Container	Preservative	Holding Time	Laboratory
B-8	1-250 mL GWM, TFE lid	EPA 418.1, 9045	Cool ≤4°C		Core-Aurora
	1-250 mL GWM, TFE Lid	EPA 1311-Benzene EPA 1311-Metals		14 days to extraction 6 months to extraction	
	1-6 in x 2 in ID Lexan Sleeve	ASTM-D-2216-80			Core-Bakersfield
	1-6 in x 2 in ID Lexan Sleeve	API-RP-40			
B-9	7-250 mL GWM, TFE Lid	EPA 418.1	Cool ≤4°C	28 days	Core-Aurora
	1-250 mL GWM, TFE Lid	EPA 9045			
	1-6 in x 2 in ID Lexan Sleeve	ASTM-D-2216-80			Core-Bakersfield
B-10	1-250 mL GWM, TFE Lid	EPA 8270A	Cool ≤4°C	14 days to extraction	Core-Aurora
	2-250 mL GWM, TFE Lid	EPA 8020 RCRA Metals		14 days 6 months	Core-Bakersfield
	1-6 in x 2 in ID Lexan Sleeve	CEC, Clay Type, ASTM-D-2216-80			

Table 2 (cont'd)

Sample Analysis, Containers, Preservative and Holding Time Requirements by Sample Location

Sample Location	Container Requirements	Analysis per Container	Preservative	Holding Time	Laboratory
B-11	6-250 mL GWM, TFE Lid	EPA 418.1	Cool ≤4°C	28 days	Core-Aurora
	1-250 mL GWM, TFE Lid	EPA 8270A		14 days to extraction	
	1-250 mL GWM, TFE Lid	EPA 8020		14 days	
	1-250 mL GWM, TFE Lid	EPA 8020(D)			
	1-250 mL GWM, TFE Lid	EPA 415.1, 9045			
	1-250 mL GWM, TFE Lid	RCRA Metals		6 months	
	1-250 mL GWM, TFE Lid	RCRA Metals(D)			
	1-125 mL GWM, TFE Lid	Back. Hetero. Bact. Non-Vol. HC Util. Vol. HC Util.			GTEL
	6-6 in x 2 in ID Lexan Sleeve	Particle Size Distribution ASTM-2325			Core-Bakersfield
	1-6 in x 2 in ID Lexan Sleeve	API RP-40			
B-12	1-250 mL GWM, TFE Lid	EPA 1311-Benzene EPA 1311-Metals	Cool ≤4°C	14 days to extraction 6 months to extraction	Core-Aurora
	1-6 in x 2 in ID Lexan Sleeve	ASTM-D-2216-80 ASTM-D-2974			Core-Bakersfield

Table 2 (cont'd)

Sample Analysis, Containers, Preservative and Holding Time Requirements by Sample Location

Sample Location	Container Requirements	Analysis per Container	Preservative	Holding Time	Laboratory
B-13	2-125 mL GWM, TFE Lid	RCRA Metals	Cool ≤4°C	6 months	Core-Aurora
	1-6 in x 2 ID Lexan Sleeve	ASTM-D-2434-Vertical ASTM-D-2434-Horizontal			Core-Bakersfield
	2-6 in x 2 in ID Lexan Sleeve	ASTM-D-2216-80			
B-14	6-250 mL GWM, TFE Lid	EPA 418.1	Cool ≤4°C	28 days	Core-Aurora
	1-250 mL GWM, TFE Lid	EPA 8270A		14 days to extraction	
	1-250 mL GWM, TFE Lid	EPA 8020		14 days	
	1-250 mL GWM, TFE Lid	EPA 1311 - Benzene EPA 1311 - Metals			
	1-6 in x 2 in ID Lexan Sleeve	ASTM-D-2216-80			Core-Bakersfield
TR-1	1-250 mL GWM, TFE Lid	EPA 8270A	Cool ≤4°C	14 days to extraction	Core-Aurora
	2-125 mL GWM, TFE Lid	EPA 8020, 8020(D)		14 days	
	1-125 mL GWM, TFE Lid	RCRA Metals		6 months	
	2-125 mL GWM, TFE Lid	RCRA Metals RCRA Metals(D)			
TR-2	1-250 mL GWM, TFE Lid	EPA 8270A	Cool ≤4°C	14 days to extraction	Core-Aurora
	1-125 mL GWM, TFE Lid	EPA 8020		14 days	

Table 2 (cont'd)

Sample Analysis, Containers, Preservative and Holding Time Requirements by Sample Location

Sample Location	Container Requirements	Analysis per Container	Preservative	Holding Time	Laboratory
TR-3	2-250 mL GWM, TFE Lid	EPA 8270A, 8270A(D)	Cool ≤4°C	14 days to extraction	Core-Aurora
	1-125 mL GWM, TFE Lid	EPA 8020		14 days	
	1-125 mL GWM, TFE Lid	RCRA Metals		6 months	
	1-125 mL GWM, TFE Lid	RCRA Metals			
TR-4	1-250 mL GWM, TFE Lid	EPA 8270A	Cool ≤4°zC	14 days to extraction	Core-Aurora
	1-125 mL GWM, TFE Lid	EPA 8020		14 days	
	1-125 mL GWM, TFE Lid	RCRA Metals		6 months	
	1-125 mL GWM, TFE Lid	RCRA Metals			
TR-5	1-250 mL GWM, TFE Lid	EPA 8270A	Cool ≤4°zC	14 days to extraction	Core-Aurora
	1-125 mL GWM, TFE Lid	EPA 8020		14 days	
	1-125 mL GWM, TFE Lid	RCRA Metals		6 months	
	1-125 mL GWM, TFE Lid	RCRA Metals			

Table 2 (cont'd)

Sample Analysis, Containers, Preservative and Holding Time Requirements by Sample Location

Sample Location	Container Requirements	Analysis per Container	Preservative	Holding Time	Laboratory
MW-14	3-40 mL VOA Vials	EPA 601/602	HC1 to pH ≤2	14 days	Core-Aurora
	3-40 mL VOA Vials	EPA 601(D)			
	1-1L Amber Glass, TFE Lid	EPA 625		7 days to extraction	
	1-1L Glass TFE Lid	EPA 418.1	H_2SO_4 to pH ≤2	28 days	
	1-500 mL Polyethylene	CAM Metals	HNO_3 to pH ≤2	6 months	
MW-15	3-40 mL VOA Vials	EPA 601/602	HC1 to pH ≤2	14 days	Core-Aurora
	1-1L Amber Glass, TFE Lid	EPA 625		7 days to extraction	
	1-1L Glass TFE Lid	EPA 418.1	H_2SO_4 to pH ≤2	28 days	
	1-500 mL Polyethylene	CAM Metals	HNO_3 to pH ≤2	6 months	

Table 2 (cont'd)

Sample Analysis, Containers, Preservative and Holding Time Requirements by Sample Location

Sample Location	Container Requirements	Analysis per Container	Preservative	Holding Time	Laboratory
MW-16	3-40 mL VOA Vials	EPA 601/602	HCI to pH ≤2	14 days	Core-Aurora
	3-40 mL VOA Vials	EPA 602(D)			
	1-L Amber Glass, TFE Lid	EPA 625		7 days to extraction	
	1-L Glass TFE Lid	EPA 418.1	H_2SO_4 to pH ≤2	28 days	
	1-500 mL Polyethylene	CAM Metals	HNO_3 to pH ≤2	6 month	

(1) Inicates one analysis from this sample location
(D) Indicates duplicate analysis
GWM - Glass Wide-mouth
TFE - Teflon-lined

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For those boreholes that have samples designated for chemical and/or biological analyses the soil column within the Lexan tube will be removed with a plunger device (as necessary) so that it lies uniformly onto a flat board. The decision as to what sections of the column to collect for sampling will be based on the criteria of table 1, visual observation and PID screening.

Once the soil column has been removed and a decision has been made as to what section to collect for sample analysis, stainless steel spoons and trowels will be used to cut, remove and place the sample into appropriate containers. The containers will be immediately capped with teflon-lined lids and placed into an ice-filled cooler.

For those boreholes that have samples designated for geotechnical analyses the targeted section for sampling will be cut from the Lexan tube using a power saw fitted with a blade designed for cutting through plastic. A decision on what section of the tube to cut will be based on the criteria of table 1 and visual observation. The sections cut for sampling will be a minimum of 6-inches long. The resulting tube will be immediately sealed with foil, plastic end caps secured with packing tape and placed into an ice-filled cooler. This process should result in obtaining relatively undisturbed samples for analysis.

In the event that both chemical/biological and geotechnical samples are to be collected from the same borehole, the geotechnical samples will first be cut from the Lexan tube. The remaining soil column can then be removed from the tube for chemical/biological analyses.

3.3 Analytical Methods for Soils

The data and measurements taken from soil samples in the vadose zone will provide a wide variety of chemical, biological and geotechnical parameter information. The different parameters and methods are identified below.

3.3.1 Chemical Analyses

The following chemical analyses will be performed on soil samples obtained from the site:

Chemical Analyses:

Data Parameter	EPA Method
Total Petroleum Hydrocarbons (TPH)	418.1
Polynuclear Aromatic Hydrocarbons (PAH)	8270A
Benzene, Toluene, Ethyl benzene, Xylene (BTEX)	8020
Total Organic Carbon (TOC)	415.1
Soil pH	9045
Toxicity Characteristic Leaching Procedure - Benzene	131 1/8240A
Toxicity Characteristic Leaching Procedure - Metals	1 311/6010
RCRA Metals	6010/7470/7471

Specific analytes and method detection limits for PAHs, BTEX and RCRA Metals are shown in tables 3, 4 and 5 respectively. All soil samples collected for chemical analysis will be shipped per chain-of-custody procedures to:

Core Laboratories
10703 East Bethany Drive
Aurora, Colorado 80014-2696
(303) 751-1780

The appropriate QA/QC protocols for Core-Aurora are presented in appendix A.

Table 3

Polynuclear Aromatic Hydrocarbons by EPA Method 8270A[1]
Analytes and Detection Limits

Analyte	Soil Detection Limit (μ/Kg)[2]
Acenaphthene	330
Acenaphthylene	330
Anthracene	330
Benzo(a)anthracene	330
Benzo(a)pyrene	330
Benzo(b)fluoranthene	330
Benzo(g,h,i)perylene	330
Benzo(k)fluoranthene	330
Chrysene	330
Dibenzo(a,h)anthracene	330
Fluoranthene	330
Fluorene	330
Napthalene	330
Phenanthrene	330
Pyrene	330

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1 Method Reference: EPA SW-846, Test Methods for Evaluating Solid Waste, Third Edition, November 1986

2 Detection limits may vary due to matrix interferences

Table 4

EPA Method 8020 - BTEX Compounds[1] Analytes and Detection Limits

Analyte	Soil Detection Limit (μ/Kg)[2]
Benzene	1
Toluene	1
Ethyl benzene	1
Xylenes	1

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[1] Method Reference: EPA SW-846, Test Methods for Evaluating Solid Waste, Third Edition, November 1986

[2] Detection limits may vary due to matrix interferences

Table 5

RCRA Metals[1]
Analytes, Methods, and Detection Limits

Analyte	Method[2]	Soil Detection Limit (mg/L)[3]
Arsenic	EPA 6010	5
Barium	EPA 6010	1
Cadmium	EPA 6010	0.5
Chromium	EPA 6010	1
Lead	EPA 6010	5
Mercury	EPA 7470/7471	0.1
Selenium	EPA 6010	10
Silver	EPA 6010	1

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1 Unfiltered Basis
2 Method Reference: EPA SW-846, Test Methods for Evaluating Solid Waste, Third Edition, November 1986
3 Detection limits may vary due to matrix interferences

REX66.TBL

3.3.2 Biological Analyses

The following biological analyses will be performed on site soils.

Biological Analyses:

Data Parameter	Method
Background Heterotrophic Bacteria	Standard Method for Water and Wastewater Examination of (Section 9215)
Volatile Hydrocarbon Utilizers	Standard Method for Water and Wastewater Examination of (Section 9215)
Non-Volatile Hydrocarbon Utilizers	Standard Method for Water and Wastewater Examination of (Section 9215)
Micronutrient Analysis (NO_3, PO_4, K)	Hach Field Kit

Biological samples designated for laboratory analysis will be shipped per chain-of-custody procedures to:

GTEL
4080 Pike Lane
Concord, California 94520
(415) 685-7852

The appropriate QA/QC protocols for GTEL are presented in appendix B.

3.3.3 Geotechnical Analyses

The following geotechnical analyses will be performed on site soils.

Geotechnical Analyses:

Data Parameter	Method
Lithology	Unified Soil Classification System
Particle Size Distribution	Laser
Saturated Horizontal Hydraulic Conductivity	ASTM D-2434
Saturated Vertical Hydraulic Conductivity	ASTM D-2434
Cation Exchange Capacity	Asborded Water
Clay Type	X-Ray Diffraction
Humic Content	ASTM D-2974
Moisture Content	ASTM D-2216-80
Capillary Moisture Relationship	ASTM D-2325
Dry Bulk Density	API RP-40

All geotechnical samples should be shipped per chain-of-custody procedures to:

Core Laboratories
3430 Unicorn Road
Bakersfield, California, 93308
(805) 392-8600

The appropriate QA/QC protocols for Core-Bakersfield are presented in appendix C.

3.4 Groundwater Sampling Methods

Prior to sample collection at least 2 to 3 well casing volumes of groundwater should be purged from monitor wells before sampling. These purge volumes can be determined as follows:

- Measure inside diameter of well casing and convert to units of feet.

- Divide inside well casing diameter by 2 to determine inside radius (**r**).

- Determine well casing volume (V) in ft^3 by using the following formula:

  $V (ft^3) = 3.14 \times r^2 (ft)^2 \times$ (Total Well Depth (ft) - Depth to Water (ft))

- Convert casing volume from ft^3 to gallons by multiplying (V) by 7.48 $gals/ft^3$.

- Multiply (V) by 3 to determine the total volume of water to be purged from the well.

All wells should be purged with a submersible pump. Samples should be collected upon full recovery of the well. If full recovery exceeds 3 hours, samples should be collected as soon as sufficient water volume is available. It is anticipated that purge volumes will vary from approximately 14 to 54 gallons and that a maximum pumping rate of 2.0 gpm can be attained. To prevent aeration and possible volatilization of contaminants pumping should be controlled so that groundwater does not cascade back into the well. Low pumping rates are preferred since it may prevent disturbance to the zone of stagnation immediately above the well screen and serve to provide a sample of groundwater representative of the aquifer.

To ensure that a sample of fresh formation water from the surrounding aquifer is collected the following pumping procedure should be used:

- Set the intake of the pump such that it is below the static water level and near the center of the screened interval.

- Start the pump and monitor drawdown in the well with a water level probe that has been previously deployed down the well.

- Maintain the pump intake at a level approximately 5 feet below the declining water table. When drawdown stabilizes, the pump intake can be maintained at that level until the desired purge volume has been removed. If however, drawdown continues and the water level approaches within 1 foot of the pump intake, the pumping rate should be reduced until drawdown stabilizes. The water level in this circumstance should be maintained at or near the top of the well screen.

- As groundwater is being purged from the well the total volume being purged should be tracked by filling 2-gallon buckets until the total volume to be purged is obtained.

Some general, sampling procedures that should be followed include:

- Avoid placing clean sampling equipment directly on the ground to prevent cross-contamination. Pump hose lines must not contact soil during sampling.
- Slowly lower sampling equipment into the well to prevent degassing of the water, prevent mixing of the stagnant water column above the well screen and damage to the equipment.
- When floating product is encountered in the well it should be removed as completely as possible to prevent contamination of the sampling pump. Free product should be bailed slowly to prevent excessive mixing of the product with the underlying water column.
- Sample wells from the least to most suspected or apparent contamination; this will reduce cross-contamination analytical artifacts.

3.5 Collection of Groundwater Samples for Chemical Analysis

The following analytical methodologies selected for groundwater samples from the site require specific sample acquisition techniques, which are described below.

3.5.1 Halogenated and Aromatic Volatile Organics Samples (EPA Method 601/602)

Method 601/602 samples consist of three 40 mL glass vials containing concentrated HCl as a preservative to lower the pH of the sample to less than 2. The preservative will be added by sample management personnel prior to delivery of the sample containers to the field. Samples will be collected using a submersible pump, with a recommended pump rate of 200-300 mL/minute. The septum vial should be filled until it is just overflowing. Cap the vial, invert and tap vial on hand. If a bubble exists, discard the sample and repeat the sampling. Do not attempt to add additional sample to a vial containing a bubble. Samples will be placed in an ice-filled cooler immediately following collection.

3.5.2 Base/Neutral/Acid (BNA) Organic Compounds (EPA Method 625)

BNA samples consist of a 1,000 mL amber glass bottle with a teflon lined cap. Groundwater is placed in the container using a submersible pump as described in the Method 601/602 sampling procedure discussed above. Bottles should be completely filled so that head-space is minimized. Caps must be securely closed. No preservative other than cooling to 4 degrees Centigrade (C) immediately after collection is required.

3.5.3 Total Petroleum Hydrocarbons (TPH) Samples (EPA Method 418.1)

TPH samples consist of 1,000 mL glass bottle containing H_2SO_4 as a preservative to lower the pH to less than 2. The preservative will be added by sample management personnel prior to delivery of the sample containers to the field. Bottles will be capped with a teflon lined septum. Groundwater is placed in the container using a submersible pump as described in the Method 601/602 sampling procedure discussed above. Bottles should be completely filled so that headspace is minimized. Caps must be securely closed. Samples will be placed in an ice-filled cooler immediately following collection.

3.5.4 (CAM) Metals Samples

Unfiltered metal samples of groundwater will be obtained from new monitoring wells. Unfiltered samples, if obtained by the method described above, require less handling, produce fewer sampling artifacts (contamination unrelated to the true quality of the groundwater), and include potentially mobile colloidal-associated metal contaminant fractions that would otherwise be eliminated by filtration.

Unfiltered total metals samples consist of one 500 mL polyethylene container containing concentrated HNO_3 as a preservative to lower the pH of the sample to less than 2. The preservative will be added by sample management personnel prior to delivery of the sample containers to the field. Samples will be placed in an ice-filled cooler immediately following collection.

3.6 Analytical Methods for Groundwater

Initial chemical samples will be collected from the monitoring wells installed during this remedial investigation. It is anticipated that these new monitor wells would be included in a quarterly sampling network of monitor wells. Fluid level measurements will be taken from these monitor wells as well as from all well points.

Data and measurements collected from groundwater samples will include analyses for dissolved chemicals as well as fluid level measurements. The initial sampling of the proposed four new monitoring wells includes five different analysis methods for evaluating groundwater contamination. These include:

Chemical Analyses:

Data Parameter	EPA Method
Halogenated Volatile Organics	601
Aromatic Volatile Organics	602
Base, Neutral, Acid Compounds (BNA)	625
Total Petroleum Hydrocarbons (TPH)	418.1
CAM Metals	6010/7196/7470/7471
Depth to Water	
Depth to Product	
Product Thickness	

A summary for the initial sampling of these new wells is provided in table 6.

The specific analytes and method detection limits for EPA Methods 601, 602, and 625 are shown in tables 7, 8, 9 respectively. The specific analytes and method detection limits for the CAM metals are shown in table 10.

All groundwater samples collected for analysis should be shipped to Core Laboratories per chain-of-custody procedures to the following address:

Core Laboratories
10703 East Bethany Drive
Aurora, Colorado, 80014-2696
(303) 751-1780

3.7 Field QA/QC

The quality of the field sampling process is checked by making an evaluation of how data analysis for samples collected from various locations on site compare to one another. In addition, decontamination samples are collected to verify that equipment is satisfactorily cleaned. Also, decontamination, waste handling and, health and safety practices are considered part of the QA/QC program. Three types of quality control checks will be collected and analyzed. The elements of field QA/QC are discussed in the sections below:

Table 6
Initial Sampling and Analysis Summary for Proposed Monitoring Wells

Borehole	Monitoring Well ID	EPA 601	EPA 602	EPA 625	EPA 418.1	CAM Metals
B-4	MW-14	2D	1	1	1	1
B-13	MW-15	1	1	1	1	1
B-12	MW-16	1	2D	1	1	1
B-14	MW-17	1	1	1	1	1
Trip Blanks		1				
Field Blanks		1				
Rinsate Samples		1				
Total Samples		**8**	**5**	**4**	**4**	**4**

D Include Duplicate Sample

Table 7

EPA Method 601 - Halogenated Volatile Organics[1] Analytes and Detection Limits

Analyte	Groundwater Detection Limit (µg/L)[2]
Bromodichloromethane	1
Bromoform	1
Bromomethane	1
Carbon Tetrachloride	1
Chlorobenzene	1
Chloroethane	1
2-Chloroethylvinyl Ether	1
Chloroform	1
Chloromethane	1
Dibromochloromethane	1
1,2-Dichlorobenzene	1
1,3-Dichlorobenzene	1
1,4-Dichlorobenzne	1
Dichlorodifluoromethane	1
1,1-Dichloroethane	1
1,2-Dichloroethane	1
1,1-Dichloroethene	1
1,2-Dichloropropane	1
cis-1,3-Dichloropropene	1
Methylene Chloride	1
Tetrachloroethene	1
1,1,2,2-Tetrachloroethane	1
trans-1,2-Dichloroethene	1
trans-1,3-Dichloropropene	1
1,1,1-Trichloroethane	1
1,1,2-Trichloroethane	1
Trichloroethene	1
Trichlorofluoromethane	1
Vinyl Chloride	1

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1 Method Reference: Federal Register, July 1, 1990 (40 CFR Part 136)
2 Detection limits may vary due to matrix interferences.

Table 8

EPA Method 602-Aromatic Volatile Organics[1]
Analytes and Detection Limits

Analyte	Groundwater Detection Limit ($\mu g/L$)[2]
Benzene	1
Chlorobenzene	1
1,2-Dichlorobenzene	1
1,3-Dichlorobenzene	1
1,4-Dichlorobenzene	1
Ethyl benzene	1
Toluene	1
Xylenes	

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[1] Method Reference: Federal Register, July 1, 1990 (40 CFR Part 136)

[2] Detection limits may vary due to matrix interferences.

Table 9 (cont'd)

EPA Method 625 - Base/Neutral/Acid Organic Compounds[1] Analytes and Detection Limits

Analyte	Groundwater Detection Limit (µg/L)[2]
N-Nitrosodi-n-propylamine	10
N-Nitrosodiphenylamine	10
Phenanthrene	10
Pyrene	10
1,2,4-Trichlorobenzene	10
4-Chloro-3-methylphenol	10
2-Chlorophenol	10
2,4-Dichlorophenol	10
2,4-Dimethylphenol	10
2,4-Dinitrophenol	50
2-Methyl-4,6-dinitrophenol	50
2-Nitrophenol	10
4-Nitrophenol	50
Pentachlorophenol	50
Phenol	10
2,4,6-Trichlorophenol	10

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1 Method Reference: Federal Register, July 1, 1990 (40 CFR Part 136)
2 Detection limits may vary due to matrix interferences.

Table 10

CAM Metals[1] Analytes, Methods, and Detection Limits

Analyte	Method[2]	Groundwater Detection Limit (mg/L)[3]
Antimony	EPA 6010	0.1
Arsenic	EPA 6010	0.05
Barium	EPA 6010	0.01
Beryllium	EPA 6010	0.005
Cadmium	EPA 6010	0.005
Chromium	EPA 6010	0.01
Chromium(IV)	EPA 7196	0.01
Cobalt	EPA 6010	0.03
Copper	EPA 6010	0.01
Lead	EPA 6010	0.05
Mercury	EPA 7470/7471	0.0002
Molybdenum	EPA 6010	0.05
Nickel	EPA 6010	0.04
Selenium	EPA 6010	0.1
Silver	EPA 6010	0.01
Thallium	EPA 6010	0.1
Vanadium	EPA 6010	0.05
Zinc	EPA 6010	0.01

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[1] Unfiltered Basis

[2] Method Reference: EPA SW-846, Test Methods for Evaluating Solid Waste, Third Edition, November 1986

[3] Detection limits may vary due to matrix interferences

3.7.1 Field Duplicate Samples

Duplicate samples will be collected in the field and analyzed to check for sample reproducibility. Duplicates will only be collected for critical chemical analyses in accordance with table 1 and 6 for soil and groundwater respectively.

3.7.2 Trip Blanks

Trip blanks are used to check ambient conditions both at the sampling site and during handling and transport of samples to the laboratory. Analysis of these samples determines if ambient chemical contaminants are affecting environmental samples. Trip blanks consist of three 40 mL sample vials filled with analyte free reagent water by the laboratory. The blanks are then shipped to field personnel where they are kept with investigative samples as they are collected, processed, packaged and shipped. Usually one trip blank will accompany each cooler of samples designated for chemical analyses.

3.7.3 Field Blanks

Field blanks consist of a group of laboratory cleaned sample containers which are transported empty into the field and are used to check ambient air conditions during sample collection in the field. Field blanks are prepared by filling laboratory cleaned sample containers with analyte free reagent water at the sample location.

3.7.4 Rinsate Samples

Rinsate samples consist of a group of laboratory cleaned sample containers which are transported empty into the field. They are used to check the thoroughness of decontamination procedures. Decontamination samples are prepared by pouring analyte free reagent water over sample collection equipment that has been decontaminated and collecting the water in appropriate containers.

3.7.5 Decontamination

Decontamination of drilling, excavation and sampling equipment will occur prior to each soil boring, test trench, and sampling event. Standard operating procedures for decontamination are provided in appendix D.

3.7.6 Waste Handling

Pumped or otherwise produced water will be disposed of in a manner that poses no threat of contamination to any surface or ground water in the vicinity. If the water is determined to be hazardous, it will be contained and disposed of in a manner consistent with appropriate regulations.

3.7.7 Site Health and Safety

All GCL and on-site subcontracting personnel will read, sign, and abide by the health and safety procedures established by GCL Site Health and Safety Plan (appendix E).

4.0 Sample Management and Custody Procedures

Each sample received by the analytical laboratory for processing must be properly documented to ensure complete and accurate analysis for all requested parameters and to show that samples have not been compromised in the event of a legal action concerning the integrity of samples.

The system of documentation provided in the following text is designed according to EPA Contract Laboratory Program (CLP) requirements. This system provides for an efficient means of tracking each sample from the time of collection through final data reporting.

4.1 Field Logbook

The field logbook is a controlled evidentiary document and is maintained accordingly. Field logbooks provide a means for recording all field work and data collection activities at the site. Entries will be as descriptive and detailed as possible so that a particular situation can be reconstructed without reliance on memory alone. Where feasible, the logbook will consist of printed, formatted pages to facilitate data entry and standardization. The field logbook will be kept on-site and will be maintained by the task leader or his assigned representative.

All collected measurements and samples are recorded. During sampling events, sample number, date, and time of sampling, depth of sample and any other pertinent information are included in the logbook. All entries are made with indelible ink and, legibly written with language that is factual and objective. No erasures are permitted. If an incorrect entry is made, the data will be crossed out with a single strike mark, initialed and dated. Entries will be organized into easily understandable tables, diagrams, sketches and/or maps when appropriate to better delineate sample information and field conditions.

Log books in general will include the following information:

- Date and time of entry
- Purpose of sampling, drilling or other field activities
- Equipment used and procedures followed
- Names and affiliation of all sampling or field team members

- Name and address of field contact (federal, state, local)
- Description of samples, drilling and/or other field activities
- Waste components and concentration (if known)
- Actual number, location, depth and size of sample taken
- Description of sampling point
- Date and time of sample collection
- Maps, sketches or photographs of sampling site
- Field observations

The following guidelines will be followed for recording notations in the logbook:

- Each page is signed, dated, and numbered.
- Blank pages are marked as such.
- Each entry is identified by time (24-hour clock).
- Weather conditions and significant changes are reported daily.
- Logbook extensions (field sheets, purge records, etc.) will be recorded in the logbook.
- Logbooks will be returned to proper files upon its completion, during absences from the site, or at the end of the investigation.

4.2 Sample Identification

A convenient and standard practice is to assign a sample number of 10 digits to each sample indicating the date and time the sample was collected, as follows:

- Year (2 digits)
- Month (2 digits)
- Day (2 digits)

- Time (24-hour clock; 4 digits)
- Site descriptor (letter or number)

For example, a sample collected at 2:45 p.m. (14:45 on the 24-hour clock) on May 15, 1993, would be assigned the sample number: 9305151445.

Sample duplicates, and blanks required for QA/QC analysis will be labeled and given sample numbers according to the same scheme. All sample numbers and the associated sample location will be recorded for all samples in the field logbook.

4.3 Sample Containers

Immediately following sample collection, all sample containers will be labeled with an adhesive label containing the information needed to positively identify the sample and the analysis appropriate for it. Labels are usually supplied by the laboratory performing the analyses and are usually already affixed to the sample containers. The labels will be marked with waterproof ink.

Included on the label are:

- Project and site identification
- Sample number
- Sample preservation
- Date and time of sampling
- Name of sample collector
- Any other information needed for sample analyses

4.4 Sample Shipping and Handling

Samples will be handled, shipped, and analyzed in accordance to EPA CLP chain-of-custody procedures (EPA 1981, 1984) and CLP processes since these guidelines are designed for the creation of valid and legally defensible data.

Some samples obtained from the site may contain significant amounts of toxic or flammable constituents. Therefore, specific Department of Transportation (DOT) restrictions on sample transport may be required; all DOT shipment requirements will be observed, when appropriate.

4.5 Chain-of-Custody

After collection, identification, and preservation, the sample is maintained under chain-of-custody procedures (EPA 1981, 1984) until it is analyzed by the laboratory and the results have been reported.

Field chain-of-custody procedures include sealing each sample container with a chain-of-custody seal. The chain-of-custody seal is an adhesive seal with spaces for recording the following information:

- Sample number
- Project and site identification
- Date
- Signature and printed name of individual responsible for sample collection

This information is recorded on the seal, using waterproof ink. The seal is affixed over the lid of the sampling container so that the container can not be opened until the seal is broken. The seal is not to be broken except by laboratory personnel at the time the sample container is opened for analysis. A typical chain-of-custody seal is shown in appendix F.

Transfer of custody and shipment procedures include filling out a chain-of-custody record form to accompany samples to the laboratory. The chain-of-custody record should contain

- Sample number
- Signatures of sample collectors
- Date and time of sample collection
- Sample type (e.g., groundwater, soil)
- Identification of sample site (well, soil boring, etc.) and depth of collection
- Number of containers
- Signatures of persons involved in chain of possession
- Inclusive dates of possession

- Airbill number if applicable
- Date of sample receipt (given by the laboratory)

A chain-of-custody form also serves as the sample analysis request form and is required to accompany the samples to the laboratory.

The chain-of-custody form provides the analytical laboratory with information and instructions as to the types of samples shipped, and types of analyses to be performed on the samples. The following information should be included:

- Party and person requesting analyses
- Sample number
- Date of sample collection
- Project and job number or other identification code.

An example of a chain-of-custody form is presented in appendix G.

5.0 Calibration Procedures and Frequency

Calibration procedures and frequency are the responsibility of the designated field investigation team leader for field equipment and of the chosen laboratory.

5.1 Field Equipment

All equipment used in field analyses or sampling must have documented maintenance and/or calibration procedures usually supplied by the manufacturer. These procedures will be made available to all relevant personnel and include the following:

- Equipment identification
- Equipment necessary to accomplish calibration
- Procedures and schedule for calibration and/or maintenance

If an instrument has been in the field for longer than two weeks, it shall be returned to an equipment maintenance station to undergo calibration and maintenance checks. An equipment log sheet, as well as calibration worksheets (where applicable), are kept for each piece of field equipment whose use affects measurement quality. Equipment log sheets are bound into equipment logbooks and contain the following information:

- Date of calibration and/or maintenance
- All data pertaining to the calibration and/or maintenance procedure
- Next due date of calibration and/or maintenance
- Adjustments made and the accuracy of the equipment following calibration
- Record of equipment failure or inability to meet performance specifications

Calibration procedures and the required frequency of calibration are integral components of the manufacturer's specifications for each piece of field equipment. These calibration procedures are available with the manufacturer's operating instructions and should be followed accordingly.

The following types of equipment will be required at this Site:

- Photoionization Detector
- Combustible Gas Indicator
- pH meter
- Turbidity Meter
- Specific Conductivity Meter
- Thermometer

5.2 Laboratory Equipment

A laboratory which follows EPA CLP or similar protocols will be used for all laboratory analyses. It will be the laboratory's responsibility to perform calibration procedures for all analytical equipment using procedures and frequencies routinely required by EPA.

6.0 Laboratory QA/QC

Since data generated from sample collection must be both technically and legally defensible if challenged, laboratory services and analysis procedures must be EPA approved. The laboratory selected should be able to provide a recent Statement of Work (SOW) or show certification for EPA-approved methodologies for organic and inorganic analyses. Selecting such a laboratory insures that their procedures and calibration methods provide the most accurate and valid data available.

6.1 Purity of Standards, Solvents, and Reagents

All reagents will be of the highest standard laboratory quality obtainable. Where applicable, reference standard solutions will be traceable to the National Bureau of Standards (NBS). Each new lot of reagent grade chemicals shall be tested for quality of performance. Laboratory-pure water is prepared by a special distilled and/or deionized water system augmented by individual filter cartridges and polishers located at each outlet port. The polishers include special particulate filters, organic resins, and inorganic resins.

6.2 Analytical QC

Quality control for analytical samples is based on the use of a standard control matrix to generate precision and accuracy data that are compared on a daily basis to control limits. This information, in conjunction with method blank data, is used to assess daily laboratory performance.

This method of QC is performed for every routine analysis to demonstrate that laboratory operations are "in control." The main elements of analytical QC are:

- The analysis of Laboratory Control Samples, which include Duplicate Control Samples, Single Control Samples, and method blanks, and
- The use of calibration standards to assure that both qualitative identification and quantitative measurements are within control limits.

6.3 Laboratory Sample Custody

Samples received and data generated by the chosen laboratory will be controlled by the guidelines presented below.

6.3.1 Sample Login

Upon receipt of samples for analysis, a representative of the chosen lab will perform the following:

- Verify that all chain-of-custody and analysis request forms are filled out properly and are in order, verify that custody seals are properly signed and unbroken
- Login samples, assign unique log numbers, and attach the numbers to the sample containers
- Open a project file and enter login data on a computer
- Check turn-around times and begin analysis as necessary
- Store samples in proper sample bank

6.3.2 Analyzing the Sample and Procedural Detail

Samples will be analyzed by chemists, technicians and appropriate laboratory personnel. Analysis results will be recorded with detail of all procedural modifications, deviations, or problems associated with the analyses in a parameter workbook.

7.0 Data Validation and Reporting

Upon completion of analytical procedures, data undergoes QA/QC review before reporting for screening purposes. As required by EPA, data must be officially validated by recognized data reviewers before it is considered valid. This task may be subcontracted to a qualified data validation entity.

The data validation process is a review of analytical laboratory data according to procedures and requirements established and adopted by the EPA in the Functional Guidelines for Data Validation (EPA, 1988). The data reviewing entity will evaluate whether the parameters of precision, accuracy, representativeness, completeness, and correctness have been met.

Precision is measured during the data validation process as the relative percent difference between analytical results for laboratory duplicates.

Accuracy is measured as a percent recovery for a spiked sample from the specified analysis. Matrix spikes and analytical spikes are used to evaluate the inorganic data for accuracy; matrix spikes and surrogate spikes are used to evaluate organic data for accuracy.

Completeness and correctness are determined by checking documentation and calculations for instrument calibration or tuning and correction factors, internal standards, and laboratory blanks.

When QC criteria are not completely met, the data reviewing entity attaches qualifiers, or designated code letters, indicating a deviation from normal or acceptable data quality.

Data validation requires submission from the laboratory of all chain-of-custody information, all quality control data, sample data, calibration, methodology, and procedural information, proper report forms, and all raw (and/or instrument) data.

As outlined in various EPA guidelines, the following factors will be considered in evaluating the precision, accuracy, representativeness, comparability, and completeness (PARCC parameters) of data and data collection processes:

- Sample identification documentation. This requirement consists of keeping detailed records of samples in logbooks, on chain-of-custody forms, and in data management systems.

- Sample preservation and holding times. Various types of samples must be preserved, stored, and analyzed within time frames such that data generated will be representative of the true value analyzed for in the sample.

- Field sampling methodology. Correct methods of sample collection will create comparability of data and representativeness of results. Evaluation of sample collection techniques in the field and of data generated from the analysis of field replicates provides indications of sampling methodologies.

- Analytical laboratory methodology. Quality of the analytical technique affects data precision and accuracy. Laboratory technique is determined by evaluating the results of data generated from the analysis of sample duplicates, laboratory spikes, and performance evaluation samples.

- Validation of data. A combination of the above factors determines whether the data collected is complete and is evaluated by data validation techniques.

The creation of quality PARCC parameters and legally defensible data will be ensured by following the procedures set forth in EPA guidelines for field activities and sampling procedures. Following of chain-of-custody guidelines for the collection and transfer of samples (EPA 1981, 1984) will also ensure the creation of valid data.

The creation of valid data will also be insured by following EPA-approved methodology. The EPA-approved protocols to be followed are designed to provide analytical data of consistent, known, and documented quality.

Upon completion of data validation, data is generally submitted to an interpreting entity in report form. Validated results are submitted on the data validation report forms. These forms have the pertinent sample and project information.

Copies of all analytical data and/or final reports are retained in the laboratory files and will be stored on computer disk at the laboratory for a minimum of one year. A method of permanent data archival is generally decided at the end of one year.

Preventive Maintenance

An inventory control system for equipment and instrumentation will create the basis for maintenance and calibration control.

Inventory control documentation should include:

- Description of item
- Manufacturer, model number, internal identification number
- Timing and frequency of routine maintenance, servicing, and calibration.

8.0 References

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Appendix A

Core Laboratories QA/QC Protocols for Chemical Analyses

CORPORATE QUALITY CONTROL STATEMENT

CORE LABORATORIES

A Division of
Western Atlas International
(A Litton/Dresser Company)

Core Laboratories
1300 South Potomac Street
Suite 130
Aurora, Colorado 80012
303/751-1780

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INTRODUCTION

This document provides an overview of the Quality Assurance and Quality Control Processes that are in use at the Corporate and Laboratory Level of Core Laboratories. It is intended to summarize policies and procedures that are detailed in our Standard Operating Procedures and Policies.

QUALITY POLICY

To provide on-time, error-free service, data, reports, and products that meet or exceed industry standards and/or our customer's requirements.

To practice error prevention rather than error correction and to perform each task right the first time.

To provide service second to none at a competitive price.

QUALITY ASSURANCE DEFINITIONS

Quality Assurance is a "Systematic Management Design" encompassing a multitude of interrelated disciplines aimed at securing the highest possible quality in services, products and data that will be of value to, meet the needs of and satisfy the requirements of clients.

The terms Quality Assurance (QA) and Quality Control (QC) are often used interchangeably. At Core Laboratories, the term Quality Control is used to define specific daily functions at the laboratory level which include the application of procedure protocols, use of standard equipment, statistical control limits, related administrative activities and verification. Quality Assurance is used in a broader philosophical sense together with management style and long term goals to describe the whole integrated program for assuring reliability in measurement and generation of data.

ORGANIZATIONAL STRUCTURE

Core Laboratories is a Division of Western Atlas International Inc. of Houston, Texas. Core Laboratories consists of three operating entities; the North American Operations Division, the Analytical Chemistry Division and the International Division.

The Quality Process is a top priority of the President of the Company and, as illustrated in the accompanying organizational chart, is the primary mission of the Executive Vice-President. The Quality Assurance Department reports directly to the executive vice-president and coordinates development of the quality efforts in Core Laboratories.

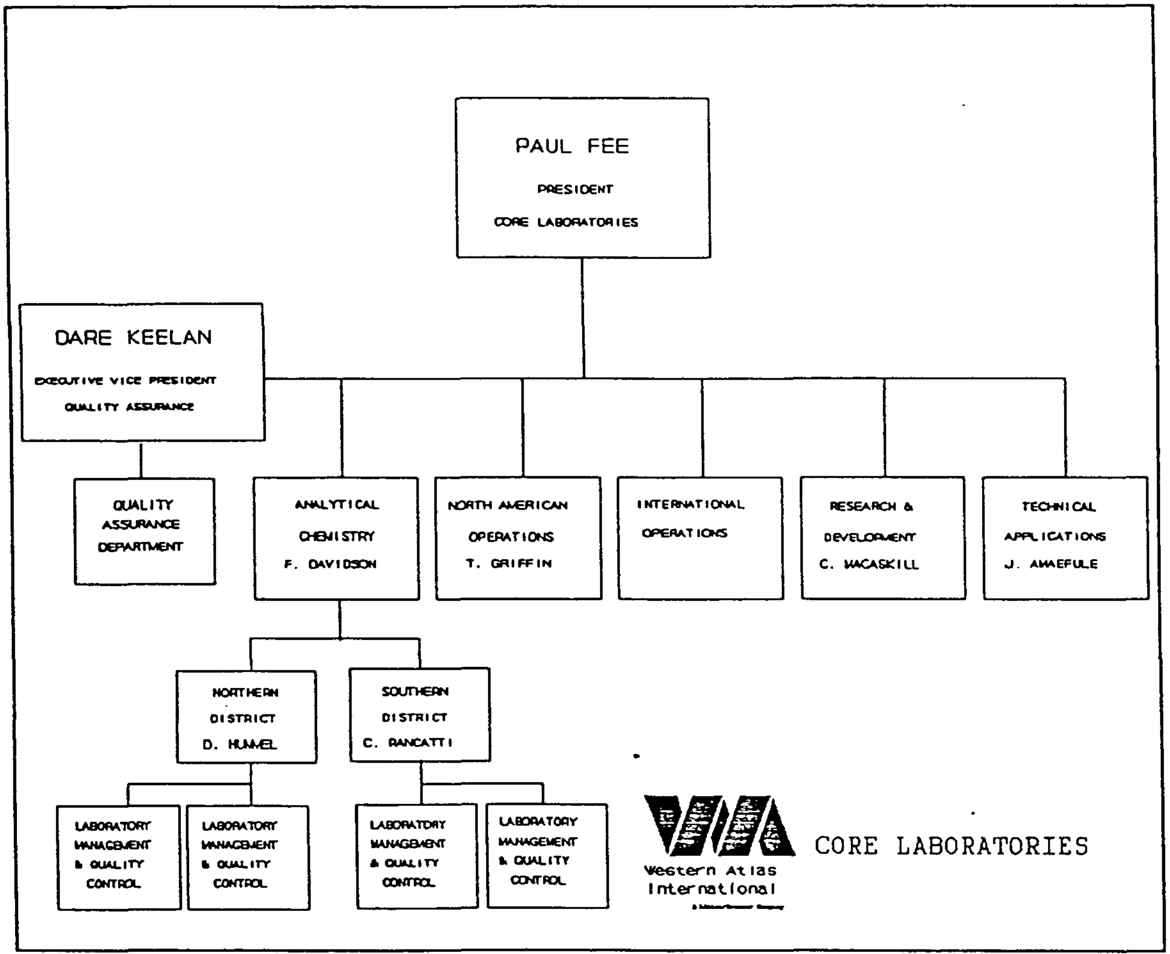


Figure 1
Organizational Chart

RESPONSIBILITIES AND AUTHORITY

Good Quality Control at a location is achieved by undertaking a systematic approach to all aspects of Laboratory Management and it is effective only if there is full commitment at all levels from the President down.

Managers and Supervisors are responsible to implement the process in a manner that is consistent with company policy. They are provided with the tools required and may freely request assistance from Quality Assurance personnel and technical specialists whenever needed.

ON-SITE QUALITY CONTROL OFFICER

The Manager or Laboratory Supervisors at each location are required to delegate QC responsibilities to a Quality Control Officer. Those responsibilities include being knowledgeable and able to communicate company policy, administer policies for proper maintenance and calibration of laboratory utilities, instruments, equipment and reagents. Also, they are to review and approve data quality prior to reporting and ensure that all quality control activities are being performed by laboratory personnel, etc.

DOCUMENTATION HIERARCHY

Policies and Procedures for all management and technical activities are communicated by a multi-tiered series of documents called the Corporate Quality Process. They provide the communication for conformance to the requirements that have been designed to meet the need of clients. The diagram and explanations depict the organization.

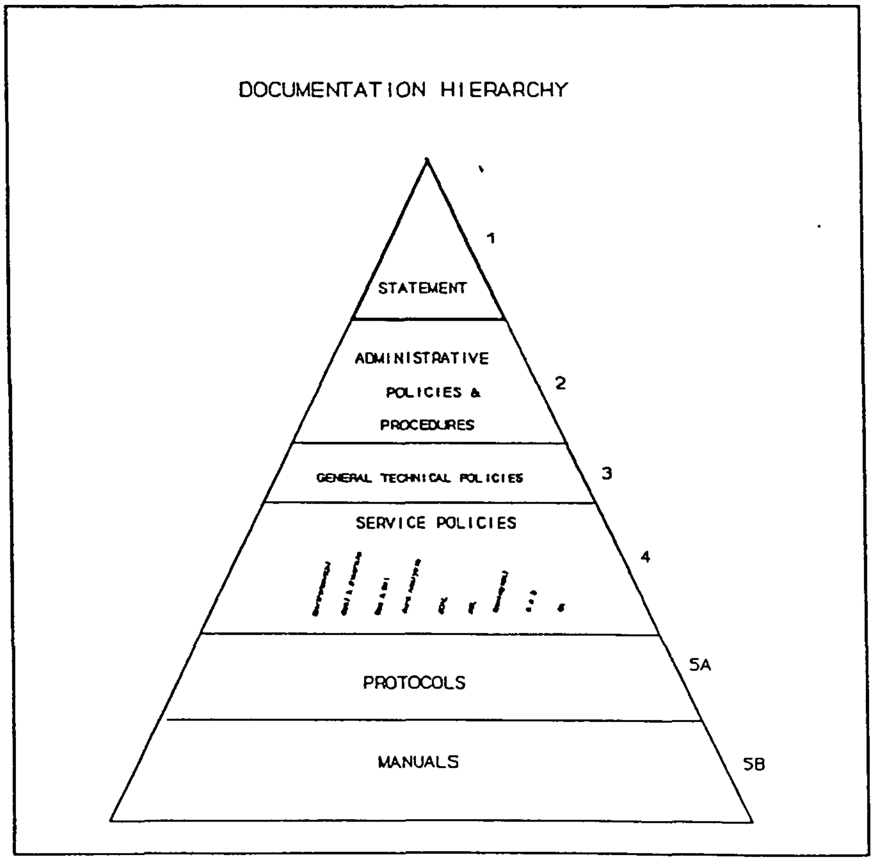


Figure 2

The purpose of each documentation tier is described as follows:

Tier 1: Corporate Statement

The purpose is to summarize corporate policy applicable to all departments and functions and to describe the quality process which the company will use.

Tier 2: Administrative Policies and Procedures

This deals with general laboratory operations applicable to all services. It includes such things as general laboratory management, housekeeping, training, information systems, chain of custody of records, etc.

Tier 3: General Technical Policies

These include specific policies for generic equipment usage and calibrations which are applicable to all disciplines. For example: ovens, thermometers, pressure gauges, transducers, vacuum pumps, etc.

Tier 4: Service Policies

This outlines specific policies unique to a particular service discipline. These include all aspects of Environmental Services.

Tier 5a: Protocols

Protocols are brief summaries of technique which can apply to a particular test sequence or piece of apparatus.

Tier 5b: Manuals

This heading describes the detailed step-by-step operating, calibrating, and interpretation procedures performed for each analysis.

Each process component is documented appropriately as to intent, goals and operational parameters. As presented, duplication is minimized and standardization is promoted.

GENERAL LABORATORY QUALITY CONTROL ADMINISTRATION

As a guideline, total quality control efforts will consume not less than 10% and "typically" not more than 20% of all employee effort. All data that is produced at a laboratory shall be verified with quality control documentation.

Quality Control at the laboratory level is accomplished through policies and procedures that addresses the following:

A) TRAINING

B) METHOD SELECTION

C) SAMPLE TRACKING AND INFORMATION SYSTEM

D) INSTRUMENT, EQUIPMENT, UTILITIES AND REAGENT CONFIRMATION

E) DATA QUALITY CONFIRMATION

F) CLIENT NEEDS AND DATA RELATIONSHIP VERIFICATION

G) REPORTING OF DATA

H) PERFORMANCE AND SYSTEMS AUDITS

Essentially, all of the activities and concepts above are shown in the diagram below which shows how the daily quality control activities are performed on every sample.

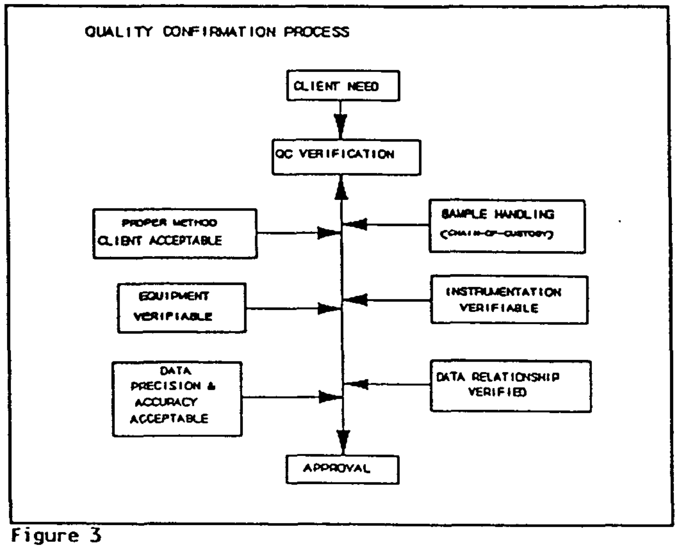


Figure 3

TRAINING

Every employee should know how to do the job and what is expected of them.

It is the responsibility of Managers and Supervisors to groom promising employees for positions of greater responsibility. It is Company Policy to promote from within wherever possible.

Training will be provided for all individuals who are involved in any kind of technical decision making, service or production. Our single greatest challenge is training; therefore, top priority should be given to help each individual learn and succeed in Core Lab.

TRAINING OBJECTIVES

The primary importance to Core Laboratories is safety. Safety meetings are held once per month (documented) and each employee is trained through the MSDS programs, etc. Also, included in general training are the principles of Quality Assurance and Quality Control Indoctrination and company expectations.

Technical training pertinent to data production includes Method Training (theory and application), computer training as appropriate, etc.

Administrative training includes Data Handling, Data Relationships for each service area, Receiving and Reporting.

COMPONENTS

Training components and sequences shown below shall be followed:

Indoctrination to Core Laboratories

Analytical Procedure Review

Hands-on Demonstration

Practice, Practice, Practice

Theory, Interpretation and Troubleshooting

Proficiency Certification

TRAINING RECORDS

Training Progress reports for each type (or group) of analyses are kept with the personnel file of each employee.

This record is to be used as documented evidence as to an employee's contribution and abilities and is an effective tool for merit reviews and QA/QC verification.

METHOD SELECTION

METHOD SELECTION CRITERIA

The basis for any method selection is Client need and/or Client specification. Unless specified otherwise, environmental related analysis shall be by EPA approved methodology.

When a variety of standard methods exist and the client has no preference or specification, or if no standard method is available, Core Lab staff experts will specify the method of choice. Experts are designated by Quality Assurance and Division Management.

Methods in Core Lab are standardized by Technical Expert Committees. Deviations from these methods are not allowed except for circumstances where Client needs run counter to the "Core Lab Approved" methodology. In this case, deviations must be documented in the submittal form within the job folder and in the final report.

METHOD DOCUMENTATION

Core Laboratories documents methods that are:

A) Exclusive to Core Lab or not common in Standards Literature.

B) Efficiency improvements for Environmental procedures.

Any method documentation is to be performed by senior technical personnel, evaluated through the Quality Assurance Department, and approved at the Corporate Level before placing the method into routine production.

The site Quality Control Officer should be notified as well as Quality Assurance Management that a certain procedure is to be documented.

The procedure will need to be tested for sensitivity to interferences, accuracy and precision by a method specified by Quality Control.

SAMPLE TRACKING AND INFORMATION SYSTEM

Laboratory information systems follow the processes illustrated in the following diagram:

CHAIN-OF-CUSTODY/SAMPLE RECEIVING

Sample receiving policies are designed to meet the needs of every situation. Chain-of-Custody forms or other client supplied information shall be signed off at the time of sample receiving and contained in a Job folder.

Regardless of Client needs, Chain-of-Custody (or sample submittal) records will be maintained throughout the lab until the final disposition of the sample (i.e. properly documented disposal).

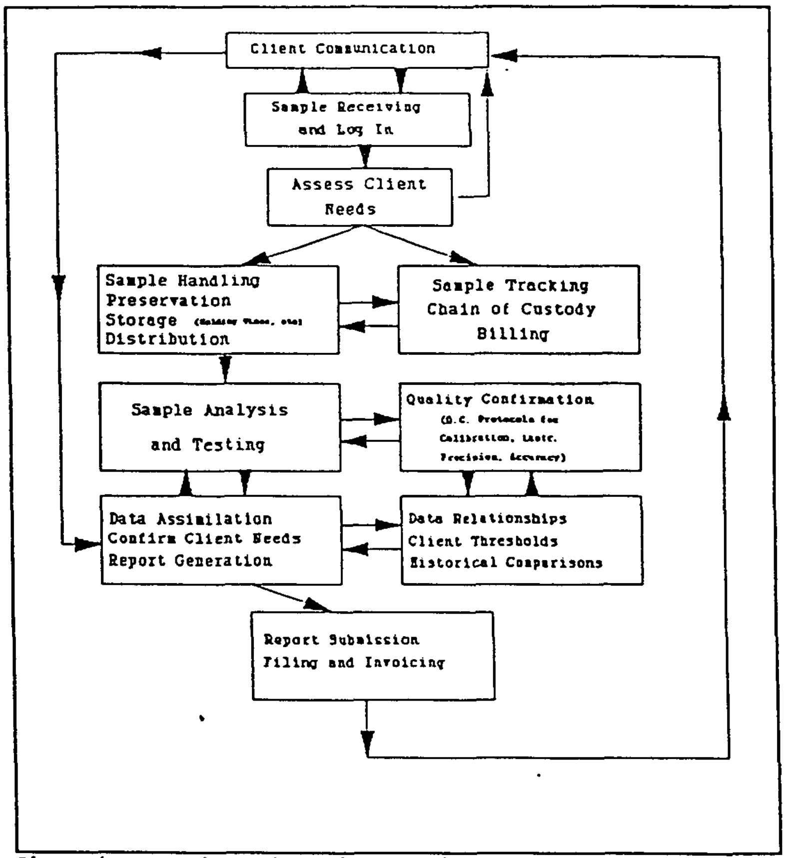


Figure 4 -- Routine Information Flow in the Laboratory

Sample Receiving and Log In -- are part of the same process and should be done in consecutive order. Neither is complete until both are finished.

GENERAL POLICIES

Record all information in blue or black ink. Any perishable samples with limited holding times or easily damaged samples are given top priority for log in and analysis.

Receiving Clerks and others assigned to accept samples from carriers and Clients must be made aware of Company Policy as well as client agreements on Chain-of-Custody rules and how to properly receive samples.

<<< Violation of Chain-of-Custody rules can void even the best analysis if the data should happen to go to Court.>>>
A sample is under laboratory custody if:

A) An employee has signed a delivery receipt, or
B) It is in your actual possession, or
C) It is in your view after being in your physical possession,
D) It was in your possession and then you locked or sealed it up to prevent tampering,
E) It is in a secure area (i.e. inside the laboratory).

Sample Receiving and Log In shall be done by qualified individuals who are specifically trained in sample log in, client communication, and the capabilities of the laboratory.

Clients are encouraged to include written sample submittal information which itemizes the sample ID's, parameters and other important information. Labs should provide sample transmittal forms to aid in the handling process.

SAMPLE ACCOUNTING AND LABORATORY SUBMITTAL FORMS

High priority is placed upon proper log in of samples because errors here will propagate through the system. Sample accounting involves the following types of paperwork:

A) **Chain-of-Custody Document** - Usually client generated for important samples. Used for legal traceability and integrity purposes, illustrated below.

B) **Client Paperwork** - Ideally will be submitted for all samples. It describes the desired services and supporting information.

C) **Laboratory Sample Submittal Form** - This is generated by the laboratory either manually or with the aid of a LIMS. Included are the testing codes and all important information that is required to perform analysis.

Upon receipt of samples in custody, the package and/or cooler should be inspected and any damage to the sealing tape or custody seals noted. The Chain-of-Custody form should be marked that the seals, packaging or locks were intact upon receipt if no tampering or damage appears to have occurred.

The package/container and/or cooler should be opened to verify that each item listed on the sheet is present and correctly identified. If all information is verified, the next "Received By" box on the Chain-of-Custody record should be signed and dated.

Notes on errors and inconsistencies are to be made on the Laboratory Sample Submittal Form/Chain-of-Custody as to the condition. Each set of comments must be initialled and dated.

Accounting for all received samples is to be completed prior to Sample Log In and compared against client supplied information (i.e. client documents, Chain-of-Custody or verbal order).

A Laboratory Sample Submittal Form is to be used for each set of samples received by the laboratory. This is an internal hard copy that should include the following:

A) Client name, address, contact
B) Date and time received
C) Information described above on condition of custody seals/tape/locks/etc.
D) Discrepancies (if any) as described above
E) Client Sample ID's
F) Parameters for measurement verses verified laboratory procedures
G) Any special Client requests or precautions highlighted
H) Initials of person performing the log in
I) Hazardous characteristics of samples, (i.e. MSDS)

The Laboratory Sample Submittal Form should be rechecked for accuracy prior to final entry into the LIMS.

VERBAL COMMUNICATION WITH SUBMITTER

Any verbal discussions with the client on the integrity of the samples should be recorded in ink in a Phone Log or in a laboratory notebook. Copies of these notes should be included with the sample paperwork in the Job folder.

SAMPLE LOG IN

GENERAL POLICY

All samples that are received during normal operating hours shall be logged in by the end of the working day.

Sample Log In is to be performed before any analyses are run.

Top priority shall be given to perishable or volatile samples which must be logged in immediately.

Log In is to be as complete as possible the first time to maximize efficiency and accuracy.

JOB NUMBER AND JOB FOLDER

An ascending value Job Number (i.e. 89---- which is usually computer generated) shall be assigned to each sample series consisting of one or more samples. Where practical, for example, with multiple submittals of samples at different times from the same well, the same discreet job number may be used for several sample submittals. The practicality of this option will depend on local practice and invoicing procedures.

Each Job Number will include a two digit year code and four digits for consecutive numbering. Similar job numbers from separate locations are distinguished by the location code.

Individual Sample Numbers will be assigned using consecutive, ascending values plus the Job Number (891242-22 is the 22nd sample in a job).

A Job folder shall be prepared consisting of a letter or legal size manila folder with the job number and client name on the tab and the following items included and fastened in:

A) Completed Field Data Form (if applicable)
B) Log In Sheet
C) Completed Laboratory Sample Submittal Sheet (computer generated if possible)
D) All written client correspondence specific to those samples
E) Any significant notes made during conversations with the client about the integrity of the samples
F) All billing information

During progression of the job through the laboratory, all raw data sheets/computer generated hard copies, graphs etc., are added to the folder as is appropriate. Ultimately, the lab copy of the final report and invoice also reside here.

LOGBOOK

Each laboratory is to maintain a logbook to record receipt of all jobs.

The Logbook shall be one of the following:

A) A bound ledger
B) A bound notebook
C) A three ring binder filled with pages of computer generated hard copies of log in information. Paper used should be reinforced so that the holes do not pull out.

The following information is to be included as a minimum:

A) The Job number and the number of samples in the Job
B) Client ID number from the LIMS
C) Client Name
D) Date of receipt

E) Type of samples (i.e. Environmental Water Samples, RAD, WAT, etc.)
F) Initials of the log in person
G) Invoice number

An entry into the Logbook is to be made each time samples are to be logged in without exception, regardless of whether the LIMS is being used or not.

FILING CONFIGURATION

There are two categories of files which contain Job Folders and are described below:

ACTIVE JOB FILES contain the following:

Incoming Jobs -- Consisting of those newly logged in jobs where the samples and work assignments have not yet been distributed.

Note: Newly logged in jobs are to be reviewed for accuracy, initialled and dated by an experienced person prior to placing in the active file.

Active Jobs -- Incomplete jobs that are in progress where samples and paperwork have been distributed to the analysts.

Approval Pending Jobs -- Data complete Jobs that await final QC inspection for analytical quality, historical and data relationship comparisons, and Client worthiness inspection. For some laboratory disciplines this would be the point at which the written interpretative report and covering letter would be prepared.

Note: Once all written material has been added, the final report and job folder are to be approved by the Laboratory Supervisor and/or QC Officer, signed and dated.

After signature, final reports **and invoices** are issued to the client.

JOB ARCHIVE FILE -- Completed jobs which have been reported, billed, and filed sequentially according to Job number. The Job Archive File is to be kept for a minimum of 5 years.

SAMPLE LABELS AND SAMPLE DISTRIBUTION

Labels with Laboratory Job numbers and Sample numbers are to be fixed to each sample bag, bottle, wrapper, packet, cylinder or container without exception. Preferably, these should be computer generated.

Samples are to be distributed to appropriate active sample holding areas, refrigerators, etc., depending upon the service area protocols and sample perishability.

Lab work/LIMS generated bench sheets, with appropriate parameter codes indicated (special detection limits also noted), shall be distributed to analysts. All QA/QC forms must be stapled to these data sheets (see example).

The manila job folder is to be kept in the Active Job File. The manila folder must contain a completed Chain-of-Custody record, plus any shipping records, client correspondence, etc. applicable to that project.

All data sheets should be distributed to the appropriate person or location in the laboratory.

WORK FLOW AND SAMPLE PRIORITY ANALYSIS

Work is delegated according to holding times and other priorities as determined by the Supervisor and Service Area Protocols.

When possible, work is delegated with the aid of a LIMS and LIMS generated bench sheets may be used for recording of data.

The Laboratory Supervisor or his assistant is to review the active samples and assign work to appropriate analysts according to their training and responsibilities.

Work assignments are made in order to complete the oldest work first.

All analyses are to be completed on or before the due date and/or holding times.

To avoid confusion, analysts are required to enter results into the computer and bench work sheets (and notebooks for ACD) as soon as analysis is complete.

A LIMS should be utilized for status reports prior to beginning each analysis.

DATA RECORDING

GENERAL POLICY

It is the policy of Core Lab to strive for error-free performance in all efforts. That is, all tasks should be performed "right the first time". In addition, it is the responsibility of the person performing the analysis to detect any errors that are generated by them or the processes that they are using to generate the data.

All entries into logbooks, lab notebooks and similar documents must be in ink. They should be rechecked for transcription accuracy frequently.

LIMS and other computer programs are to be used wherever possible to record, assimilate and report data.

Each analyst is responsible for entering correct data into the LIMS immediately after each analysis.

Each analyst is responsible for detecting any errors in the data and in the event of an error, taking corrective action and notifying the proper authority.

Corrections of errors in a personal notebook or on bench work sheets should be made by crossing a single line through the error and entering the correct information. No information should be erased. Changes made subsequently are dated and initialed.

Changes made to other data records on sample logbooks, Chain-of-Custody documents and Laboratory Sample Submittal Forms are made by crossing a single line through the error, dating and initialling.

UNDER NO CIRCUMSTANCES IS CORRECTION FLUID USED DURING ANY PROCESS OF SAMPLE HANDLING, DATA PROCESSING, OR REPORT PREPARATION.

LAB NOTEBOOKS

All notebooks and logbooks should have identification numbers and all have pre-printed page numbers. All analysts will be issued notebooks. This a mandatory possession and must be used at a minimum for recording any non-routine activity, such as the preparation of a calibration stock solution.

Entries should be made in a legible format, clearly labeled for the type of work being performed, signed and dated at the top of each page.

If inserts are included (computer tapes, chromatograms, etc.), they must be stapled securely to the page and signed across the insert edge and the page.

Notebook Format

The pages of information shall conform to standard company formats so that sample ID's, quality control samples, calibrations, dilutions, date of analysis, etc. are clearly indicated. Data should be collated so that recalculation of analytical data can be performed.

Computerized Bench Sheets

These can be used in place of notebooks under certain conditions if all of the calibration and quality control data is included.

Data Entry into the LIMS

The analyst is expected to notify the supervisor of any problems with QC samples, prior to entry of data into LIMS! Identified problems are to be corrected before recording in the computer.

The analyst is to ensure that the data is correctly entered into the computer by proofreading and paying special attention to transposition errors. All data entry will be initialled by the Analyst.

If the LIMS identifies further QC problems, the analyst is to immediately notify his/her supervisor and take steps to correct the problems.

RECORD KEEPING

All completed job files (folders) should be kept in a secure Job Archive File storage area to prevent tampering. Storage time is 5 years or more.

Client correspondence (initialed project notes, quotations, etc.) specific to a Sample Job or similar projects should be maintained in the job folder.

Miscellaneous client correspondence should be kept in Personal Files, Lab Notebooks, or in a Phone Log for a minimum of 2 years.

INSTRUMENT, EQUIPMENT, UTILITIES AND REAGENT CONFIRMATION

Verification of proper instrument and equipment operation, and calibration are the responsibility of designated analysts.

These fundamental QC components are always to be done at the bench before and during the testing or analysis.

Any equipment used to produce data should have documentation available that verifies proper operation and calibration for all time periods during which the samples were tested or analyzed. Any result that is reported should be verifiable in terms of proper instrument operation.

Included are items such as GC, Spectrophotometers, thermometers, transducers, pressure gauges, etc. Class A volumetric glassware does not require specific verification, except in certain cases (i.e. when used for density).

Calibration and maintenance protocols and record books should be accessible at all times.

LABORATORY UTILITIES

Laboratory services include air supplies, vacuum service, DI water, power, atmosphere (temp, humidity, makeup) barometers, etc. Listed here are some basic policies, specifications and control guidelines. Any laboratory service that is installed shall meet the requirements set forth here.

DEIONIZED WATER

Deionized Water (DI) systems with an activated Carbon column to remove organics are strongly recommended over Distillation units.

Conductivity is to be checked daily and recorded in a bound logbook with date, initials of the person responsible and any remedial or maintenance activities.

Control Limit = 2 umhos.
Warning Limit = 1.8 umhos.

If 2 umhos is exceeded, immediate action is required and includes replacing columns and flushing the lines.

Other DI Water Specifications

Elemental Analysis should be performed on the DI water that is used for standard and sample makeup on a minimum of once per week for each analytical parameter.

Control Limit = Instrument Detection Limit (IDL)

For ultra low trace metal analysis, a secondary Deionizing Unit may be necessary. DI water service to be used in Trace Organic Analysis shall be polished with columns to remove organic contaminants, etc.

LABORATORY COMPRESSED AIR SUPPLY

Larger labs (greater than 5,000 square feet) require a centralized system. Typically, a laboratory should install a compressor with a 50 gallon tank capable of continuous 100 psi use.

A regulator should be set to allow 40 +/- 2 PSI Air Service to the Laboratory.

A sedimentation/condensate bowl and subsequent filter should be installed in line for instrument air.

Maintenance Control - On a weekly basis or more frequently, check the Oil Level in the compressor and drain the tank of condensate. Replace filters as recommended by the manufactures.

LABORATORY VACUUM SUPPLY

A central vacuum system capable of producing 22 inches or more of mercury is required.

An in-line trap system for collection of fumes is mandatory to prevent corrosion.

Maintenance Control - Check the oil once per week at a minimum. Monitor the vacuum in psi and record in a system logbook. Replace oil in the frequency suggested by the manufacturer.

LABORATORY FUME HOODS

Hoods should be segregated according to use.

Organic Hoods

A hood which is **designated** for organic solvents shall not have oxidizers such as nitric or perchloric acid used or stored in them. Air velocity through the opening of the hood should be approximately 100 linear feet per minute.

Perchloric Acid Hoods

Perchloric acid should only be used in a designated stainless steel hood designed for its use. Air velocity through the opening of the hood should be approximately 300 feet per minute.

Maintenance Control - On a monthly basis, perchloric hoods should include stack and hood wash downs.

General Purpose Hoods

Mixed use hoods should be designated and restricted to only compatible uses. Strong oxidizers and organic should not be allowed in the same hood at the same time. Never use perchloric acid in a general purpose hood.

ELECTRICAL SERVICES

Laboratories should be located in light industrial areas with access to single and three phase power. Available power and circuits should be adequate to promote flexibility of operation within the facility. Computers and other sensitive equipment should have adequate surge protectors to protect from voltage spikes.

EQUIPMENT

Equipment will include any type of device that is used for measuring or controlling weight, volume, temperature, pressure, time, or flow.

PRESSURE AND VACUUM GAGES

Monitoring of pressure and vacuum gages are done calibrated on a frequency based on the characteristics of the test. Testing is done using a mercury manometer or NBS traceable pressure transducer.

DILUTERS AND DISPENSERS

Any laboratory that is doing high volumes of analysis which require serial dilution of analyses should have at least one diluter which is capable of performing dilutions in the range of 1:5 to 1:100.

Calibrations should be checked daily (for each day used) by gravimetry using a top loading balance.

Control Limit = 1% relative error on a single dilution.

GLASSWARE

Glassware is to be segregated and stored in a separate labeled drawers or cabinets for the following:

Phosphorous analysis
Trace Metal digestions
Volumetric Glassware
Organic Analysis

All glassware shall be rinsed with DI immediately after used and washed before the end of working hours.

VOLUMETRIC GLASSWARE AND PLASTIC WARE

Class A volumetric glassware does not require routine calibration.

Volumetric dispensers, plastic micro and macro pipets are to be calibrated gravimetrically using temperature controlled DI and an electronic balance on a daily basis. Record in the analyst's laboratory notebook.

Control Limits = 1% relative accuracy for 1 ml or less and
0.5% relative accuracy for greater than 1 ml.

THERMOMETERS

Any thermometer used in the Water Laboratory for monitoring instruments and procedures shall be identified and calibrated once every six months against an NBS traceable thermometer. Data shall be recorded in a thermometer logbook or in its respective instrument logbook.

Temperature Corrections shall be placed directly on the thermometer with indelible tape or on the device it monitors.

WATER BATHS AND HEAT BLOCKS

These devices that are used for temperature critical procedures shall operate with:

Control Limits = ± 2 Degree C of the prescribed temperature.

INCUBATION UNITS

Record temperature daily to ensure that it operates within the Control limits of 35 Degree ± 0.5 Degree C. Immediately adjust or repair as it is inappropriate if the temperature deviates from these limits.

DRYING OVENS (TDS 180 Degree C)

Mechanical Convection Ovens are recommended. Check oven temperatures daily and record in its logbook.

Control Limit = 180 Degree ± 2 Degree C. Immediately adjust or repair if outside the control limits. (Too low is more Critical than too high).

Recalibrates thermometer on a semiannual basis against an NBS Traceable Thermometer.

DRYING OVENS (GENERAL)

Drying ovens for general purposes shall have mechanical convection and be capable of operating at temperatures from 100 Degree to 200 Degree C.

Control Limits = ± 2 Degree C of the set temperature.

MUFFLE FURNACES

Muffle furnaces shall be electrically heated and capable of maintaining 1000 Degree C for extended time periods.

Control Limit = ± 25 Degree C (Method Specified Operating Temperature)

REFRIGERATOR(S)

Any refrigerator or walk in cooler should be monitored daily and the temperature recorded. A temperature recording device will also suffice for temperature records.

Control Limit = 4 Degree ± 2 Degree C. If outside this range, adjust or repair immediately.

AUTOCLAVES

Record temperature, pressure and time of **each run** in its bound equipment logbook. Temperature should be measured with a thermometer located in the exhaust line.

Control Limit ≥ 121 Degree C. Repair or adjust immediately if the control limit is not met. Test performance with spore strips or suspensions monthly. Record results in the same logbook.

INSTRUMENTATION

General Instrumentation is defined as any device that is used to directly or indirectly generate data by measuring weights, concentrations, specific physical properties, etc. that are common to most laboratories. Examples would include conductivity meters, analytical balances, Chromatographs, etc.

INSTRUMENT QUALITY CONFIRMATION

The following summarizes some of the quality control monitoring that is done in Core Laboratories to ensure verifiable operation.

ANALYTICAL BALANCES

Calibrate all analytical balances on a weekly basis utilizing the three Class S weights shown. Record all calibrations in the balance logbook.

Control Limits =

Standard Weights	Control Limit
1.0000 Gram	±0.3 mg
10.0000 Grams	±0.5 mg
50.0000 Grams	±1.0 mg

If one of the above control limits are exceeded, then the balance should be recalibrated or serviced immediately.

If the balance is to be used for:

TOP LOADING BALANCES

Calibrate all top loading balances on a weekly basis utilizing at least three Class S weights. Record all calibrations in the balance logbook.

Control Limits =

Standard Weights	Control Limit
10.00 Grams	±0.01 grams
50.00 Grams	±0.05 grams
250.00 Grams	±0.05 grams

PH METERS

Meters with DVM outputs are preferred which display a minimum of 0.01 pH units. Calibration is done each time the method is performed using pH buffers of 4.00 and 7.00 or 7.00 and

10.00. Linearity is checked with a third standard. Buffers are used only once and must closely bracket the sample.

Control Limits = +/- .05 pH units from the known value

SPECIFIC ION METERS

For specific ion work, several standards and a blank are used to calibrate and check the meter staying within the linear range with standards and samples. Control Limits are established for each analyte within the method. Over 90 % of all problems arise from the Specific Ion Electrode. Store, clean and maintain according to the manufacturers recommendations.

Calibrate using at least three standards that span 2 decades of concentration where the lowest standard is at the reported detection limit. Example: 0.1, 1.0 and 10.0 mg/l standards are used.

Control Limits ≥ 53 mv. (The optimum slope should be 59 mv and the minimum acceptable is 53 mv). If lower than this, clean, repair or replace the electrode (or membrane if appropriate).

CONDUCTIVITY METERS

Check accuracy with a 0.01 M KCl solution (1413 umhos) once each use. Record the measurement on the bench sheet.

Control Limit for the 0.01 M KCl solution ≥ 1340 umhos at 25o D. If measurement is less than this, clean, replatinize or replace the cell. (If reading is above 1413 umhos, then the meter has a problem or the solution strength is wrong.)

Warning Limit - If the meter response is less than 1400 umhos, correct the cell constant K by multiplying by (1413/KCl Std. Rd.)

SPECTROPHOTOMETERS AND FILTER PHOTOMETERS

These shall meet the EPA drinking water requirements.

On an annual basis, spectrophotometers shall be checked for wavelength accuracy using NBS traceable color filters and wave length and linearity data shall be recorded in their logbooks.

Control Limits = ± 2.5 nm for wavelength accuracy. Adjust or refurbish necessary to meet the specs.

Follow the Manufactures recommended maintenance and adjustment frequencies.

Calibrate for each parameters by utilizing a blank and at least three standards. Correlation Coefficient (R) shall be 0.995 or better in all cases. Alternatively, if R is not available from the instrument, the residual error of each standard shall not exceed ± 5%.

UV/VIS SPECTROPHOTOMETERS

All absorption cells will be kept scrupulously clean, free of scratches, fingerprints, smudges, and evaporated film residues. The sampling system is to be cleaned at the end of each use. Sampling system should be filled with DI water when left unused overnight. Replacement source lamps, tubing and other expendables will be maintained at all times. Wavelength calibration and linearity checks will be performed similarly to the spectrophotometers.

NEPHELOMETER

Water Laboratories should have nephelometer for doing turbidimetry. Check and maintain according to the manufacturers recommendations. The nephelometer should be check for linearity and be capable of producing a correlation coefficient (R^2) of 0.995 or better.

AUTOANALYZERS

Autoanalyzers should use chemistries that are compatible with EPA approved methodologies. Evaluation of this shall be performed before any system is purchased. The following are general operating criteria that the system should meet for correct analysis of samples:

A) Peaks should be resolved so that the baseline is restored between each.
B) Baseline should be monitored and corrected for by analyzing a blank every 15th sample as a minimum.
C) Monitor a Laboratory Control Sample 10% of the time.
    Control Limit = 90% to 110% recovery.
D) Check for leaks before each use by visual inspection.

ATOMIC ADSORPTION SPECTROPHOTOMETER

Shall meet the EPA CLP requirements or other governing body. Minimum Core Lab requirements also include:

A) Double beam optics (for any type of full service lab)
B) Background correction (which shall be Smith-Heifte,

Zeeman, or D2
C) Graphics capability
D) Programmable quality control features*
E) RS 232 interface capability

*Allows easy processing of detection limit data, etc.

Spectrophotometers shall be checked for wavelength accuracy every six months using the following elements:

A) Copper at 324.7 nm
B) Zinc at 213.9 nm
C) Sodium at 589 nm

Do this by optimizing the instrument with the appropriate hollow cathode lamp and aligning the monochrometer on the exact wavelength. Record the offsets for each.

Control Limits = ± 2.5 nm for wavelength accuracy. Adjust or refurbish necessary to meet the specs.

Hollow Cathode Lamps are monitored for stability and arcing and replaced when baseline stability becomes erratic and noisy.

Follow the Manufacturer recommended maintenance and adjustment frequencies. These should be written up in protocol form and posted by each instrument.

Measure and adjust the nebulizer uptake of DI water at least once per week. Follow the prescribed limits set up by the manufacturer for proper operation.

During the setup of each parameter for analysis, a standard solution of the element of interest should be aspirated into the burner and the <u>absorbance</u> measured and recorded. Control limits should be formulated at the 95% level.

Calibration is done with a minimum of three standards and a blank each time the instrument is operated and follows the same linear fit constraints as specified above for spectrophotometers.

HEATED GRAPHITE ANALYZER

Graphite furnaces shall comply with any EPA specifications. HGA's will be compatible with the host AA so as to allow complete automation. In addition, the following are minimum standards for new instrumentation for Core Lab.

Automatic Data Acquisition and Instrument Control
Peak Area and Height Capability

Autosampler with X/Y Programmability preferably
Graphics Capability
Software that is compatible with EPA CLP protocols

Instrument protocols and operational protocols based on experience and manufacturer recommendations. These should be posted and followed at some preestablished frequency.

Calibrations are done with three standards and a blank each time the instrument is utilized.

INDUCTIVELY COUPLED ARGON PLASMA OPTICAL EMISSION SPECTROPHOTOMETER

Each new type of Instrument that is on the market shall be evaluated and approved by the R&D group in conjunction with the Analytical Chemistry Division. Instruments evaluations shall include user surveys for reliability, soundness of the system, and service availability.

ICP's will include:

IBM PC compatibility

Peak Scanning capability with associated graphics

Background subtraction capability and inter-element correction software

An Autosampler preferably with X/Y configuration

Compatibility with CLP Protocols

Sequential units should have accurate peak searching capability and should be able to select the correct peak even when two peaks are within 0.05 nm apart.

Operational Protocols and Controls are set up to ensure proper operation of the instrument. This shall include all alignment and tuning operations for the torch and optics as well as the frequency of monitoring. Based on experience and manufacturer recommendations, control guidelines are prepared at each laboratory to identify operational specifications that will add the confidence of the analytical process.

These instruments are calibrated by the operator every time an analysis is performed. The standards used are prepared from a known stock standard and are appropriate for the level being analyzed. Working standards are prepared on a daily basis. The instrument is zeroed using deionized water and matrix blanks are run when needed. A verification standard prepared from a separate source is analyzed with each analytical batch or every ten samples (whichever is more frequent) to verify calibration. An interference check standard for ICP is analyzed periodically. Records are kept detailing the instrument performance. Service contracts are maintained with the manufacturers of these instruments and on a yearly basis the instruments are cleaned and recalibrated to meet manufacturer's specifications. If a flask in an instrument's operation is detected by the operator, repair procedures are implemented immediately.

TOTAL ORGANIC HALOGEN ANALYZER (TOX)

Any instrument purchased will conform to current EPA specifications.

The temperature sensing device should be checked once ever six months to ensure accurate readout. Control Limit = 800 Degree C ± 25 Degree.

Instrument operation parameters are as follows:

A) Analyze all samples in duplicate.

B) Check efficiency of the coulometric cell by direct injection of an aqueous standard directly into the cell.

Control Limit = 95% recovery of the standard.

C) Check Pyrolysis efficiency by combusting Trichlorophenol after the cell had passed the constraint outlined in line B.

Control Limit = 90% recovery (overall) of the standard.

D) Analyzed blanks every 10 to 15 samples from nitrate washed carbon columns.

Control Limit = 5 ug/l. (The Method Detection Limit.)

TOTAL ORGANIC CARBON ANALYZER (TOC)

Sensitivity and baseline will be carefully monitored. Scrubbers, driers, and pump tubing will be checked prior to each use and changed when necessary. Zero adjustment and span checks are performed each use. Calibration occurs each time the instrument is used with at least one standard (that is higher in concentration than the highest sample) and one blank. Linearity checks will be performed every six months.

Sample cell will be disassembled and cleaned every six months or more frequently if warranted due to the nature of samples being analyzed. Pump tubing will be replaced monthly and injection port septum will be replaced every one hundred injections or more frequently if a leak develops. Spare consumables and boards are stocked at the laboratory if case malfunction does occur.

GAS CHROMATOGRAPHS

Each instrument and detection system is calibrated using a multi-point calibration curve for the analytes of interest.

Each day a daily calibration standard is run to check the GC system resolution and response for analysis. The daily calibration standard must be within ± 15% of the multi-point response factor for analysis to continue. If calibration falls outside those limits and cannot be easily corrected, the GC must then be recalibrated with a multi-point calibration curve. If the daily calibration standard meets the criteria, analysis of real samples can be accomplished.

A method blank of laboratory water or soil is also run to determine that laboratory practices to prevent contamination are being observed and maintained.

GC septa will be replaced weekly or more frequently if large numbers of injections are being made. Molecular sieves, moisture traps, and hydrocarbon traps on carrier gas lines will be replaced regularly. Detectors will be dismantled and cleaned when necessary as evidenced by instrument response. Spare columns for all methods run will be stocked at the laboratory. Minor parts subject to malfunction will also be maintained at the laboratory. Standard response factors and baseline will be carefully monitored and will trigger more frequent detector cleaning if any deterioration is observed.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY (GC/MS)

Every 12 hours, the GC/MS must meet certain tuning performance criteria. For Volatile Organics analysis, a tuning standard of bromofluorobenzene (BFB) is run and must meet certain ion abundance criteria. An example of the performance standard criteria is attached. For semivolatile analysis, the GC/MS tuning standard is decafluorotriphenylphosphine (DFTPP) an example is attached. Then a daily calibration standard is run and must meet the multi-point calibration average response factor criteria within ± 25%. Once this has been established, analyses can be accomplished.

DATA QUALITY CONFIRMATION

DATA VERIFICATION

For each analytical batch of samples, the following Quality Measurement samples should be analyzed. Repeatability (precision), percent recovery (accuracy) and blank verifications should be within the control limits (found Tables of Service Area Policies) at all times.

For any given batch of samples, depending upon the analytical technology, many of the following QC elements are judged for acceptability against control limits and technical judgement. Data derived from these analyses should be organized, retained and accessible.

Initial and continuing calibration verification
Calibration blanks and verification
Matrix preparation blanks
ICP interference check sample
Spike sample recovery
Duplicates (and Spike Duplicates)
Surrogate Recoveries
Instrument detection limits and control sample
Standard addition results
Serial dilution results
Holding times

The following scenarios are required for each batch of samples that are analyzed.

Acceptable Data -- If no outliers are detected, the data is judged to be acceptable.

Unacceptable Data -- If statistical outliers are detected, it is the analyst's responsibility to:

A) Immediately discontinue data production.
B) Inform their immediate supervisor or QC Officer.
C) Investigate and identify the cause of the problem.
D) Take remedial action to correct the problem <u>once confirmation of the problem has been made with the appropriate authority</u>.
E) <u>If necessary, reanalyze</u> all samples that are in question with quality measurement samples as specified in the Service Area Protocols.

QUALITY CONTROL SAMPLES

The following Quality Control Samples will be analyzed with each batch of analytical samples to measure data quality at the time of analysis.

Duplicate Samples -- shall be analyzed as a minimum (as is possible) at least once per batch of samples or at a rate of 10% within each batch of sample analysis. Preferably, duplicates will consist of samples that are analyzed from batch to batch, but will at least consist of maximized time and order differences within a batch.

Reference Standard -- analyzed at least once per sample batch and/or not less than a rate of 10% of the total work load. These will consist of Spikes where applicable and Reference Materials of similar matrix to the samples being analyzed.

Calibration Confirmation -- Calibration standards of any comparative type analysis (such as Atomic Adsorption Spectrophotometry) must be confirmed to be accurate by the use of a secondary source of standard.

Laboratory Control Sample (LCS) -- Specifically, the LCS's are for immediate feedback for the analyst in order to detect problems as soon as possible. Preferably, these are traceable to NBS, EPA, and have been taken completely through the sample preparation and analysis procedure.

Blank Confirmation -- Where applicable, a blank analysis will be done for each set of samples. For instruments which autofeed multiple samples, there should be at least one check sample/blank per instrument run. Any type of trace contaminate analysis will require blank determination as a part of the QC protocol.

ACCURACY VERSUS PRECISION

Accuracy is the closeness of a measured result to the true value. Precision, on the other hand, is the closeness of repetitive results to each other and not necessarily the closeness to a known value. Systematic errors, i.e. calibration problems or interferences, can severely effect the accuracy of a measurement system and NOT effect the precision. But highly accurate data from a system can imply a precise measurement. Accuracy is usually quantitated as a mean percent of recovery, whereas precision is termed as a range. The quality of laboratory work is measured by those two quantities.

ACCURACY MONITORING PROCEDURES

Accuracy is monitored in the laboratory by the analysis of standards of known concentration and also by the spiking of samples. These are calculated as follows:

$$\text{FOR STANDARDS: } \% \text{ recovery} = P = \frac{\text{observed value}}{\text{known value}} \times 100$$

$$\text{FOR SPIKES: } \% \text{ recovery} = P = \frac{\text{observed - original value}}{\text{spike value}} \times 100$$

From the accumulation of recovery data and the calculation of the mean percent recovery and standard deviation, a Shewhart Control Chart is prepared. The upper control limit is the mean percent recovery plus three standard deviations and the lower control limit is the average minus three standard deviations. The initial chart prepared is invalid if less than fifty percent of the initializing data fall within this interval.

To apply the control chart, monthly add new data and update the chart. Either of the following two conditions would indicate an out-of-control situation:

A) Any point beyond the control limits.

B) Seven successive points on the same side of the average line or other trend.

When an out of control situation occurs, the problem is determined through systematic trouble-shooting, then all analyses since the last in-control point are repeated. Control charts (not always graphical) are maintained for each parameter; standards, spikes and known samples are recorded daily on appropriate forms or in the LIMS.

PRECISION MONITORING PROCEDURES

Precision data is treated in a similar fashion as the accuracy data. Control charts are prepared from the percent difference between replicate measurements of data within a specific range. In applying the precision control chart, an out of control situation occurs when a point exceeds the Upper Control Limit.

CONTROL LIMITS FOR ACCURACY AND PRECISION

Precision and Accuracy Control Limits are documented for each of the environmental procedures and can be review by the client on request. These Control Limits are listed in tables in the service area protocols. Eventually, they will be listed in the computerized Laboratory Information System (LIMS) for automated Quality Control.

CLIENT NEEDS AND DATA RELATIONSHIP VERIFICATION

DATA RELATIONSHIPS

Techniques are listed within each of the Service Areas or Analytical Disciplines along with control limits where applicable to identify problems. It is Company Policy to use these to judge overall acceptability of the data by senior technical personnel in the laboratory.

HISTORICAL DATA REVIEW

Whenever possible, background information on a sample series should be compared against the current analyses that are to be reported. Client-imposed or In-house Control Limits shall be used to judge data acceptability, if possible, and/or senior level personnel at the laboratory shall make judgments as to the quality.

CLIENT NEEDS

Client communicated data criteria should be compared against the measured data to ensure that his/her needs are met.

REPORTING OF DATA

Final reports for distribution to the client are usually computer generated. An initial report of results may be made to the client either verbally or by telephone, but a written final report confirming all previous information becomes the report of record. The actual content of the final report will normally be in a format agreed mutually between Core Lab and the Client prior to testing.

The Laboratory Supervisor, Laboratory Manager or Quality Assurance Officer will sign each report prior to mailing.

Raw Data, instrument QC confirmation, and other special QC Data will be provided with the report if requested. Depending upon the magnitude of the QC documentation requested, extra charges may have to be imposed. It is essential that the Client and the Laboratory communicate the Documentation Requirements prior to initiation of the work.

For any trace constituents where no detectable concentration is encountered, Core Laboratories will submit a Core Laboratories Reportable Detection Limit (CLRDL). This is a minimum concentration that we will report on a routine basis. Each CLRDL is statistically achievable to exceed the 99% confidence level and is verified by each laboratory. The term CLRDL is met to be comparable to EPA's Contract Lab Program term "Contract Required Detection Limit."

PERFORMANCE AND SYSTEM AUDITS

The Site QA Officer is responsible for carrying out performance and system audits to ensure that data meets quality requirements.

SYSTEM AUDITS

System audits are qualitative evaluations of laboratory quality control measurements to determine if measurement systems are being used appropriately. These audits are to be performed by site laboratory personnel on a quarterly basis using audit forms supplied by Corporate Headquarters. Audits are based on Company Policies and Procedures and evaluated with a percentage score. Secondly, on an annual basis, a Corporate Audit consisting of a Company Executive, a Peer from another Laboratory and the Quality Assurance Manager. The same audit form is used and scored for evaluation. Merit review of the site manager will be tied to the Audit Evaluation.

DATA MANAGEMENT AUDITS

With the Computerized LIMS, the Quality Assurance Manager can via modem, look into the files of any Environmental Laboratory within the Corporation. Items that will be reviewed will include percent of Quality Assurance within the work load, number of outliers, trends on specific parameters, etc.

PERFORMANCE AUDIT

Performance audits are a quantitative evaluation of the QA/QC program based on Round Robin Participation. Each laboratory is required to participate in at least one EPA sponsored Round Robin. Also, blind samples of a known composition or behavior will be submitted by the site QA officer without the knowledge of the analyst to ensure that these check samples are analyzed as part of routine operation. The QA officer will compare these results to the known results and implement corrective action in this instance if results are unacceptable.

AUDITS -- PROBLEM IDENTIFICATION AND CORRECTION

Audits are used as a means of problem identification and as a source of documentation. Once identified, the site is responsible to correct the problem and confirm with written documentation. They are free to request Corporate assistance wherever needed.

If it is determined that the level of corrective action requires major operational changes, the District Manager or Vice-President of the Analytical Chemistry Division will become involved to implement corrective action.

OTHER QUALITY ASSURANCE CONSIDERATIONS

Identified in this section are some important considerations that are essential to a successful operating laboratory.

PERSONNEL SAFETY

Providing a safe environment in which to work is of prime importance at Core Laboratories. This is accomplished in two parts:

1) Providing a safe work place, and
2) Having properly trained employees in regard to safety procedures which include worker right to know, etc.

A member of the laboratory staff is designated as the Laboratory Safety Officer. He appoints and is chairman of the Safety Committee. It is the responsibility of the safety committee to perform a monthly inspection of the facility and to complete a Safety Inspection Report. Copies of this report go to the Laboratory Manager and to the Analytical Chemistry Division Headquarters Office. The Laboratory Safety Officer also conducts monthly safety meetings for the laboratory. Results of the laboratory inspection are discussed as well as various topics on personnel safety instruction (such as first aid procedures, respiratory safety, etc.).

WASTE MANAGEMENT AND DISPOSAL

The goal is to operate every laboratory within the regulatory boundaries and eliminate the Client's and Core Laboratories' liability for such waste. Each laboratory is required to have a waste management plan which includes the following components:

- TRAINING
- WASTE REDUCTION
    - (Return samples to client or dispose of according to regulations)
    - Reuse solvent as much as possible
- WASTE CONTROL COORDINATOR
- WASTE MANAGEMENT PLAN
    - Responsibilities Delegation
    - Waste Identification and Segregation
- DISPOSAL SCHEDULES
- WASTE DISPOSAL POLICIES
- OTHER WASTE POLICIES
- LABORATORY SEWAGE SYSTEM

CONSUMABLES AND SUPPLIES

SUPPLIERS

Core Laboratories, due to its diverse analytical interests, must purchase supplies and equipment from a variety of sources. Assurance of quality in materials purchased from these suppliers is essential in maintaining quality in the laboratory. Major suppliers are required to demonstrate quality assurance criteria on materials purchased through published specifications on materials purchased (i.e. lot analysis, precision and accuracy of instruments, etc.). The following are major suppliers for Core Laboratories:

American Scientific Products
Company
4660 Pine Timbers, Suite 100
Houston, Texas 77041
(713) 462-8000

General Laboratory
Supply
3307 Preston Road
Pasadena, Texas 77505
(713) 487-0633

Fisher Scientific Company
10700 Rockley Road
Houston, Texas 77001
(713) 495-6060

VWR Scientific Inc.
P.O. Box 33348
Houston, Texas 77233
(713) 641-0681

PURCHASING AND INSPECTION OF SUPPLIES

A Purchase Order Book is maintained for each order placed. Information documented in this book includes: date of order, purchase order number, catalog number of item(s) ordered, quantity ordered, description of item(s) ordered, price, and verification of receipt of order. Upon receipt of order, materials are visually inspected by designated staff members (all reagents are dated) and items checked off on packing slip. Any discrepancies are also noted on packing slip and form is then given to Laboratory Supervisor for verification. Corrective action is then undertaken with supplier, if necessary, for those items found to be defective.

REAGENTS AND SUPPLIES

Reagents and supplies must meet established quality criteria prior to their use in an analytical procedure. All reagents must meet A.C.S. (American Chemical Society) Reagent Grade specifications or better and volumetric glassware must meet NBS Class A specifications. Standards and reagents are checked against past standards and commercial sources for contamination prior to their use in an analytical procedure. Standards are also checked on a routine basis (due to their tendency to degrade over time) and records of this are maintained in laboratory notebooks, as well as on the reagent bottles themselves.

PREPARED REAGENTS

Prepared reagents are those reagents that are prepared by an analyst for a specific procedure that must meet certain concentrations and other requirement as specified in a documented procedure.

All prepared reagents for each method used in the general water lab should be stored in a low form box or tray with the procedure label or refrigerated if needed.

Each prepared reagent bottle should be properly labeled with reagent name, concentration data, standardization information, preparation date (expiration Date if needed) and initialled by the preparer. Prepared reagent bottles are to be kept clean and not to be left empty (except for reagents that exhibit low stability). <u>All pertinent notes as to its preparation should be recorded in the analyst's notebook.</u>

ACS certified reagents are to be used unless specified otherwise. Purchased reagents are to be dated (and also after opening.)

GENERAL PURCHASE POLICIES FOR MAJOR INSTRUMENTATION

The Technical Development Group of Core Laboratories shall keep records of approved major equipment that meet Core Laboratories Standards in terms of specification, performance, reliability and service. New instrumentation can be purchased if it goes through an evaluation guidelines which encompass software and hardware compatibility, quantifiable specification requirements such as resolution, signal to noise ratio, performance on unknown samples, etc.

New instrument evaluations shall be conducted by the Technical Development Group or by senior technical personnel at the laboratory level.

VERIFICATION OF SOFTWARE

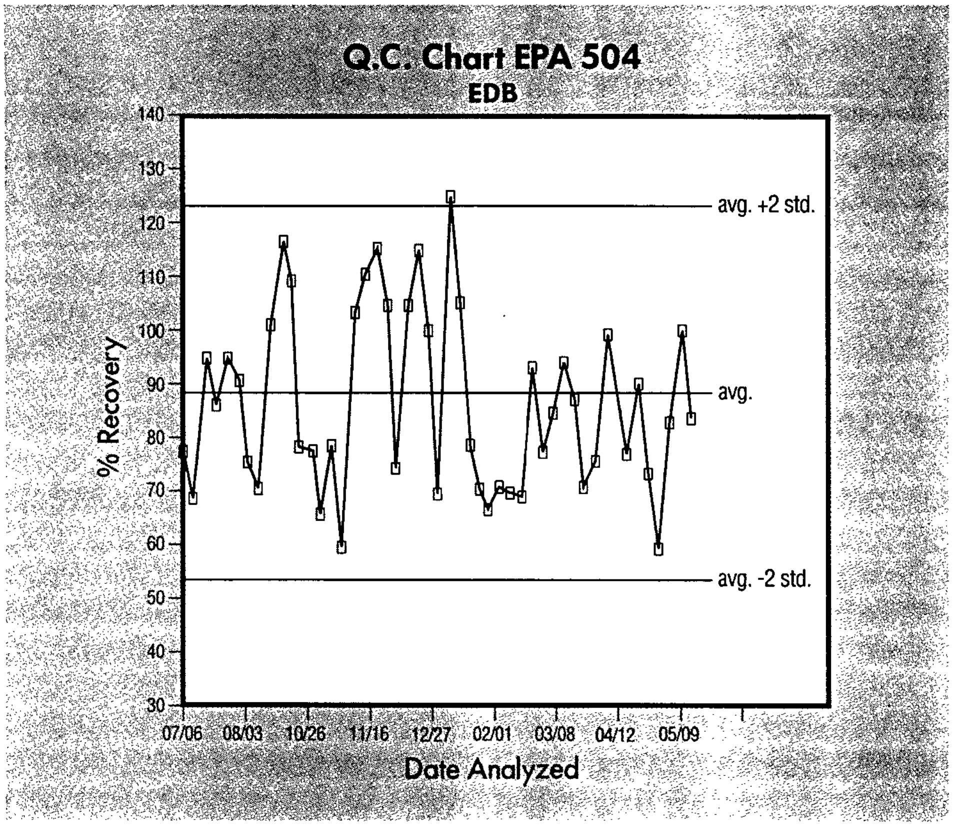
All the computer software in use by any ACD Lab has been rigorously tested and verified by Quality Assurance or the Software Department. Any changes to existing software must be thoroughly documented and can only be performed under professional supervision.

Appendix B

GTEL/Remediation Technology Laboratory Methods

GTEL Environmental Laboratories, Inc.

QA/QC Plan Synopsis



GTEL
ENVIRONMENTAL
LABORATORIES, INC.

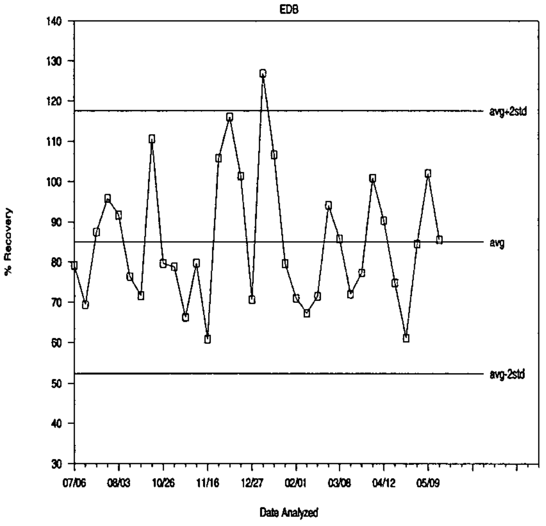
QA/QC Plan Synopsis

GTEL QA/QC Plan Synopsis

Revision 4

February 1993

Q.C. Chart EPA 504



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LABORATORIES, INC.

No part of this manual may be used by other parties to promote other business purposes. This document has been prepared exclusively for customers and professional associates of GTEL in order to facilitate clear commumication concerning project requirements and to foster allignment between customer needs and laboratory procedures.

GTEL
ENVIRONMENTAL
LABORATORIES, INC.

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1 Introduction

GTEL operates under a quality assurance program which touches on every level of the company and controls every aspect of the analysis of samples. The GTEL QA/QC Manual governs the operation of GTEL's five analytical laboratories. The QA/QC Synopsis is an abridged version of the GTEL QA/QC Manual, approved by GTEL management to be provided exclusively to customers for their internal quality planning needs.

Quality Policy

GTEL is committed to the production of analytical data of the highest quality and to continuous improvement in all areas of its operation. Only procedures and techniques meeting the highest standards will be used. As a result of having a focus on environmental analyses, an emphasis is placed on timeliness of work, exacting quality, and dependable, legally defensible data. Each operation maintains a local perspective in its scope of services and customer relations and applies the guidance of the GTEL QA/QC Manual in order to maintain a national and international perspective in terms of quality.

The corporate goal for all segments of GTEL operations is for nationwide uniform product and service quality of the highest caliber. The process of achieving this goal entails continuous evaluation and action. GTEL management requires documentation of existing practices and improvement action plans at every stage in the improvement process. This documentation process is followed by management in order to demonstrate control of the laboratory operations.

A spirit of innovation is an essential element to the success of GTEL in solving the complicated analytical problems encountered with environmental samples. This spirit, combined with the discipline and attention to detail required to provide the level of service expected by our customers, is what makes GTEL stand out among others in this field. This same spirit is what drives the continuous striving for quality improvement and is the keystone to the GTEL quality program. In the words of the late John K. Taylor, formerly senior chemist with the National Institute of Standards and Technology (National Bureau of Standards),

> **"The goals of yesterday**
> ***are the commonplace occurrences of***
> **today and the outmoded practices of tomorrow."**

Fields of Testing Covered

The approach of this plan is to provide a baseline level of quality assurance and quality control across all methods. The methods specifically mentioned in this manual include the most frequently requested water and soil techniques currently needed to provide environmental analytical services anywhere in the United States. The principles expressed in the GTEL QA/QC Synopsis are applicable to all analyses performed at GTEL.

2 Organization and Responsibility

Each person involved in the generation of data is explicitly part of the QA/QC Program. The staff has specifically delegated QA/QC responsibilities.

Responsibility for the Quality Assurance System

The overall responsibility for quality lies with the General Manager and the corporate management team reporting to the General Manager. Within each laboratory, the Laboratory Director is ultimately responsible for the quality of the laboratory analyses and services. Surveillance and maintenance of the quality assurance system is provided by the Director of Quality Assurance and the Laboratory Quality Assurance Managers.

All employees of GTEL are responsible for knowing the content of this quality assurance plan and upholding the standards therein. Each person will carry out his/her daily tasks in a manner consistent with the goals expressed in this manual and in accordance with the procedures in this manual and the laboratory standard operating procedures (SOPs).

Quality Assurance Manager

All quality assurance responsibilities at the laboratory level are coordinated by the Quality Assurance Manager. The independence and objectivity of the QA/QC program depends on the Quality Assurance Manager being independent of the data-generating process, therefore the Quality Assurance Manager in each laboratory reports to the corporate Director of Quality Assurance. Responsibilities include the development, evaluation, and documentation of QA/QC policy and development of QC procedures which are appropriate for the GTEL projects. The Quality Assurance Manager and QA staff perform regular audits of reports and records to ensure that the data generation processes and documentation comply with the QA Manual. The Quality Assurance Manager is responsible for reporting all QA compliance issues not addressed in a timely fashion to the Director of Quality Assurance.

Organizational Structure

Organization of GTEL Environmental Laboratories, Inc. is shown on the organization chart, Figure 1. The key functional and operations managers at the time of the publication of this document are listed below.

Senior Management

Scott C. Ames, Vice President, General Manager, Milford, NH
Safy Khalifa, Ph.D., National Technical Director, Concord, CA
Kent Carter, Director of Customer Service, Wichita, KS
Michael Webb, Director of Quality Assurance, Milford, NH
John Hennessy, Director of Finance, Milford, NH
Phillip T. Koch, Director of Sales and Marketing, Milford, NH

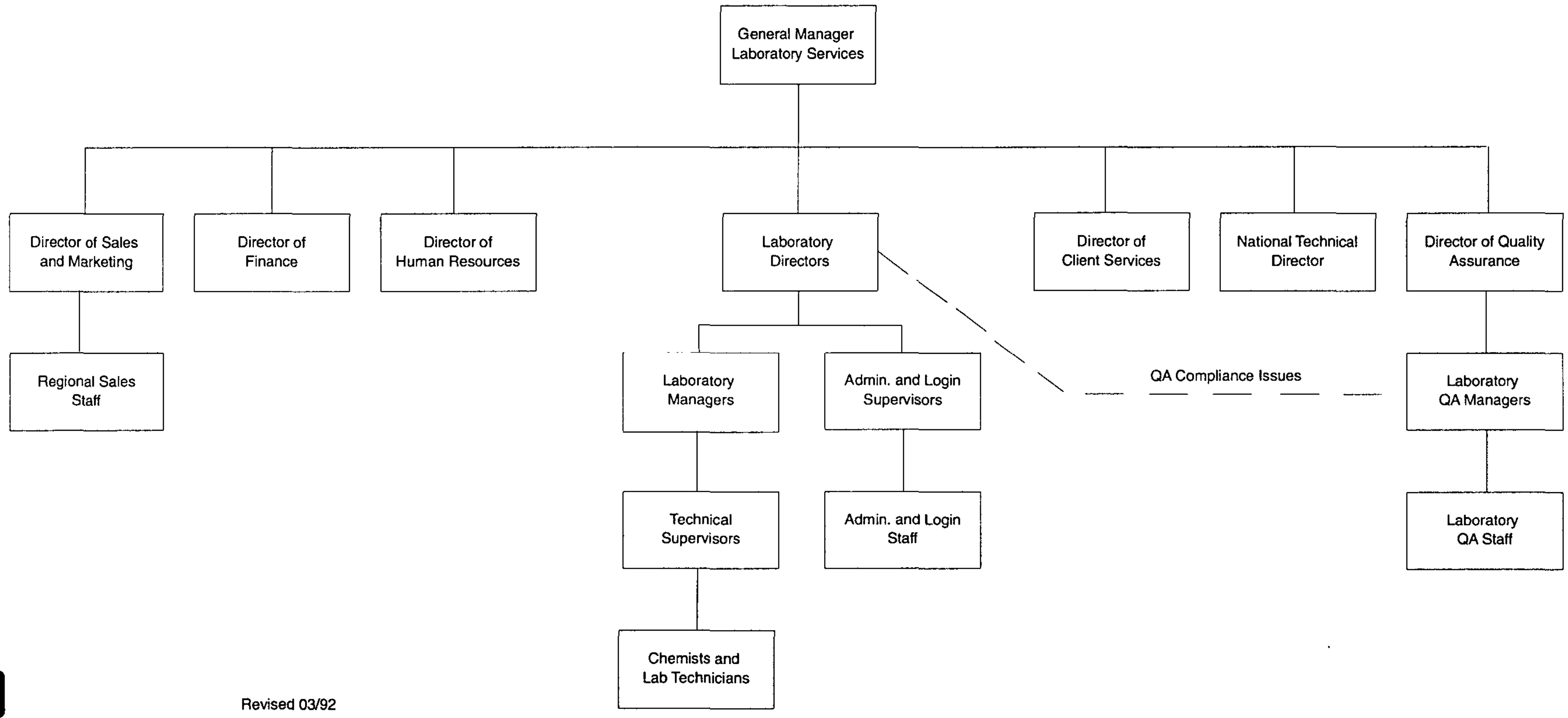
Regional Management

Susan Uhler, Laboratory Director, Milford, New Hampshire
Terry Loucks, Laboratory Director, Wichita, Kansas
Joan Greenwood, Laboratory Director, Torrance, California
Eileen Bullen, Laboratory Director, Concord, California
Harold Vernon, Laboratory Director, Tampa, Florida

Figure 1

GTEL Environmental Laboratories, Inc.

Organizational Structure



Revised 03/92

3 Quality Assurance Objectives

The following GTEL Environmental Laboratories quality assurance objectives are described below: precision, accuracy, representativeness, completeness, and comparability (PARCC).

Precision

The laboratory objective for precision is to equal or exceed the precision demonstrated for these analytical methods on similar samples and to meet or exceed precision data for these analyses published by the U.S. EPA. Precision is defined as the degree of reproducibility of the measurements under a given set of conditions. Precision is documented on the basis of replicate analyses, usually duplicate or matrix spike duplicate samples.

Accuracy

The laboratory objective for accuracy is to equal or exceed the accuracy demonstrated for these analytical methods on similar samples and to perform better than the recovery data published by the U.S. EPA. Accuracy is defined as the bias in a measurement system. Accuracy is documented on the basis of recovery of matrix spikes, spiked reference materials introduced into selected samples of a particular matrix.

Representativeness

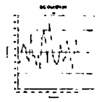
The laboratory objective for representativeness is to provide data which are representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a set of samples. The representativeness of the analytical data is a function of the procedures and carefulness used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

Completeness

The completeness objective for an analysis is to provide sufficient data of acceptable quality such that the goals of the analytical project can be achieved within the time frame required. The overall project completeness is expressed as the percentage of unqualified data for the entire project.

Comparability

The comparability objective is to provide analytical data for which the accuracy, precision, representativeness, completeness and detection limit are similar to these quality indicators for data generated a) by other laboratories for similar samples, and b) data generated by GTEL over time. The comparability objective is documented by interlaboratory studies carried out by regulatory agencies or carried out for specific projects or contracts; and by comparison of periodically generated statements of accuracy, precision and detection limits with those of other laboratories.



4 Sampling Quality Assurance

GTEL does not routinely provide sampling services. This section is concerned with the quality of the laboratory support systems, the infrastructure which supports the sample integrity, and sample handling processes, and the clients' sampling programs. The overall quality of data can be no better than the quality of the sample provided to the analyst. The laboratory cannot accept responsibility for improper sampling of client-procured samples and will analyze the samples as delivered. However, the detailed analysis request and custody documentation procedures developed by GTEL provide a means for keeping track of preservation and sample handling factors which affect sample integrity.

Preservatives and Cleaned Sampling Containers

GTEL Laboratories purchases pre-cleaned sampling containers for use by clients. These are obtained from reputable container manufacturers and are cleaned in accordance with EPA specifications. Upon request, preservatives are provided to the client or dispensed into the appropriate cleaned sampling containers. Because certain samples require more preservative than others, GTEL provides pH paper and other supplies so that the sampler can confirm that the samples are properly preserved and make adjustments as necessary at the time of sampling.

Definition of Holding Time

Holding time is the time from sampling until initiation of analysis. The date and time of sampling documented on the field chain-of-custody form establishes the time zero. When the maximum allowable holding times are expressed in days, the holding time is based on a twenty four hour day measured from time zero in the time zone where the sample was taken. The first day of holding time is not passed until twenty four hours after sampling. Holding times for analysis include any necessary re-analysis.

The sampling time must be documented on the COC form or provided in writing by the client. For short holding times, such as 48 hours, scheduling of sampling and analysis early in the week is highly recommended so that analysis can be completed prior to the weekend.

Definition of Turnaround Time

Turnaround time is the time from receipt of samples to the transmittal of analytical data by mail or facsimile. The signing of the COC form by the sample control staff sets the zero time for the reporting turnaround time. The required turnaround time will be based on a twenty four hour day, times the number of days, from the time of signing of the COC form, not including weekends and holidays.

Recommended Containers, Preservation, Holding Times

The preservation and holding criteria specified in Tables 1 and 2 come from a variety of regulatory sources. If a source is not available, the item is flagged with an asterisk to signify that it is a GTEL internal guideline. The information contained in these tables is subject to regulatory revision at irregular intervals. GTEL Laboratories will make every effort to update and circulate any revisions as soon as they are announced. However, it is the responsibility of the individual sampler to confirm the information contained in these tables. A telephone call to the local GTEL laboratory customer service representative is recommended.

TABLE 1

Recommended Containers, Preservation, Storage, and Holding Times for Water, Wastewater, Groundwater, Soil and Waste

Description	Method	Matrix	Sample Container[1]	Preservation[13]	Prep/Analysis Holding Time	Minimum Volume
Ethylene Dibromide (EDB)	504	H_2O	G (b) TefSep	Cool 4°C[2,4]	28 days	40 mL[3]
GC-Purgeable Halocarbons	601	H_2O	G (b) TefSep	Cool 4°C[2,4]	14 days	40 mL[3]
GC-Purgeable Aromatics	602	H_2O	G (b) TefSep	Cool 4°C HCl pH<2[2,4,5]	14 days[5]	40 mL[3]
GC-Purgeables	8010-8020	H_2O	G (b) TefSep	Cool 4°C HCl pH<2[2,4]	14 days	40mL[3]
GC-Purgeables	8010-8020	Soil/Waste	G (b) TefSep or TefCap	Cool 4°C[2,4]	14 days	100g or 4oz. Jar[3]
GC/MS Purgeables	624	H_2O	G (b) TefSep	Cool 4°C HCl pH<2[2,4,5]	14 days[5]	40 mL[3]
GC/MS-Purgeables	8240	H_2O	G (b) TefSep	Cool 4°C HCl pH<2[2,4]	14 days	40mL[3]
GC/MS-Purgeables	8240	Soil/Waste	G (b) TefSep or TefCap	Cool 4°C[2,4]	14 days	100g or 4oz. Jar[3]
GC-Pest. & PCBs	608	H_2O	AG (a) TefCap	Cool 4°C 5<pH<9[2]	7/40 days[6]	1L[3]
GC-PCBs only	608	H_2O	G (a) TefCap	Cool 4°C	7/40 days[6]	1L[3]
GC-Pest. & PCBs	8080	H_2O	AG (a) TefCap	Cool 4°C 5<pH<9[2]	7/40 days[6]	2 L[3]
GC-PCBs only	8080	H_2O	AG (a) TefCap	Cool 4°C[2]	7/40 days[6]	2 L[3]
GC-Pest. & PCBs	8080	Soil/Waste	AG (a) TefCap	Cool 4°C	14/40 days[6]	100g or 8oz. Jar
HPLC-PAHs	610	H_2O	AG (a) TefCap	Cool 4°C Store in dark[2]	7/40 days[6]	1L[3]
HPLC-PAHs	8310	H_2O	AG(a) TefCap	Cool 4°C Store in dark[2]	7/40 days[6]	2 L[3]
HPLC-PAHs	8310	Soil	AG(a) TefCap	Cool 4°C	14/40 days[6]	100g or 8oz. Jar
GC/MS Semivolatiles	625	H_2O	AG (a) TefCap	Cool 4°C Store in dark[2]	7/40 days[6]	1L[3]
GC/MS-Semivolatiles	8270	H_2O	AG(a) TefCap	Cool 4°C/ dark[2]	7/40 days[6]	2 L[3]
GC/MS-Semivolatiles	8270	Soil/Waste	AG(a) TefCap	Cool 4°C	14/40[6] days	100g or 8oz. Jar
TPH as Gasoline	Mod. 5030/8015	H_2O	G (b) TefSep	Cool 4°C HCl pH<2[4]	14 days	40mL[3]
TPH as Gasoline	Mod. 5030/8015	Soil	G (b) TefSep or G (a) TefCap	Cool 4°C[4]	14 days	100g or 4oz. Jar
TPH as Diesel	Mod. CA LUFT	H_2O	G (a) TefCap	Cool 4°C	14/40 days[6]	1L[3]
TPH as Diesel	Mod. CA LUFT	Soil	G (a) TefCap	Cool 4°C	14/40 days[6]	100g or 8oz. Jar

TABLE 1 (continued)

Recommended Containers, Preservation, Storage, and Holding Times for Water, Wastewater, Groundwater, Soil and Waste

Description	Method	Matrix	Sample Container[1]	Preservation[13]	Prep/Analysis Holding Time	Minimum Volume
Petroleum Profile, Hydrocarbon Screen	ASTM D2887	H_2O	G (a) TefCap	Cool 4°C	14/40 days[6]*	1L[3]
Petroleum Profile Hydrocarbon Screen	ASTM D2887	Product	G (b) TefSep or G (a) TefCap	Cool 4°C	14/40 days[6]*	100g or 8oz. Jar
Oil and Grease	413.1, 413.2	H_2O	AG (a) TefCap	Cool 4°C HCl, pH<2[14]	28 days	1L[3]
Oil and Grease	9071	Soil	G (a) TefCap	Cool 4°C	28 days[7]*	100g or 8oz. Jar
Petroleum Hydrocarbons	418.1	H_2O	AG (a) TefCap	Cool 4°C HCl pH<2[14]	28 days[7]*	1L[3]
Petroleum Hydrocarbons	Mod. 3550/ 418.1 or SM 503D&E	Soil	G (a) TefCap	Cool 4°C	28 days[7]*	100g or 8oz. Jar
AAS Metals, except CrVI, or Hg	200 series	H_2O	P or G (c)	HNO^3 pH<2[8]	6 mos	500 mL
Metals-AA	7000	H_2O	P or G(c)	HNO_3 pH<2[8]	6 mos.	500 mL
Metals-AA	7000	Soil	P or G (c)	Cool 4°C	6 mos.	100g or 8oz. Jar
ICP Metals	200.7	H_2O	P or G(c)	HNO_3pH<2[8]	6 mos	500 mL
ICP Metals	6010	H_2O	P or G(c)	HNO_3 pH<2[8]	6 mos.	500 mL
ICP Metals	6010	Soil	P or G(c)	Cool 4°C	6 mos.	100g or 8oz. Jar
Chromium VI	7196 218.4	H_2O	P or G	Cool 4°C	24 hrs.	500 mL
Mercury (Hg)	245.1	H_2O	P or G(c)	HNO_3pH<2[8]	28 days	500 mL
Mercury	7470	H_2O	P or G(c)	HNO_3 pH<2[8]	28 days	500 mL
Mercury	7471	Soil	P or G(c)	Cool 4°C	28 days	100g or 8oz. Jar
Organic Lead	Calif. LUFT	H_2O	G	Cool 4°C, minimum headspace[4]	Extract ASAP*	500 mL
Organic Lead	Calif. LUFT	Soil	G	Cool 4°C	Extract ASAP*	200g or 40z. Jar
General Inorganics	9000 Series	Soil	P or G (c)[15]	Cool 4°C	not to exceed the specification in water	100g or 8oz. Jar
Ion Chromatography Anions	300.0	H_2O	P or G (b)	Cool 4°C[9]	Analyte Dependent[9]	500 mL
Acidity	305.1 SM 402	H_2O	P or G	Cool 4°C	14 days	500 mL
Alkalinity	310.1 SM 403	H_2O	P or G	Cool 4°C	14 days	500 mL
Ammonia	350.1, 350.3	H_2O	P or G	Cool 4°C H_2SO_4 pH<2	28 days	500 mL
Asbestos (Bulk)	EPA Interim	Bulk	G	None	indefinite	100g or 40mL vial
BOD	405.1	H_2O	P or G	Cool 4°C	48 hrs.	500 mL

TABLE 1 (continued)

Recommended Containers, Preservation, Storage, and Holding Times for Water, Wastewater, Groundwater, Soil and Waste

Description	Method	Matrix	Sample Container[1]	Preservation[13]	Prep/Analysis Holding Time	Minimum Volume
Bromide	320.1	H_2O	P or G	N/A	28 days	500 mL
Chloride	325, 9250	H_2O	P or G	None	28 days	500 mL
Chlorine, total residual	330.1 SM 408	H_2O	P or G	None	Analyze immediately[16]	500 mL
COD	410.1	H_2O	P or G	Cool 4°C H_2SO_4 pH<2	28 days	500 mL
Color	110.3	H_2O	P or G	Cool 4°C	48 hrs.	500 mL
Cyanide, total	335.2, 9010	H_2O	P or G(a)	Cool 4°C N_aOH pH>12[12]	14 days[12]	1 L
Cyanide, free	SM 412H	H_2O	P, G, AG(a)	Cool 4°C N_aOH pH>12[12] Store in dark	14 days[12]	1 L
Cyanide	335.2-CLP M	Soil	P or G (c)	Cool 4°C	14 days	100g or 4oz. Jar
Fluoride	340.2 SM 413	H_2O	P	None	28 days	500 mL
Hardness	242.1, 200.7	H_2O	P or G	H_2SO_4 pH<2 or HNO_3 pH<2	6 mos.	500 mL
Kjeldahl nitrogen	351.2	H_2O	P or G[15]	Cool 4°C H_2SO_4 pH<2	28 days	1 L
Nitrate	353.2, 9200	H_2O	P or G[15]	Cool 4°C	48 hrs.	500 mL
Nitrate-nitrite	353.2	H_2O	P or G[15]	Cool 4°C H_2SO_4 pH<2	28 days	500 mL
Nitrite	353.2	H_2O	P or G[15]	Cool 4°C	48 hrs.	500 mL
Orthophosphate	365.2	H_2O	P or G	Filter immediately, Cool 4°C	48 hrs.	500 mL
Oxygen, Dissolved	360.2	H_2O	G Bottle and top	None	Analyze immediately[16]	250 mL
pH	150.1	H_2O	P or G	None	Analyze immediately[16]	500 mL
Phenols	420.1, 9065	H_2O	G	Cool 4°C H_2SO_4 pH<2	28 days	1 L[3]
Phosphorus (total)	365.1, 365.2	H_2O	P or G	Cool 4°C H_2SO_4 pH<2	28 days	500 mL
Residue, Filterable (TDS)	160.1	H_2O	P or G	Cool 4°C	7 days	500 mL
Residue, Nonfilterable (TSS)	160.2	H_2O	P or G	Cool 4°C	7 days	500 mL
Residue, total	160.3	H_2O	P or G	Cool 4°C	7 days	500 mL
Specific conductance	120.1, 9050	H_2O	P or G	Cool 4°C	28 days	500 mL
Standard Plate Count	SM 907C[10]	H_2O	P or G (sterile)	Cool 4°C[2]	6 hrs.	500 mL
Standard Plate Count	SM 907C	Soil/Solid/ Waste	P or G (sterile)	Cool 4°C	6 hrs.	100g or 8oz. Jar
Sulfate	375.2, 9035	H_2O	P or G	Cool 4°C	28 days	500 mL
Sulfide	376.2, 9030	H_2O	P or G	Cool 4°C Zn Acetate, pH>9[11]	7 days	500 mL
Sulfite	377.1	H_2O	P or G	None	Analyze immediately[16]	500 mL
Surfactants	425.1	H_2O	P or G	Cool 4°C	48 hrs.	500 mL

TABLE 1 (continued)

Recommended Containers, Preservation, Storage, and Holding Times for Water, Wastewater, Groundwater, Soil and Waste

Description	Method	Matrix	Sample Container[1]	Preservation[13]	Prep/Analysis Holding Time*	Minimum Volume
Temperature	170.1	H_2O	P or G	None	Analyze immediately[16]	N/A
TOC	415.1, 9060*	H_2O	P or G(a) TefCap	Cool 4°C H_2SO_4 pH<2	28 days	500mL or 1L
TOC	Mod. 9060	Soil	G (a) TefCap	Cool 4°C, Minimum Headspace*	28 days*	100g or 8oz. Jar
Total Coliform	SM 909A[10], EPA 9132*	H_2O	P or G (sterile)	Cool 4°C[2]	6 hrs.	500 mL
Total Coliform	EPA 9132	Soil/Solid	P or G (sterile)	Cool 4°C	6 hrs.	100g or 8oz. Jar
TOX	9020	H_2O	P or G(a) TefCap	Cool 4°C H_2SO_4 pH<2	28 days	1L
TOX (Extractable)	EPA 600/ 4-84-008	Soil	G (a) TefCap	Cool 4°C, Minimum Headspace*	28 days*	100g or 8oz. Jar
Total Halide	Parr Bomb & EPA 300.0	Oil or Soil	G (a) TefCap	Minimum Headspace*	28 days*	100g or 8oz. Jar
Total Halide	9076	Oil	G Tef Sep, Tef Cap	Minimum Headspace[4]	28 days*	40mL
Turbidity	180.1	H_2O	P or G	Cool 4°C	48 hrs.	500 mL
Ignitability	EPA 1010	Soil/Liquid	G (b) TefSep or G (a) TefCap	Cool 4°C[4]	ASAP	100g or 8oz. Jar[6]
Corrosivity	EPA 9040	Liquid	P or G	Cool 4°C	ASAP	100g or 8oz. Jar
Reactivity	SW 846, Section 7.3	Waste	P or G	Cool 4°C	ASAP	100g or 8oz. Jar
EPTOX Metals	EPA 1310	Liquid Waste	P(c) or G(a or c)	Cool 4°C	28 days to leaching[17]	1000mL
EPTOX Metals	EPA 1310	Solid Waste	P(c) or G(a or c)	Cool 4°C	28 days to leaching[17]	100g
TCLP Metals only	EPA 1311	Liquid Waste	P(c) or G(a or c)	Cool 4°C	28 days to leaching[17]	1000mL
TCLP Metals only	EPA 1311	Solid Waste	P(c) or G(a or c)	Cool 4°C	28 days to leaching[17]	500g
TCLP Metals & Semi-Volatiles	EPA 1311	Liquid Waste	G(a) Tef Cap	Cool 4°C	14 days to leaching[17]	3000mL
TCLP Metals & Semi-Volatiles	EPA 1311	Solid Waste	G(a) Tef Cap	Cool 4°C	14 days to leaching[17]	500g
TCLP Volatiles	EPA 1311	Liquid Waste	G(b) Tef Sep	Cool 4°C[2]	14 days to leaching[17]	200mL
TCLP Volatiles	EPA 1311	Solid Waste	G(b) Tef Sep or Tef Cap	Cool 4°C[4]	14 days to leaching[17]	100g

"*" indicates GTEL internal guidance rather than a binding regulatory preservation requirement or holding time. Exceptions may occur in particular states.

Table 1 Footnotes

[1] G(x) = glass; AG(x) = amber glass; P(x) = plastic; TefSep = Teflon septum; TefCap = Teflon lined cap; x = cleaning protocol as follows: a = acid wash + solvent wash + oven dry (for semi volatiles or metals); b = oven dry (for volatiles); c = acid wash (for metals and certain inorganics only). Protocols (a) and (c) are not acceptable for nitrate and total nitrogen analyses.

[2] For organics and bacteriological analyses, sodium thiosulfate (0.008%) is required for all chlorinated waters. Amber glass ("AG" under sample container), where specified, is required in order to keep samples in the dark.

[3] Samples must be provided in duplicate to cover for breakage and provide sufficient sample for QC procedures. Labs using whole-sample autosamplers for volatiles in water (GC or GC/MS) will require vials in triplicate. EDB analysis requires 4 vials. Extractable organics with matrix spike/matrix spike duplicate QC protocols require a triplicate sample.

[4] Sample containers not filled completely, thus risking volatile loss, will be noted as a non-conformance at the time of inspection for log-in. All samples for volatile organics in water with a bubble larger than 5mm will be noted.

[5] Samples with purgeable aromatics must be acidified with HCl to <pH2 in order to have a 14 day holding time, unacidified samples potentially with purgeable aromatics have only a 7 day holding time. Method 624 GC/MS analysis not including aromatics has a 14 day holding time without acidification.

[6] 7 days from sampling date for extraction, 40 days from extraction date for analysis of the extract. 14 days until extraction if listed as 14/40.

[7] EPA does not control TPH holding times. The holding time given is the laboratory practice by analogy with Oil and Grease. Various states have more restrictive requirements.

[8] Samples for dissolved metals must be filtered immediately on site. Except for drinking water compliance monitoring, requests to filter upon arrival at the laboratory will result in data being flagged as follows: "The analytical result represents the dissolved metals at the time of filtering in the laboratory." Requests to acidify metal samples at the laboratory will be honored, however 16 hours will be allowed after acidification before any sub samples for digestion are taken (EPA Method 200.9).

[9] Certain anions require special handling. Holding times and preservation for a particular sample will be determined by the requirement for the anion of interest with the shortest holding time, e.g. nitrate and nitrite - 48 hours; orthophosphate - filter and 48 hours.

[10] Standard Methods for the Examination of Water and Wastewater, 16th Edition, 1985.

[11] Four drops of saturated Zinc Acetate solution (4 grams/10mL) per 100mL of sample and 50% NaOH solution to pH>9.

[12] The presence of sulfide reduces the holding time to 24 hours. Optionally screening for sulfide with lead acetate paper in the field and sulfide removal is required prior to pH adjustment. Sulfide is removed by addition of cadmium nitrate powder until a negative screening test is obtained, followed by filtering. All samples must be adjusted to pH >12 with NaOH after filtering.

[13] Sample preservation should be performed immediately upon sample collection except when specifically allowed by the method. Documentation is inspected at the time of sample receipt to assure samples are properly preserved (See Section 5).

[14] EPA allows the use of HCL or H_2SO_4 as a preservative, but HCl is preferred by GTEL to reduce waste handling costs. Only if analysis is going to be delayed beyond four hours after sampling must samples be acidified and refrigerated. Samples for Method 418.1 need not be refrigerated for up to 48 hours after sampling.

[15] Acid washed containers are not appropriate for nitrate and total nitrogen (N) analyses. Use glass containers ordered with the appropriate cleaning protocol (e.g. for soils, I-Chem V220-0250, or equivalent). Glassware for volatile organics is acceptable for these N analyses.

[16] Samples must be analyzed within 15 minutes of sampling.

[17] 14 days for organics, 28 days for mercury, 180 days for other metals until the leaching step. Additional holding time is allowed after leaching for the sample preparation/extraction and analysis, as per the preservation/holding time guidelines listed for the analytes in water and leachates by SW-846 methods, e.g. metals other than Hg: HNO_3 pH <2, 180 days; or volatiles: Cool 4°C, HCl pH <2, 14 days.

Table 2

Recommended Containers, Preservation, Storage, and Holding Times for Air Analysis

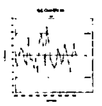
Description	Method	Matrix	Sample Container[1]	Preservation[2]	Prep/Analysis Holding Time*	Minimum Volume
Volatiles in Air	EPA Method 18	Air	Tenax Tubes or Tedlar Bag[1]	Tenax: Cool 4°C; Bags: ambient temperature[2]	Tenax: 14 days* Bags: 72 hrs.	variable[3]
Gasoline Hydrocarbons	GC/FID	Air	Tenax Tubes or Tedlar Bag[1]	Tenax: Cool 4°C Bags: ambient temperature[2]	Tenax: 14 days* Bags: 72 hrs.	variable[3]
BTEX	GC/PID	Air	Tedlar Bag	Bags: ambient temperature[2]	Bags: 72 hrs.*	*1 Liter Air*
BTEX	GC/MS	Air	Tedlar Bag	Bags: ambient temperature[2]	Bags: 72 hrs.*	*1 Liter Air*
Volatiles in Air	EPA TO1	Air	Tenax Tubes[1]/glass	Cool 4°C	14 days*	variable[3]
Asbestos (Air)	NIOSH 7400	Air	Millipore aerosol monitor case or equivalent (permanent slide mount)	None	indefinite	variable

"*" indicates GTEL internal guidance rather than a binding regulatory preservation requirement or holding time. Exceptions may occur in particular states.

[1] Tenax tubes must be sealed and both tubes and bags must be packaged with activated carbon, and segregated from sources of organics.

[2] Keep bags out of direct sunlight and minimize temperature variation in order to prevent condensation.

[3] Caution must be taken to avoid exceeding breakthrough volume of Tenax tubes. Recommendation: take replicate samples at different volumes to demonstrate that breakthrough has not occurred.



5 Sample Custody and Handling

The sample handling procedures discussed below are intended to maintain the integrity of both the samples and the documentation necessary to support the analytical data for evidenciary purposes should the need arise.

Chain of Custody

All client samples analyzed by GTEL are handled as if they are of an evidenciary nature. The possession of samples must be traceable from the time samples are collected in the field until the analysis is completed and samples are released for disposal.

Custody is defined as:

a) In actual physical possession;
b) In the view after being in physical possession;
c) In a locked area after being in physical possession; and
d) In a designated, locked storage area.

GTEL provides sample labels and a Chain of Custody (COC) and Analysis Request Form for use by clients. The COC and all other forms used to document the proper handling of the samples contain a location(s) for appropriate signatures. All individuals who have custody of the sample are required to sign the forms in black ink and date the entry. GTEL provides custody seals upon request.

Formal sample custody begins with the disbursement of pre-cleaned/pre-preserved sampling containers to the sampler. The documents accompanying the shipment of precleaned containers from GTEL should be signed and dated by the recipient to initiate the custody record.

Sample Receiving

Samples will be received only by the Login Staff, who are laboratory personnel properly trained to handle samples of evidenciary nature. Two critical custody related steps occur in the sample receipt procedure and care must be taken to document them properly.

a) Transfer of samples to the laboratory by use of a common carrier will be documented on the COC form and a copy of the shipping documents will become part of the permanent project file.

b) The Sample Custodian (a member of the Login Staff) is responsible for maintaining custody of the samples during the login and distribution processes and for assuring that all records documenting that possession are properly completed and placed in the project file.

Sample integrity upon receipt will be documented by the Login Staff. Primary factors such as the presence of ice or frozen coolant packs in the shipping container with the samples, intact custody seals, and the record of proper preservation are checked. Proper sampling and preservation in the field are the responsibility of the client.

The samples will not be allowed to warm to room temperature during the login and distribution processes. The samples will be secured under lock and key in refrigerated storage. Samples not requiring refrigeration will be kept in locked storage cabinets or locked storage rooms.

Documentation

The primary custody elements which will be completed and/or retained are as follows:

a) Chain of Custody and Analysis Request Form

b) Shipping documents, for example the bill of lading or air bill

c) Internal Chain of Custody Record

d) Sample preparation worksheets.

Sample Identification

Every sample container received by GTEL and every sample generated by sub-sampling in order to allow different analyses to be performed on the same sample will be individually identified by a GTEL sample number as follows:

L9-04-123-01

where:

L = Lab identifier as follows:

M = Milford T = Torrance W = Wichita C = Concord F = Florida

9 = year 04 = month

L9-04-123 = work order number (the 123 is a sequential number which identifies a batch of samples received in the noted month)

-01 = sequential number (01 to 99) identifying each client sample in the batch.

Each replicate sample container for each client sample will be identified by an alpha code (A,B,C...) or set number (1 of 3, 2 of 3 ...).

Sample Tracking and Management

GTEL maintains sample information records in a laboratory information management system (LIMS) computer system. This chronological record will contain all samples received or generated by sub-sampling in order to allow a single sample to be analyzed by different analyses. Any sample sets which have special handling or urgent analysis or holding time requirements will be immediately recorded into a tracking record (or identified on a computer output), assuring that all projects get handled and completed as requested by the client or required by the circumstances.

Confidentiality

Each laboratory will assure that the following procedures concerning confidentiality and security are readily available to all personnel. All new employees will be indoctrinated concerning confidentiality and security procedures within the first week of employment.

1. No client's name, neither a person's name or a company's name, or site location will go on analytical reports unless specifically requested.

2. No client's name, neither a person's nor a company's name, will be written on correspondence or be verbally transmitted in reference to a particular project except to the client, persons named on the Chain of Custody (COC) and Sample Analysis Request Form, or their designated representative.

3. Any request for analytical data or project information by anyone, other than those noted on the COC and Sample Analysis Request Form, will not be fulfilled without a written release by one of the people so designated.

4. Information not on the COC and Sample Analysis Request Form associated with a specific work order will not be incorporated into an analytical report, except by instruction in writing by the client or the client's designated representative.

Security of Project Data and Samples

The following security procedures will be followed:

1. Visitors to GTEL must sign in at the reception area and be escorted while inside the facility.
2. Refrigerators, freezers, and other sample and data storage areas will be kept locked when not supervised.
3. Samples will remain in locked sample storage areas until removed for sample preparation, or analysis, or disposal. Each supervisor will maintain a list of the location of all storage area keys or maintain personal possession of them.
4. The location of the stored samples and/or extracts will be recorded in the sample tracking computer or in the internal COC record.
5. Only the Sample Custodian and supervisory personnel will have keys to the sample storage areas.
6. Managers are responsible for knowing which employees are in the building after hours.
7. Employees are responsible for registering all guests accompanying them.
8. Keys will be issued to individual employees only upon written approval by the employee's immediate supervisor. Keys will be returned by employees during an exit interview.

Electronic Data Records

The computerized data collection and handling systems used by GTEL will assure that each data entry and data file is uniquely identified so that data can reliably be stored and retrieved without loss. Lotus 123 spreadsheets have range protection enabled in order to prevent corruption of ranges with formulas. It is the responsibility of each GTEL laboratory manager to ensure that the computerized data handling systems used within their jurisdiction are sufficiently supervised and are used by sufficiently trained personnel such that data corruption is prevented. Laboratory systems audits will periodically verify the integrity of these programs.

Sample Disposal

Samples and sample extracts will remain in refrigeration or other appropriate storage at least two weeks after the analytical report was mailed. Sample extracts with extended holding times will be maintained properly up to thirty days after reporting. Samples older than thirty days beyond the date of reporting will be disposed. Assigned laboratory personnel are given the responsibility for removing all old samples from the secure storage and assuring of their proper disposal according to the laboratory standard operating procedure for disposal of waste samples. Hazardous samples are explicitly handled as hazardous waste.

6 Analytical Procedures

The analytical procedures used by the laboratory will fulfill the quality assurance objectives. The major methods and method categories covered by this document are described in Table 3, followed by a list of reference documents. The method numbers appear in Table 3 followed by letter tags in parentheses (A, B, C, ...) which refer to the pertinent reference documents. GTEL-specific methods are noted by "GTEL" in parentheses.

Table 3
Method Descriptions

Method (Reference)	Analytes	Instrumentation	Description/Application
EPA 5030/8020 (C), 602 (A)	Volatile Aromatics	GC/PID, P&T, modified for capillary column, some applications have GC/FID as well	Sensitive to benzene, substituted benzenes, and oxygenated compounds, e.g. MTBE, less so to interfering aliphatics. Soils generally performed by methanol extraction (high level by 5030).
EPA 5030/8010 (C), 601 (A)	Volatile Halocarbons	GC/ELCD, P&T, modified for capillary column	Specific to halogenated compounds; subject to interference only by unknown halocarbons. Solids generally performed by methanol extraction (high level by 5030).
EPA 8240, 8260 (C), 624 (A), CLP (J)	Volatile Organics	GC/MS, P&T, modified for capillary column	Discerns most volatile organics, with specific ID by mass spectrometry (MS). Can provide tentatively identified compounds (TICs); slightly less sensitive than by GC. High and low level soil techniques available.
EPA 504 (F)	EDB	GC/ECD, micro-extraction	A volatile organics technique for water, with 20ppt detection limit. Susceptible to interferences. A GTEL-modified technique must be used for soils.
EPA 8270 (C), 625 (A), CLP (J)	Semi-volatile Organics	GC/MS, capillary column	Discerns most organics, with specific ID by mass spectrometry (MS). Can provide tentatively identified compounds (TICs). Less sensitive than by GC or HPLC.
EPA 3550[1]/8310 (C), 610 (A)	Polycyclic Aromatic Hydrocarbons (PAH) or Polynuclear Aromatics (PNA)	HPLC/UV and fluorescence	Very sensitive to high molecular weight aromatics which fluoresce, but compounds usually are not reported below 1 ug/L. Very useful for fuel oil spills.
EPA 3550[1]/8080 (C), 608 (A), CLP (J)	Pesticides and PCBs	GC/ECD	Very sensitive to halogenated compounds, sometimes needs special cleanup to remove interferences.
EPA 600/4-81-045 (X)	PCBs in Oil	GC/ECD	Waste dilution in solvent followed by appropriate cleanup procedures to remove hydrocarbons and/or sulfur.
EPA 3050[2]/6010 (C), 200.7 (B), CLP (K)	Metals	ICP	Sensitive to wide variety of metals, some to the ppb level in water. Interference check samples are used to monitor degree of Fe, Al, etc. interference common in soils.

1 3550 is a sonication extraction for solids; Soxhlet extraction (Method 3540) may be used instead of 3550; 3510, a liquid/liquid extraction followed with concentration, is used for waters

2 3050 is a vigorous acid digestion for soils and sludges; 3010 and 3020 digestion is available for total metals in waters.

Table 3 (continued)
Method Descriptions

Method (Reference)	Analytes	Instrumentation	Description/Application
EPA 3050^2/7000 series (C), 200 series (B), CLP (K)	Metals	AA Spectrometry, Flame, Furnace, Manual Cold Vapor	Graphite Furnace and Cold Vapor techniques sensitive to low ppb level in water. Zeeman background correction necessary for As, Se in certain matrices.
EPA 9000 series (C), 300 series (B) (9010, 335.2)	Various Inorganic Parameters (e.g. Total Cyanide in Water)	method specific, (e.g. Colorimetric)	Colorimetric, etc., techniques dependent on various sample prep and treatment methods to separate samples from matrix and prevent interferences.
EPA 335.2 CLP-M (K)	Total Cyanide in Soil	UV/VIS Spectrophotometry	Colorimetric technique following strong acid distillation.
EPA 9020 (C)	Total Organic Halides (TOX) in Water	TOX Analyzer with microcoulometric detection	Activated carbon adsorption followed by high temperature reduction and detection.
EPA 600/4-84-008, App. D	Extractable Organic Halides (EOX) in Soil	TOX Analyzer with microcoulometric detection	Extraction of soils followed by pyrolysis/microcoulometry. Fluorine containing species are not detected.
EPA 9060 (C), 415.1 (B)	Total Organic Carbon (TOC) in Water	FID or IR Analyzer	Organic/inorganic carbon separation followed by oxidation and detection as CO_2 by IR or as CH_4 by FID.
EPA 418.1 (B)	Total Recoverable Petroleum Hydrocarbons (TPH) in Water	IR Spectrometry	0.5 ppm detection level for water. Silica gel is used to remove biogenic material from the Freon extract. Some loss of volatile hydrocarbons is expected.
SM503 D&E (D)	Total Recoverable Petroleum Hydrocarbons (TPH) in Soil	IR Spectrometry	An exhaustive extraction of soils or sludges by Soxhlet extractor. Otherwise the same as Method 418.1. Significant loss of volatile hydrocarbons expected; as low as 5 ppm detection level if specified.
3550/418.1 (C,B), Sonication Bath/418.1 (GTEL)	Total Recoverable Petroleum Hydrocarbons (TPH) in soil	IR Spectrometry	EPA 3550 sonication extraction or a GTEL sealed-vial sonication is adapted to Method 418.1 Some loss of volatile hydrocarbons is expected, but is minimized by the sealed-vial technique; as low as 5 ppm detection level if specified.
EPA 413.1 (B), EPA 9071 (C)	Total Recoverable Oil and Grease	Gravimetric	For use at greater than 5 ppm in water and 200 ppm in soil. Total of all Freon extractable, non-volatile organics.
EPA 413.2 (B), SM503 B&D (D)	Total Recoverable Oil and Grease	IR Spectrometry	Same methodology as EPA 418.2 except without silica gel to remove biogenic material.

Table 3 (continued)
Method Descriptions

Method (Reference)	Analytes	Instrumentation	Description/Application
CA LUFT (G), mod. EPA 8015 (C)	Gasoline Hydrocarbons	GC/FID, P&T	Purge and trap with capillary or packed column chromatography adapted for quantitation of gasoline in soils and dissolved in water as per California LUFT protocol.
CA LUFT (G)	Diesel Hydrocarbons	GC/FID, capillary column	California LUFT protocol for waters and soils.
GTEL, ASTM (E)	Simulated Distillation Petroleum Profile	GC/FID, capillary column	Product identification and matching technique for product samples, dependent on unique composition of boiling point profile of various products. Modification of ASTM 2887.
GTEL	Hydrocarbon Screen	GC/FID, capillary column	Product identification and quantitation in water and soil based on a source product profile. Some loss of volatiles expected
EPA Method 18 (H)	Volatile Organics in Air	GC/PID/FID	Source monitoring method utilizing solid absorbents or Tedlar bag. Susceptible to usual GC interferences.
EPA TO1 (I)	Volatile Organics in Air	GC/PID/ELCD	Ambient monitoring method utilizing Tenax solid adsorbent. Advantages of selective detectors configured in series to cover all analytes of interest, with very low detection limits.
EPA 1010 (C)	Ignitability	Pensky-Martens Flash Point	Closed-Cup technique for liquids. Can be extended to 200° for DOT classification tests.
EPA 1010 (C), modified	Flash Point of Soil	Pensky-Martens Flash Point, modified	Closed-Cup technique for soils, taken to 160°F. Flashpoint of soils is not regulated by EPA and there is no standard test for Ignitability for soils.
ASTM D4982 (E)	Ignitability of Solid Waste	Bunsen Burner Test	Attempt to ignite the sample is made with a Bunsen Burner. If combustion is sustained, then the sample is positive for ignitability. The EPA has no standard test for ignitability of soils.
EPA SW-846 Section 7.3	Sulfide and Cyanide Reactivity	Colorimetric (9010) and Tritrametric (9030)	Applicable to solid and liquid wastes. Results in value less than or equal to total cyanide and sulfide. Total cyanide and sulfide are acceptable methods for showing wastes are below the regulatory limit.

Table 3 (continued)
Method Descriptions

Method (Reference)	Analytes	Instrumentation	Description/Application
EPA 1311 (W)	TCLP (Toxicity Characteristic Leaching Procedure)	EPA SW-846 methods as required	Leachate procedure followed by analyte specific analysis of the mobility extract to characterize hazardous waste. Special QC as per November 24, 1992 Federal Register. For unique analytes and limits for Land Disposal Restrictions (CCWE) prior notification is required.
EPA 9040, 9045 (C)	pH, Corrosivity	pH Electrode	Direct reading electrode method; 1:1 reagent water paste for soils.
EPA 9076 (C)	Total Halide in Waste Oil	Combustion/ Microcoulometric	Determines total halide to meet the waste oil burning regulations.
SM 907C (D)	Standard Plate Count	Membrane Filter Technique	Filters retaining bacteria are cultured and counted.
EPA 9132 (C)	Total Coliform in Water	Membrane Filter Technique	Filters retaining bacteria are selectively enriched and cultured, followed by colony count.
EPA 300.0 (B)	Inorganic Anions in Water, (Total Halide in Oil and Soil)	Ion Chromatography (IC), (Parr Bomb-IC)	Aqueous solutions are prepared and evaluated directly with suppressed IC. (Parr Bomb prep for oils and petroleum contaminated soil, with summing of Cl^-, Br^-, and I^- by IC.).
EPA (T) Interim Method	Bulk Asbestos in Building Materials	Polarized Light Microscopy - Dispersion Staining (PLM-DS)	Positive identification of asbestos, by morphology, color and pleochroism, index of refraction, birefringence, and/or extinction characteristics of elongation. Estimation of % content.
NIOSH 7400 (U)	Asbestos in Air	Phase Contrast Microscopy	Quantitation by count of asbestos and other fibers greater than 0.25um in diameter collected on filters.

Laboratory Reference Documents

A. Organics in water EPA Methods 601, 602, 608, 610, 624 and 625: "Test Procedures for Analysis of Organic Pollutants", Code of Federal Regulations, 40CFR Section 136, Appendix A (most recent edition).

B. Metals in water, inorganic parameters, oil and grease, and petroleum hydrocarbons: Methods for Chemical Analysis of Water and Waste, EPA-600/4-79-020, USEPA EMSL, Cincinnati, OH, Revised, March 1983, including Method 300.0, EPA-600/4-84-017, March 1984.

C. Metals and organics in soils and mobility extracts; metals and organics in groundwater for RCRA compliance; hazardous material characterization: Test Methods for Evaluating Solid Waste, SW-846, 3rd edition, USEPA OSW, Washington, D.C., November 1986, including update 1, November, 1990.

D. Pesticides, wet chemistry, and petroleum hydrocarbons in waters, soils and sludges: Standard Methods for Examination of Water and Wastewater. 16th edition, American Public Health Association, 1985.

E. General organic, inorganic, and physical methods: Annual Book of ASTM Standards, Vols.11.01 and 11.02 for water, Vols. 5.01, 5.02, 5.03, 5.04 for petroleum products, Vol. 11.03 for Occupational Health and Safety. American Society for Testing and Materials, Philadelphia, PA. The most current version is usually cited.

F. Organics in water (drinking water): Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water, USEPA EMSL, Cincinnati, OH, September 1986.

G. Organics, TPH by gas chromatography, and toxics in soil and groundwater: Leaking Underground Fuel Tank (LUFT) Manual, State of California Water Resources Control Board, October 1989 Revision.

H. Air sampling and analysis methods organics and toxics, ambient air and stationary sources: Quality Assurance Handbook for Air Pollution Measurement Systems, Volume I, II, and III, including Section 3.16, EPA/600/4-77/027a,b,c, USEPA EMSL, Research Triangle Park, NC, August 1988.

I. Organics in ambient air: Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA-600/4-84-041, USEPA EMSL, Research Triangle Park, NC, April 1984, including Supplements, September 1986.

J. Organics in water and soil: USEPA Contract Laboratory Program Statement of Work for Organics Analysis, OLM01.8, August 1991, or most recent version.

K. Inorganics in water and soil: USEPA Contract Laboratory Program Statement of Work for Inorganics Analysis, ILM02.0, or most recent version.

L. Microbiological analysis of water and wastes: Microbiological Methods for Monitoring the Environment, EPA-600/8-78-017, USEPA EMSL, Cincinnati, OH, December 1878.

M. General and clinical analytical practices: Good Laboratory Practices Manual, PB88-180708, USFDA, St. Louis, MO, November 1987

N. Toxics research laboratory practices: Good Laboratory Practice Standards, 40 CFR, Part 792, USEPA, 1988 edition.

O. Laboratory QA/QC practices: Handbook for Analytical Quality Control in Water and Wastewater Laboratories, EPA-600/4-79-019, USEPA EMSL, Cincinnati, OH, March 1979.

P. Calibration for organics in air: Standard Operating Procedure for the Preparation and Use of Standard Organic Mixtures in a Static Dilution Bottle, EMSL/RTP-SOP-MDAD-036, USEPA EMSL, Research Triangle Park, NC, September 1987.

Q. General analytical practices and specifications: Manual for the Certification of Laboratories Analyzing Drinking Water, EPA-570/9-90-008, USEPA EMSL, Cincinnati, OH, October 1991.

R. QA practices, organics in soil and water: Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analysis, USEPA Hazardous Site Evaluation Division, Washington, D.C., February 1988.

S. QA practices, inorganics in soil and water: Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analysis, USEPA Hazardous Site Evaluation Division, Washington, D.C., July 1988.

T. Analytical techniques for bulk asbestos in building materials: 40 CFR, Part 763 (F), App. A.

U. Analytical techniques for occupational health and OSHA compliance: NIOSH Manual of Analytical Methods, 3rd Edition, February 1984, NIOSH, Cincinnati, OH, including 1985 and 1987 supplements.

V. Extractable Organic Halides in Solids: Development and Evaluation of Methods for Total Organic Halide and Purgeable Organic Halide in Wastewater, App. D, R.M. Riggin, et al, US EPA Contract #68-03-2984, 600/4/84-008, June 1983.

W. TCLP: Federal Register, June 29, 1990 and Federal Register, November 24, 1992

X. T. Bellar and J. Lichtenburg, "The Determination of Polychlorinated Biphenyls in Transformer Fluid and Waste Oils". EPA 600/4-81-045, September 1982.

Standard Operating Procedures

Standard operating procedures will be written and maintained for each standard operation used by the laboratory. SOPs will be available in the laboratory for the analysts. The Quality Assurance Manager will be responsible for carrying out the record keeping and document control procedures for the SOPs.

Method Start-up QC

As a minimum, when a new instrument is brought into service, a new standard method is implemented, and after an analyst receives training, four spikes of known concentration will be analyzed in reagent water or a blank solid matrix and the results approved by the Quality Assurance Manager. This analyst approval, all calibration and QC procedures specified by the QA Manual and pertinent SOPs, and a detection limit study will be in place before commercial sample analysis begins.

Glassware Cleaning

Glassware cleaning procedures meet EPA requirements and will be posted in the glassware cleaning areas.

Required Equipment

Overall analytical system quality begins with the timely acquisition of high quality equipment to assure efficient operation of the laboratory. GTEL will purchase equipment and supplies that meet or exceed the specifications of the analytical methods. Glassware, reagents, gases and replacement parts for analytical instruments will be purchased from reputable suppliers with a history of quality customer service. All supplies and reagents will meet or exceed the specifications set forth in the method or as recognized by professional groups, such as the American Chemical Society (ACS), American Society for Testing and Materials (ASTM), and the Association of Official Analytical Chemists (AOAC).

Facilities, Safety, and Environmental Factors

Factors in the environment of the laboratory affect the proper and safe functioning of equipment, and chemical procedures. Every GTEL facility will be designed and maintained such that the environmental specifications of the respective instrument manufacturers are met. Safety and design features provide an environment conducive to efficient and effective work on the part of analysts.

Prevention of Cross-Contamination

Design features which are intended to control cross contamination include the physical separation of extractable and volatile organics operations, the installation of hoods and air handling equipment in order to vent vapors out of solvent and sample handling areas, and segregated sample storage areas. Measures for monitoring and controlling cross-contamination are itemized in each method standard operating procedure (SOP).

Sample and Reagent Storage Temperature Monitoring

For storage of aqueous reagents and samples requiring refrigeration, a standard household or commercial refrigeration unit may be used. However, for storage of organics dissolved in flammable materials, an explosion-proof model should be used. The refrigerator shall maintain an internal temperature of 1° to 4°C (34° to 40°F) throughout the compartment. Freezers used to store volatile organic standards shall maintain an internal temperature of -10° to -20°C (14° to -45°F) throughout their compartments. The temperature of each refrigeration unit is recorded daily from in-place thermometers or thermocouples.

Waste Disposal

All GTEL employees are responsible for ensuring that hazardous wastes generated in their areas are properly labelled, handled, stored and disposed. For the safety of the persons responsible for transfer of hazardous wastes for ultimate disposal, any wastes which are not properly labelled, or are in any way unsafe to transport, will not be removed from the areas in which they are generated.

7 Calibration Procedures

Tolerances maintained in calibration are specific to the analytical methods used for particular regulatory purposes. Specific procedures for individual instruments and analytical methods are not delineated in this document. Two types of calibration are discussed, operational and periodic. Operational calibration is performed as necessary to maintain the instrument calibration within a specified tolerance. The operational calibration program involves initial calibration, QC check samples, and continuing calibration verification. Periodic calibration is carried out at a specified frequency for general purpose equipment, such as analytical balances. Notification of a supervisor of a failure of calibration and of any corrective action taken is required.

Operational Calibration Records

A bound notebook will be kept by the analyst for every instrument covered by this plan. This notebook will contain a record of each analysis, calibration, sample analysis and QC performed. Each of the following will be assembled chronologically by instrument and stored together as a laboratory record or entered in its entirety into the instrument notebook:

a) calibration data;
b) calibration verification data; and
c) method blank data.

Periodic Calibration Records

A record of all routine checks and the results of any adjustments made during periodic calibration will be maintained in a bound notebook for each piece of equipment which receives this type of calibration.

Traceability of Calibration Reference Materials

Calibration reference materials for organic analysis will be a minimum of 97% purity from a reputable supplier. Reference materials used to generate quality control samples (used to verify calibration) will be from a source independent of the calibration standards, or if not available from a reliable independent source, will be from stock standards prepared separately from calibration standards.

Low ppb level calibration standards for metals are to be prepared fresh daily with dilutions of ppm level standards. These stock standards are prepared by dilution of commercially available 1000 ppm stock solutions. Standards from a source independent from the calibration standards will be used for initial calibration verification.

In addition to maintenance of the records of the source of the calibration standards and QC reference materials, traceability to the NBS or EPA will be maintained. To the degree that NBS or EPA reference materials are available, either the calibration materials or the QC reference materials will be traceable to these sources.

Standards Preparation

In order to assure the accuracy of standards the following guidelines will be followed:

a) The best available solvent will be used. A reagent blank analysis on the solvent (by lot number) will be on file, verifying the absence of analytes of interest;
b) ACS reagent grade or better chemicals will be used;
c) Only Class A volumetric glassware and fixed-volume pipettors will be used;
d) Only properly calibrated balances, pipettors and other general laboratory equipment will be used, as verified by the periodic calibration records; and
e) Only dedicated glassware, pipets, and syringes will be used for standards preparation.

Generation and Acceptance of a Standard Curve

The standard curve is generated by the analysis of a reagent or method blank and a series of standard solutions over a concentration range appropriate for the samples to be analyzed. The number and concentration of calibration standards required is specific to the method. A minimum of three standards is necessary to demonstrate linearity.

The key characteristics to be evaluated for acceptance of the curve are as follows:

a) the degree of variation of the response factor with concentration (i.e. curvature);
b) the working range of the curve;
c) the consistency of the response factor with past experience;
d) the sensitivity of the response as it relates to detection limit and system performance requirements; and
e) the blank bias.

8 Preventative Maintenance

The objective of preventative maintenance is to produce stability and reliability in the laboratory operation. It is a management tool which has a direct bearing on the efficiency and productivity of the laboratory. Each laboratory has a preventative maintenance program outlined for instruments and each procedure performed is documented when it is completed.

9 Quality Control

The internal quality control checks routinely implemented by the laboratory are described in this section.

QC Frequency

Table 4 defines the minimum frequency of quality control samples for particular analyses and regulatory programs. If the project or contract requirements are more stringent than those listed, then the more stringent requirements are followed. The frequencies are associated with the term "EAB", which indicates that as a minimum each analytical batch will contain one QC sample, or contain QC samples at the prescribed frequency, which ever is more frequent. When the method requirement is for 10% for matrix spikes, the laboratory will use matrix spike/matrix spike duplicate pairs on 1 in 20 samples (EAB/5%), or single matrix spikes in 1 in 10 samples (EAB/10%) for fulfilling the 10% frequency.

Method QC is evaluated with quality control samples taken through the entire sample preparation, extraction, or digestion. Depending on the client request, method QC is either "batch QC" or "project-specific QC," with batch QC being the default protocol. For "batch QC," the method QC samples for the analytical batch may be selected from samples of the same matrix from only one of several projects processed at the same time in order to meet the QC frequency requirements for the entire batch. For "project-specific QC," the QC samples are selected from the project samples at the prescribed frequency. For project-specific QC, the customer typically pays for the method quality control results on the basis of the number of QC samples reported.

For each instrumental run, particularly if more than one instrument is used to complete the analysis a sample preparation batch, a "batch QC" matrix spike or duplicate, a QC check sample, or a matrix spike into reagent water (MSB) will be substituted to fulfill the batch QC frequency requirement. For GC/MS analysis for semi-volatiles (water and soil) and volatiles (medium/high level soil), each analytical run for each instrument used for each extraction batch will also contain an injection of the extraction blank for the batches being analyzed because spectral interpretation of peaks found in the blank can be sensitive to instrumental variation.

Control Limits for QC Elements

The control limits for method and instrument control are set at levels published in the source method, or are set by laboratory practice if an authoritative source is not available. The tolerances for instrument operation are not to be changed without the approval of the Quality Assurance Manager. For method control elements (blank, matrix spike, laboratory duplicate or matrix spike duplicate, surrogate spike, laboratory control sample, QC check sample, and method detection limit) statistical evaluation is often the source for the control limits.

Reagent Water Quality

Reagent, analyte-free or laboratory pure water means distilled or deionized water meeting the specifications of ASTM Type II reagent water. This water will be free of contaminants that may interfere with the analytical test in question. The ion chromatography analysis requires a resistivity of 18 megohm-cm.

Procedures to Assess Data Quality

Any statistical control limits used are determined at the 99% confidence level. The evaluation of control limits will be made after no less than twenty points are accumulated. Updates will be made at least once per year. When a system is under statistical control any of the following trends will result in corrective action.

a) 7 ascending consecutive QC results;
b) 7 descending consecutive QC results; and
c) 7 consecutive results on one side of mean (central) line.

TABLE 4

Frequency of Method Quality Control Samples

Analytes	Methods	Method Blanks	Lab Duplicate	Matrix Spike	Surrogates	QC Check
Hydrogen ion (pH), alkalinity	150.1, 310.1	N/A	EAB/5%[1]	N/A	N/A	EAB/10%[1]
Residue - TSS, TDS	160.2, 160.1	EAB[1]	EAB/5%[1]	EAB/5%[1]	N/A	EAB/10%[1]
AAS Metals	200+ Series 7000+ Series	EAB[1]	EAB/5%[1]	EAB/5%[1]	N/A	EAB/5%[1,4]
ICP Metals	200.7, 6010	EAB[1]	EAB/5%[1]	EAB/5%[1]	N/A	EAB/5%[1,4]
Misc. Inorganics for Drinking Water Compliance Monitoring	200/300/400 Series	EAB[1]	EAB/10%[1]	EAB/10%[1]	N/A	EAB/5%[4]
Misc. Inorganics	300/400 Series 9000 Series	EAB/[1]	EAB/5%[1]	N/A	N/A	EAB/5%[1,4]
Cyanide	335.2,9010	EAB[1]	EAB/5%[1]	EAB/5%[1]	N/A	EAB/5%[1,4]
BOD	405.1	EAB[1]	EAB/5%[1]	N/A	N/A	EAB/10%[1]
Oil and Grease	413.1, 413.2	EAB[1]	EAB/5%[1]	EAB/5%[1]	N/A	EAB/5%[4]
TOC, COD	415.1, 410.2	EAB[1]	EAB/5%[1]	EAB/5%[1]	N/A	EAB/10%[1]
Petroleum Hydrocarbons	418.1	EAB[1]	EAB/5%[1]	EAB/5%[1]	N/A	EAB/5%[4]
GC - volatiles	502.1, 502.2, 503.1	Daily	EAB/5%[1,2]	EAB/5%[1,2]	100%	EAB/5%[1]
EDB	504.1	Daily	EAB/5%[1,2]	EAB/5%[1,2]	100%	EAB/5%[1]
GC-volatiles	601,602, 8010,8020	EAB[1]	EAB/5%[1,2]	EAB/5%[1,2]	100%	1%[3]
GC-Pest. & PCBs	608,8080	EAB[1]	EAB/5%[1,2]	EAB/5%[1,2]	100%	1%[3]
HPLC-PAH	610,8310	EAB[1]	EAB/5%[1,2]	EAB/5%[1,2]	100%	1%[3]
GC/MS-volatiles	624,8240	EAB/[1]	EAB/5%[1,2]	EAB /5%[1,2]	100%	1%[3]
GC/MS Semi-volatiles	625,8270	EAB[1]	EAB/5%[1,2]	EAB/5%[1,2]	100%	1%[3]
TOX, TOC	9020,9060	EAB[1]	EAB/5%[1]	EAB/5%[1]	N/A	EAB/5%[1,4]
pH (soil)	9045	N/A	EAB/5%[1]	N/A	N/A	N/A
Organic Lead	Calif. LUFT	EAB[1]	EAB/10%[1]	EAB/10%[1]	N/A	EAB/5%[1,4]
Standard Plate Count	SM 907C	EAB[1]	100%	N/A[5]	N/A	N/A[5]
Total Coliform	SM 909, EPA 9132	EAB[1]	10%	N/A[5]	N/A	N/A[5]
Gasoline Hydrocarbons	Mod. 602, 5030/8020	EAB[1]	EAB/5%[1,2]	EAB/5%[1,2]	100%	1%[3]
Diesel Hydrocarbons	Mod. CA LUFT	EAB[1]	EAB/5%[1,2]	EAB/5%[1,2]	100%	1%[3]
Petroleum Hydrocarbons	3550 + 418.1	EAB[1]	EAB/5%[1,2]	EAB/5%[1]	N/A	EAB/5%[1,4]
Petroleum Hydrocarbons	9073 (draft) or SM 503 D+E	EAB[1]	EAB/5%[1]	EAB/5%[1]	N/A	EAB/5%[1,4]
Petroleum Profile	ASTM D2887	EAB[1]	EAB/5%[1]	N/A	100%	EAB10%[1]
Ignitability	EPA 1010	N/A	EAB/5%[1]	N/A	N/A	EAB/5%[1]

TABLE 4 (continued)

Frequency of Method Quality Control Samples

Analytes	Methods	Method Blanks	Lab Duplicate	Matrix Spike	Surrogates	QC Check
Corrosivity	EPA 9040	EAB[1]	EAB/5%[1]	N/A	N/A	EAB/5%[1]
Reactivity	SW 846, Sec. 7.3	EAB[1]	EAB/5%[1]	N/A	N/A	EAB/5%[1]
EPTOX/TCLP	EPA 1310	EAB[1,11]	5%	N/A[7]	N/A[7]	N/A[7]
AAS Metals	200-CLP	EAB[1]	EAB/5%[1]	EAB/5%[1]	N/A	EAB/5%[1,4]
ICP Metals	200.7-CLP	EAB[1]	EAB/5%[1]	EAB/5%[1]	N/A	EAB/5%[1,4]
Cyanide	335.2-CLP	EAB[1]	EAB/5%[1]	EAB/5%[1]	N/A	EAB/5%[1,4]
GC-Pest & PCBs	608-CLP	EAB[1]	EAB/5%[1,2]	EAB/5%[1,2]	100%	1%[3]
GC/MS volatiles	624-CLP	EAB[1]	EAB/5%[1,2]	EAB/5%[1,2]	100%	1%[3]
GC/MS Semi-volatiles	625-CLP	EAB[1]	EAB/5%[1,2]	EAB/5%[1,2]	100%	1%[3]
Asbestos (Bulk)	EPA Interim Method	N/A	10%[8]	N/A	N/A	NA[8]
Asbestos (Air)	NIOSH 7400	EAB[1]	10%[9]	N/A	NA	N/A
Volatiles in Air, Tedlar Bag	EPA Method 18	EAB[1]	EAB/5%[1]	N/A	100%	EAB/5%[1]
Volatiles in Air, Tenax Tube	EPA TO1, TO3	EAB[1]	EAB/5%[1,10]	EAB/5%[1,10]	100%	EAB/5%[1]

[1] EAB/5% = one QC sample for each analytical batch or 5%, which ever is larger. N/A = Not Applicable.

[2] Duplicate matrix spikes may replace duplicate samples, changing a 10% matrix spike frequency from one matrix spike per ten samples to one matrix spike/matrix spike duplicate pair per twenty samples.

[3] QC Check Samples will also be analyzed after every matrix spike outside of control limits.

[4] Laboratory control samples for method QC; these methods also require one QC check sample, which does not go through digestion, per initial calibration.

[5] Quantitative checks (spikes) are not possible. However, qualitative checks are necessary as follows: confirmation of identity is required on the basis of multiple-tube fermentation or other confirmation at the rate of 10%. Media QC is performed with both positive and negative organisms for each stock prepared and at least once per month.

[6] Method 504 for EDB does not require a surrogate spike.

[7] QC is performed with the analysis of leachates as established by the individual methods.

[8] Quantitative determination not applicable. Refractive index 1.68 with Amosite permanently mounted serves as a QC check for color dispersion weekly. Other permanently mounted asbestos types must be available for comparison with types found in each analytical batch.

[9] Duplicate counts by second analyst.

[10] Three replicate Tenax tubes must be supplied from the field.

[11] The batch blank for leachate analysis is an untumbled reagent blank starting with the appropriate extraction fluid. Each leaching vessel used will have a reagent blank tumbled in it once every twenty runs to evaluate the effectiveness of cleaning of the vessels.

Precision

The precision of laboratory test results will be expressed as the relative percent difference (RPD) for duplicates. RPD is derived from the absolute difference between duplicate results, D_1 and D_2, divided by the mean value of the duplicates as follows:

$$RPD = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} \times 100$$

When the RPD is calculated for matrix spike duplicates, the percent recovery is used for the values D_1 and D_2. The results for duplicates near the detection level usually are not used to determine method control because such results cannot be compared to control limits established for higher concentration levels.

The control limit for RPD is computed as follows:

$$UCL = 3.27 \times \overline{RPD}$$

where: $\overline{RPD}$ = Mean Relative Percent Difference (mean relative range)

Accuracy

Accuracy for the laboratory will be expressed as the average percent recovery of spiked samples as follows:

$$R = \frac{SSR - SR}{SA} \times 100$$

where:

R = % Recovery

SSR = spiked sample result

SR = sample result

SA = amount of spike

The accuracy interval for QC limits is computed as follows:

$$Accuracy\ Interval = Mean\ Recovery \pm 3 \times S$$

where: S = Standard deviation for individual recovery values

Representativeness

Representativeness is evaluated by comparison of analytical results for separately procured duplicate samples or field duplicates. Inhomogeneous samples impair the ability of the sampling and analytical processes to generate representative data. Representativeness is also evaluated through systems audits which establish that the procedures to protect the integrity of samples are being followed.

Completeness

Completeness is evaluated by dividing the total number of unqualified data points obtained by the maximum number of data points possible and expressing the ratio as a percent.

Comparability

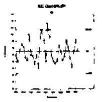
Comparability is evaluated for most of the common analyses in the inter-laboratory performance evaluations and split samples carried out by the EPA, state agencies, and GTEL clients. The laboratory, in its audit program, also collects comparability data for the various GTEL facilities in the form of blind sample results, accuracy and precision statements, detection limit study results, and evaluations of modifications of standard methods.

Method Detection Limit and Reporting Limits

The method detection limit (MDL) will be determined for all analyses on an annual basis. For methods operating under this document the **Method Detection Limit (MDL)** will be defined according to Test Methods For Evaluating Solid Waste, SW-846, Third Edition, Revision 1, December, 1987.

> "The minimum concentration that can be measured and reported with 99% confidence that the value is above zero."

It is approximately 3 times the standard deviation of a set of seven replicates at a concentration very near (within 5 times) the detection limit. The MDL is used to judge the significance of a single measurement of a future sample, and defines a limit above which false positives are very unlikely. Due to sample-specific variations and inherent variability in the MDL determination itself, GTEL provides a reporting limit slightly above the MDL levels determined by each separate GTEL laboratory. In this way GTEL also makes available uniform reporting limits across all GTEL laboratories, called the "default reporting limits." Custom reports which are suitable for particular regulatory purposes are available using other reporting levels besides the GTEL default reporting limits.



10 Data Collection, Reduction, and Reporting

The data collection, reduction, validation, and reporting protocols described below are critical to the quality assurance program. The data flow is summarized in Figure 2.

Data Collection

A record of all analyses will be recorded in a bound notebook. The following information must be included for each analysis:

a) Analyst's signature (once per analytical batch);

b) Date;

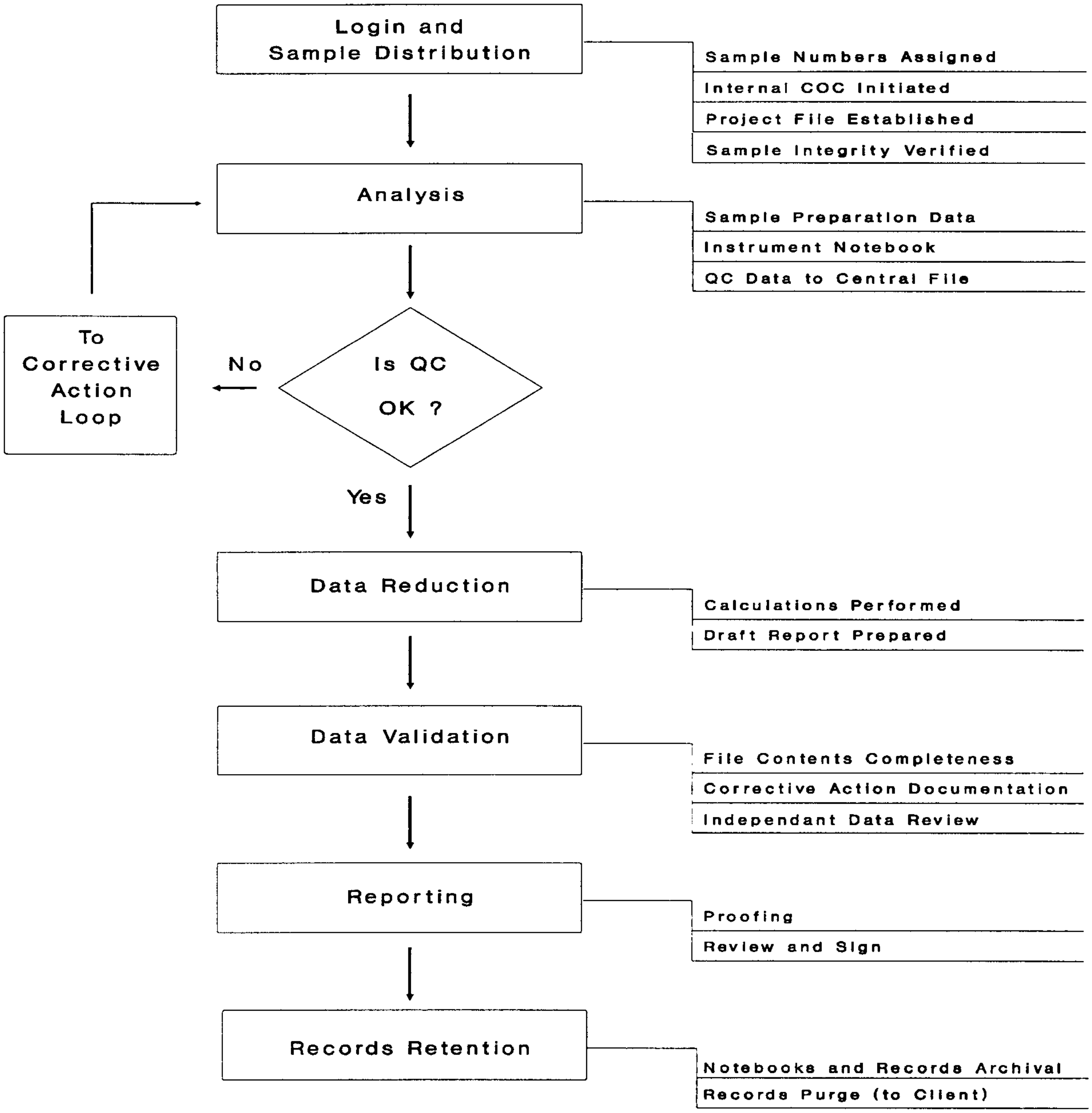
c) GTEL laboratory sample number (the work order number and dash number); and

d) Any undocumented or non-standard analysis set-up conditions, e.g. dilutions, auto-sampler position number, or other instrument conditions not covered by an SOP or instrument print-out.

For instrumental analysis, the analysis notebook will be instrument-specific and referred to as an instrument log. For other types of analysis, this logbook will also contain all raw data collected by the analyst. Any blank sections left open on a page will be crossed out.

Figure 2

GTEL DATA FLOW



Data Reduction and Reporting Conventions

In order to make data for solids comparable, regardless of the whether they are reported on a wet-weight or dry-weight basis, the percent solids will also be reported. The default convention is to report on a wet-weight ("as is") basis. Percent solids will be reported to the nearest tenth percent. The default units convention for solids is mg/kg.

In general, the data will be rounded to two significant figures. Data near the detection limit will usually be rounded to one significant digit.

Quality control results are not reported except when requested. The mean value of duplicate results will not be reported or used in the computation of percent recovery, except as noted on the report. Any analytical results for method quality control samples reported (blanks, spikes, surrogates, duplicates) will be reported in the same units as the customer samples. The rounding of the calculated results for quality control will be as follows:

Inorganics/Metals -	RPD:	nearest tenth percent
	Percent Recovery:	nearest tenth percent
Organics -	RPD:	nearest whole percent
	Surrogate and MS/MSD Percent Recovery:	nearest whole percent

Blank Correction

Any analytical result which is greater than ten times the blank value normally will be considered unbiased and no correction or indication of the presence of blank contamination will be made. Blank results below the reporting limit are generally considered acceptable. Routine analyses will not be corrected for blank bias by means of subtraction.

A corrective action will be taken if the blank exceeds the level of the reporting limit for a sample batch, or any question arises regarding whether blank contamination at any level has caused a sample result above the reporting limit. If the problem is correctable by reanalysis, the affected samples will be re-analyzed. If the problem is not correctable, then the reporting limit for that analyte will be raised, for both the samples and the blank, to a level approximately two times the standard reporting level, and all of the results for that sample batch will be flagged, indicating that the elevated reporting limit is the result of an elevated blank level for that analyte. In certain instances, raising the reporting limit to as high as ten times the blank could be justified (Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses, pp. 12-14, U.S. EPA, February 1988).

Data Validation

Data validation involves the checking of data quality and documentation. The data validation practices described will be followed to insure that data are not altered and that an audit trail is developed in the data reduction and reporting process. Data validation requires the use of the following:

a) Dated and signed entries on worksheets and in log books used for all samples;
b) The use of sample tracking and numbering systems to logically follow the progress of samples through the laboratory; and
c) The use of quality control criteria to reject or accept specific data.

The supervisor, or an independent analyst designated by the supervisor, will review the data and recalculate a minimum of 5 percent of the results on each report. These individuals will be responsible for determining whether or not the results are acceptable using the quality control criteria set forth in the method and this plan. Descriptions of problems encountered in the course of analysis and validation, along with corrective actions taken, will be documented. All changes of file contents by the analyst or data reviewer are initialed, dated, and briefly explained. Changed entries shall be crossed out with a single line and no white-out will be used.

Documentation Reported

Standard laboratory reports will contain, as a minimum, the following information:

a) Identification of the laboratory;
b) GTEL sample ID number;
c) Client sample identification;
d) Date sampled;
e) Date analyzed;
f) Date of extraction, if applicable to the verification of sample integrity;
g) Parameters measured;
i) Units in which each parameter is reported;
j) Analytical methods used, including annotation of any modifications used;
k) Reporting limits;
l) Certification statement by the person responsible for validation of the data concerning sample integrity and QC acceptance; and
m) A copy of the Chain of Custody form.

Report Revisions

Any revised/reissued report will be accordingly annotated. All reissues involving a change in a datum value will be reviewed by the Quality Assurance Manager or designee. A written justification for the change shall be included in the project file.

Records Retention

All hardcopy data output, custody records, worksheets, and other project records will be stored together in a single secure location indexed by project workorder number. The retention period will not be less than three years, or as governed by local, state and government agencies.

11 Corrective Action

The means by which the laboratory discovers, tracks, and completes the investigation of suspected data quality and service problems is described in this section.

Accountability for Corrective Action

The investigation of suspected data quality problems is initiated as a result of quality control criteria being exceeded, audit findings indicating systematic problems, or as a result of client inquiries. The laboratory Section Manager serves as the focal point for project-specific and instrument-specific problems. The laboratory Quality Assurance Manager serves as a focal point for systematic problems potentially affecting more than one project.

Corrective action at the analytical level will be initiated by the analyst or supervisor (or designee performing data review) and documented in the project folders for all samples affected. All analytical problems specific to a particular project or batch of samples will be corrected by the analyst if possible. Results of the action will be approved by the Laboratory Manager or Supervisor.

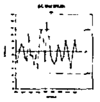
By maintaining surveillance over accuracy and precision statements, system and report audits, and client complaints, the Quality Assurance Manager will detect and correct systematic problems which have been overlooked by the laboratory supervisors in the course of daily work. All client complaints regarding data quality and operational quality (for example turn-around times) will be reported to the Quality Assurance Manager and summarized/prioritized for the Laboratory Director.

All laboratory-caused problems, internal and client related, will be documented and brought to resolution in a timely fashion. The Technical and QA Managers are accountable for the timeliness of corrective action. Any QA Manual compliance issues which are not corrected in a timely fashion will be reported to the General Manager by the QA Manager.

Completion of Corrective Action

Specific examples of required corrective actions are as follows:

a) Calibration and QC check sample failures are corrected prior to analyzing samples.
b) If spiked sample results or surrogates are outside of the acceptability limits, integration, calculations, solutions, and instrument performance are checked and corrected if necessary. Samples are re-prepared and/or re-analyzed as necessary to remove the defect or else the data are flagged.
c) If regulatory holding times for samples or re-analyzed samples have been exceeded, the analytical results will be submitted with a clear indication in the report that the holding times were exceeded.



12 Performance and System Audits

Audits measure laboratory performance against client requirements and ensure compliance with regulations and certification programs.

External Audits

It is GTEL's policy to cooperate fully with on-site inspections and performance samples submitted by certifying agencies and customers. As a minimum, the GTEL laboratories each participate in the performance sample audits conducted semi-annually by the EPA.

Systems Audits

Systems audits are a primary responsibility of the Laboratory Quality Assurance Manager and the corporate QA Director. Systems audits evaluate compliance of procedures and documentation in the laboratory with the QA Manual and SOPs. As a minimum, items covered are method compliance, sample custody, calibration and instrument maintenance history, method and instrument quality control, data reduction and calculations, data validation, method start-up QC, and records. Representative analytical projects are reviewed from inception to completion. Representative methods of each type of analysis will be audited at least annually.

Report Audit

Report audits are performed routinely by the Laboratory Quality Assurance Manager at a minimum rate of 1 in 20, and evaluate the correctness, completeness, and appearance of the laboratory reports. Report audits are performed by the corporate QA Director to assure that consistent quality and content is being delivered to clients from all of the laboratories.

Blind Sample Audits

Double-blind sample audits are performed by submitting a sample of known concentrations through ordinary sample handling procedures and comparing the reported concentrations with the known values. Blind sample audits, as opposed to double-blind audits, are only different in that the analyst is aware of the performance sample, but still is not allowed to know the true value. Blind or double-blind sample audits are to be carried out at least once annually covering representative methods of each type (GC volatiles, GC semi-volatiles, GC/MS volatiles, GC/MS semi-volatiles, metals, inorganics, hazardous waste characteristics).

* * *

13 Quality Assurance Reporting

Quality assurance reporting documents the quality control and quality assurance activities in the laboratory and provides a communication and accountability link among analysts, management and clients.

Report QC Deliverables

The standard analytical report includes no quality control documentation. However, a certification that all QC requirements were met is signed by the manager responsible for the report. The elements of reports for clients needing quality control documentation are determined by the application. Two examples are the QC summaries dubbed "Blue Level" by GTEL or full CLP Level packages. The specific QC requirements and deliverables should be determined prior to the initiation of sampling and analysis.

Periodic Reports

Certain projects under regulatory review require establishment of explicit quality assurance objectives and periodic summaries of QC conformance and corrective action. The laboratory technical and quality assurance staff will provide any information required to establish and document achievement of the quality assurance objectives for particular projects.

Reports to Management

The Quality Assurance Manager will submit a biweekly summary of QA activities to the Laboratory Managers, Laboratory Director, and Corporate Quality Assurance Director. The QA Director in turn summarizes the status of corrective actions and quality improvement initiatives for the General Manager.

* * *

APPENDIX 1

Definitions of Acronyms and Abbreviations

AAS -	atomic absorption spectrometry
ASTM -	American Society of Testing and Materials, Philadelphia, PA
BN -	base neutral extractable
BNA -	base neutral/acid extractable
BOD -	biochemical oxygen demand
BTEX -	benzene, toluene, ethyl benzene, total xylenes
CCC -	calibration check compounds
CCV -	continuing calibration verification
CLP -	US EPA Contract Laboratory Program
COC -	chain of custody form
COD -	chemical oxygen demand
DI -	deionized water
EAB -	each analytical batch
ECD -	electron capture detector
EDB -	ethylene dibromide (1,2-dibromoethane)
ELCD -	electrolytic conductivity detector
EPA -	US Environmental Protection Agency
FID -	flame ionization detector
GC/MS -	gas chromatography/mass spectrometry
GC -	gas chromatography
GFFA -	graphite furnace atomic absorption spectrometry
GTEL -	GTEL Environmental Laboratories, Inc.
HPLC -	high pressure liquid chromatography
kg -	kilogram
IC -	initial calibration
ICP -	inductively coupled plasma spectrometry
ICS -	interference check sample for ICP
ICV -	initial calibration verification
IR -	infrared spectrometry
L -	liter
LCS -	laboratory control sample (matrix spike into the blank matrix for the method, usually DI water)
LIMS -	laboratory information management system (computer system)
MDL -	method detection limit
mg -	milligram
mL -	milliliter
MS/MSD -	matrix spike/matrix spike duplicate
MTBE -	methyl tert-butyl butyl ether
NIST -	National Institute of Science and Technology (formerly NBS - National Bureau of Standards)
P&T -	purge and trap
PAH or PNA -	polynuclear aromatic hydrocarbons
PCBs -	polychlorinated biphenyls
PID -	photoionization detector
PQL -	practical quantitation limit
QC -	quality control
QCCS -	quality control check sample
RF -	response factor
RL -	reporting limit
RPD -	relative percent difference
RRF -	relative response factor
RSD -	relative standard deviation
SD -	standard deviation
SM -	Standard Methods for the Examination of Water and Wastewater, 16th ed, APHA, 1985
SOP -	standing operating procedure
SOW -	CLP statement of work
SPCC -	system performance check compounds
SRM -	standard reference material - a QC sample in a specific matrix from NIST or other source
TCLP -	Toxicity Characteristic Leaching Procedure
TOC -	total organic carbon
TOX -	total organic halide
TPH/IR -	Total Recoverable Petroleum Hydrocarbons by infrared spectrometry
UCL -	upper control limit
uL -	microliter
UV -	ultraviolet detector
VOA -	volatile organics or septum-sealed voa vials
VOC -	volatile organics

GTEL
ENVIRONMENTAL
LABORATORIES, INC

APPENDIX 2

MAJOR EQUIPMENT LIST

Description	Region					Total Units
	MW	NE	NW	SW	SE	
ATOMIC ABSORPTION AND INDUCTIVELY COUPLES PLASMAS						
Jarrell Ash AA, flame & furnace		1		1		
Jarrell Ash ICP simultaneous	1	1	1	1		
Leeman Labs ICP, 2.5 sequential					1	
Perkin Elmer AA, flame & furnace 2380	1		1			20
Perkin Elmer AA, flame, 3030B	1		1			
Perkin Elmer AA, flame & furnace 5100 Zeeman correction	1	1	1		1	
Perkin Elmer AA, furnace, 1100			1			
Perkin Elmer ICP sequential						
Perkin Elmer Mercury Analyzer	1		1	1	1	
GAS CHROMATOGRAPHS						
Gow-Mac GC, 750P			1			
Hewlett Packard GC, 5780A						
Hewlett Packard GC, 5890	14	24	7	6	8	74
Perkin Elmer Sigma 3/8500			1			
Tracor GC, 770/540						
Varian GC, 3300/3400	1		7	5		
GAS CHROMATOGRAPHS/MASS SPECTROMETERS						
Extral, ELO-400						
Finnigan, MAT-1020						16
Finnigan, Incos-50	2					
HP Mass Selective Detector, 5970	2	4	3	3	2	
HIGH PERFORMANCE LIQUID CHROMATOGRAPHS						
Dionex/Perkins Elmer, LS 3B/Waters	1	2	1		2	6
GEL PERMEATION CHROMATOGRAPHY						
GPC Autoprep Model 1002B	1	1	1			3
INFRARED SPECTROMETERS						
Perkin Elmer Infrared spectrometer, 337/881/1420	2	1	1	1	1	6
INTEGRATORS/DATA SYSTEMS						
Hewlett Packard (3390, 3392, 3396)	1	15	1		5	
Hewlett Packard RTE MS Data System	2	1		2		
Nelson Analytical Data System, 3000			4	12		
Perkin Elmer LIMS System						
Radlan SAM LIMS	1		1	1	1	74
Spectra Physics (4270, 4290	6	7	4	1		
Waters 820 Maxima Data System	5	1			1	
Waters 880 Data System		1			1	
MICROSCOPES						
Nikon Phase Contrast Microscope	1		1			
Nikon Polarized Light Microscope			1			4
Uniton Polarized Light Microscope	1					

MW - Wichita, KS
NE - Milford, NH
NW - Concord, CA
SW - Torrance, CA
SE - Tampa, FL

Issue Date: January 18, 1993

GTEL
ENVIRONMENTAL
LABORATORIES, INC

MAJOR EQUIPMENT LIST - Continued

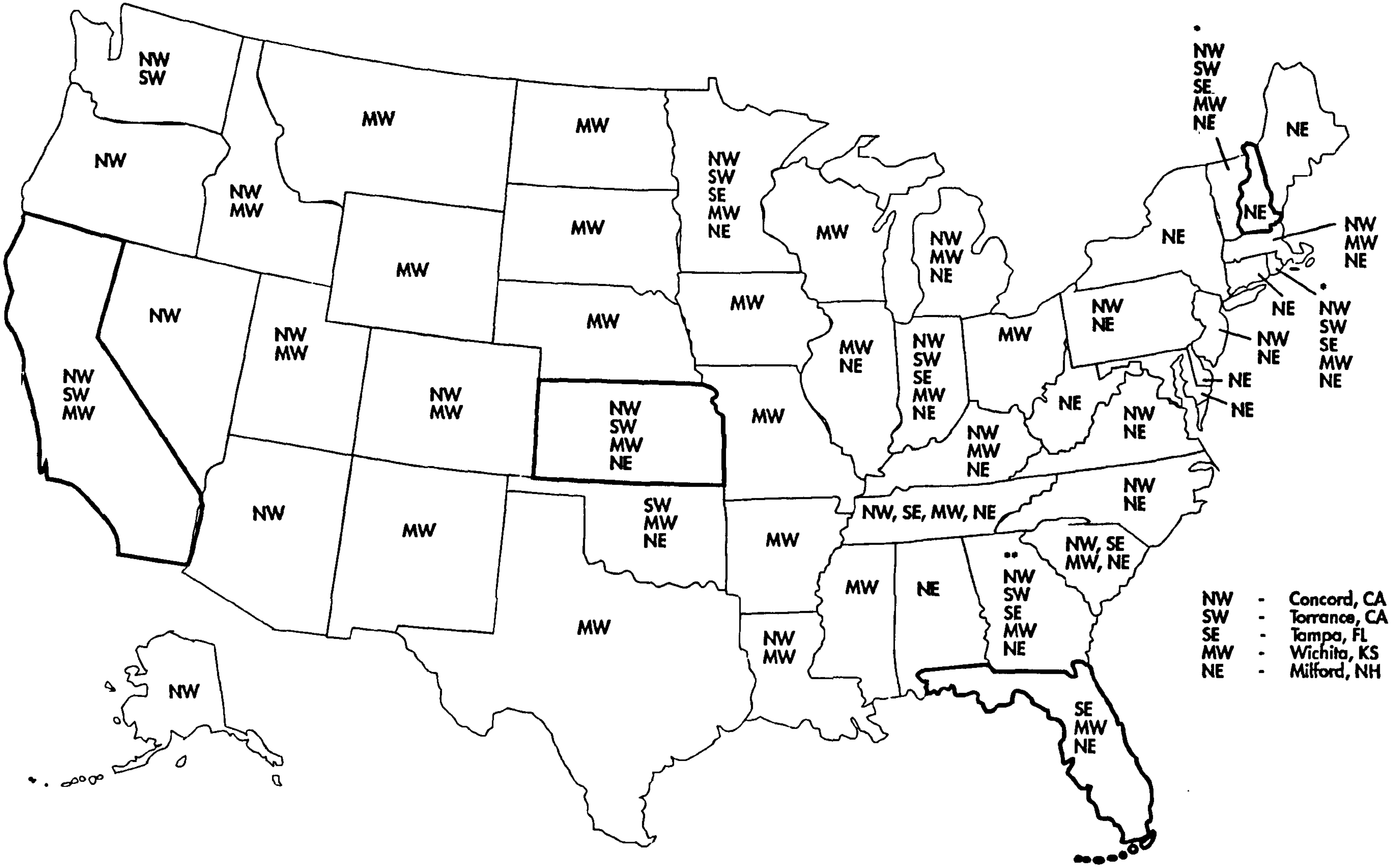
Description	Region					Total Units
	MW	NE	NW	SW	SE	
MOBILE LABS						
Horiba Infrared Spectrometer				2		
Mobile Lab Complete Unit				2		
Photo Vac 10360						
Van						8
Hewlett Packard GC 5890 FID/FID/ELCD				1		
Hewlett Packard GC 5890 PID/FID and Autosamplers				2		
Hewlett Packard GC 5890 ECD/FID				1		
PURGE AND TRAP DEVICES						
Hewlett Packard Autosampler, 7673A	4	8	5	2		
OI Corporation Autosampler	7	5	9	7	6	
Tekmar Purge and Trap	4	5	2	3		99
Varian Autosampler, 8035		2	1	1		
Tekmar ALS 2050/LSC 2000		2	7	3		
OI Purge and Trap 4460	9		1		6	
TOTAL ORGANIC CARBON ANALYZERS, TOTAL ORGANIC HALOGEN ANALYZERS, AND ION CHROMATOGRAPHS						
Dionax Ion Chromatograph, Series 4000			1	1		
Dohrmann TOC Analyzer		1	1			
Dohrmann TOX Analyzer	1					12
Lachat QuickChem Analyzer	1	1	1			
Mitsubishi TOX Analyzer	1	1	1			
Microcoulometer TOX			1			
ULTRAVIOLET/VISIBLE SPECTROMETERS						
Spectronic 20	1	2	1	1	1	5

MW - Wichita, KS NE - Milford, NH NW - Concord, CA SW - Torrance, CA
SE - Tampa, FL

Issue Date: January 18, 1993

APPENDIX 3

NOT TO SCALE



NW - Concord, CA
SW - Torrance, CA
SE - Tampa, FL
MW - Wichita, KS
NE - Milford, NH

All Laboratories are A2LA Certified

Louisiana, Missouri, Mississippi, Ohio, Texas, Georgia, Minnesota, Indiana and South Dakota are states that do not have an existing certification program. GTEL can perform analysis in these states using EPA approved analytical test methods and continue our participation in the US EPA performance evaluation studies.

Please note that, at this time, Arkansas, Illinois, North Carolina and Wyoming do not require laboratory certification for laboratories analyzing samples from Underground Storage Tanks sites.

*Rhode Island and Vermont only certify in-state laboratory

**Georgia certifies for microbiology only

U. S. Certification Status
GTEL Environmental Laboratories, Inc.

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- 4080 Pike Lane
  Concord, CA 94520
  (800) 423-7143 (Outside CA)
  (800) 544-3422 (Toll free in CA)
  (510) 685-7852 (In CA)
  (510) 825-0720 (FAX)
- 20000 Mariner Avenue
  Suite 300
  Torrance, CA 90503
  (800) 727-4835
  (310) 371-1044
  (310) 371-8720 (FAX)
- 10500 University Center Drive
  Suite 160
  Tampa, FL 33612
  (800) 933-4835
  (813) 979-9092
  (813) 979-6914 (FAX)
- 4211 May Avenue
  Wichita, KS 67209
  (800) 633-7936
  (316) 945-2624
  (316) 945-0506 (FAX)

About GTEL...

GTEL Environmental Laboratories is one of the largest environmental assessment and remediation laboratories in the United States. GTEL is committed to providing precise, reliable and cost-effective analytical services to organizations of all sizes. GTEL has earned its reputation as a leading environmental problem solver by serving the needs of small local clients as well as major corporations with multiple facilities located throughout the United States.

Today, GTEL provides a wide range of uniform services conforming to strict Quality Assurance and Quality Control Plans that meet or exceed regulatory requirements. In addition, GTEL offers a variety of custom analytical programs for clients whose requirements are not dictated by government regulations.

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Appendix C

Core Laboratories QA/QC Protocols for Geotechnical Analyses

Western Atlas
International
A Litton/Dresser Company

CORE LABORATORIES

April 20, 1994

Mr. Steve Dubyk
HGCL
505 Marguette N.W.
Albuquerque, N.M. 87102

Dear Mr. Dubyk:

Per your request, attached please find the Quality Assurance/Quality Control summary of the quoted services.

If you have any questions or clarifications please contact Dan Fargo at (805) 395-8600.

Very truly yours,

Dan Fargo

Dan Fargo
Core Laboratories

3430 Unicorn Road Bakersfield California 93308 (805) 392-8600

HYDRAULIC CONDUCTIVITY & CAPILLARY - MOISTURE RELATIONSHIPS

INSTRUMENTATION & EQUIPMENT

PUMPS

Core Laboratories utilizes Model FDS-210 positive displacement pump capable of continuously delivering fluids at rates up to 30 cc/min and at pressures as high as 10000 psi for all fluid flow through porous media studies. The recommended maintenance procedures are stringently followed and documented.

Before each analysis, the flow rate and pressure are checked against a known standard at the 95% confidence level.

LABORATORY VACUUM SUPPLY

A vacuum system capable of producing 25 inches or more of mercury is used. An in-line trap system for collection of fumes is mandatory to prevent corrosion.

Maintenance Control - Oil is checked at least once per week and is replaced at the manufacturer's suggested frequency. The vacuum is monitored in mtorr.

PRESSURE GAUGES

Pressure gauges are calibrated and certified every six months. Testing is done using a mercury manometer or National Institute of Science And Technology (NIST) traceable pressure transducer.

DEIONIZED WATER

Deionized Water system with an activated carbon column to remove organics are preferred over distillation units.

Conductivity is checked daily and any remedial or maintenance activities recorded.

Control Limit = 4 - 6 μmhos/cm. (2 - 3 ppm)

The column is replaced when the conductivity exceeds the control limit.

LABORATORY COMPRESSED AIR SUPPLY

A centralized system (compressor with a 50 gallon tank capable of continuous 100 psi delivery) is installed in the laboratory. A regulator is set to allow 75 +/- 2 psi air service to the laboratory. A sedimentation/condensate bowl and subsequent filter is installed in the line for instrument air.

Maintenance Control - On a weekly basis (minimum), the oil level in the compressor is checked and the tank of condensate drained. The filters are replaced as recommended by the manufacturer.

LASER PARTICLE SIZE ANALYSIS

INSTRUMENTATION & EQUIPMENT

Coulter LS130 - Calibration is determined by the optical design therefore, no calibration is required. All necessary adjustments are made by beam alignments. Function and operations of the analyzer is checked by the use of latron 300LS, a .3µm polystyrene latex designed by Coulter to test the PIDS module of Coulter LS130 particle sizing instruments.

Standard	Latron 300LS
Mean	0.307± 0.013µm
Standard Deviation	0.045± 0.010µm.
Volume % (Main Peak)	100%

CATION EXCHANGE CAPACITY BY ABSORBED WATER METHOD

INSTRUMENTATION & EQUIPMENT

Analytical Balances - Analytical balances are calibrated on a weekly basis utilizing the three class S weights shown below. All calibrations are recorded in the balance logbook.

Standard Limits	Central Limits
1.000 Grams	± 0.3mg
10.000 Grams	± 0.5mg
50.000 Grams	± 1.0mg

Humidity Ovens - Humidity oven temperature is maintained at 140° F ± 3° F. Relative humidity is maintained 45% at ± 5% by daily monitering of wet and dry bulb thermometers. Any thermometer used for monitoring these procedures is identified and calibrated at least every six months against a NIST traceable thermometer.

Drying Ovens - Mechanical convection ovens are checked daily. Drying temperatures are maintained at 230° F ± 3°. Oven temperatures are checked with a NIST traceable thermometer.

MOISTURE CONTENT - EQUIPMENT & INSTRUMENTATION

Top Loading Balances - Top loading balances are calibrated on a weekly basis utilizing at least three class S weights. Calibrations are recorded in a balance logbook.

Standard Weight	Central Limits
10.00 Grams	± 0.01 Grams
50.00 Grams	± 0.05 Grams
250.00 Grams	± 0.05 Grams

Drying Ovens - Drying temperatures are maintained at 230° F ± 3°. Temperatures are checked daily with a NIST traceable thermometer.

DRY BULK DENSITY - EQUIPMENT & INSTRUMENTATION

Top Loading Scales - Are utilized and are calibrated as described for moisture content above.

Extended Range Helium Porosimeter (ERPH) - Utilizes the double cell method for measuring pore volume and grain volume. Volumes are calculated by Boyle's Law equation of gas expansion.

Calibration of the porosimeter is accomplished by utilizing known grain volume and pore volume disks and plugs. Our laboratory standard for calibration is ± 0.1% for grain volume, ± 0.3% for pore volume, ± 0.5% for porosity units, and ± 0.01gm/cc for grain density.

Calibration of the ERHP is performed and recorded at the start of each batch of samples. Further, every tenth sample, the calibration must be rechecked. The computer program that supports the calibration of the ERHP does not allow for data acquisition without the machine being within our laboratory standards.

Our laboratory standards exceed accepted industry standards for grain volume, pore volume and porosity measurements.

TOTAL ORGANIC CARBON (TOC)

The TOC analysis is performed by combusting a sample in a pyrolysis tube with a Dohrman TOC analyzer. Carbon dioxide gas produced from sample combustion is determined with a Horiba PIR-2000 IR detector. The carbon dioxide produced is directly proportional to the TOC present in the sample.

All listed quality control checks are run at a frequency of every ten samples:

Quality Control (QC) Checks

Standard
Blank
Laboratory Conrol Sample (independent of the calibration standard)
Sample Duplicate

Appendix D

Standard Operating Procedure for Decontamination

Procedures for Decontamination of Equipment

1.0 PURPOSE

The purpose of this document is to describe the standard operating procedures used for decontaminating drilling/excavation and sampling equipment prior to field use.

2.0 SCOPE

To prevent contamination of ground-water samples, monitor wells or soil samples, all sampling and drilling/excavation equipment must be thoroughly cleaned prior to each use. This document describes the recommended procedures for cleaning equipment and tools before sampling.

Sampling equipment dedicated to a particular well will be cleaned before installation and after any maintenance requiring removal of that equipment from the well. Other equipment will be cleaned prior to each use.

Equipment used in each of several wells or soil borings/excavations will be cleaned prior to use at each individual site.

These procedures are designed to fully comply with the requirements of RCRA ground-water monitoring requirements.

3.0 PROCEDURES

3.1 Equipment Preparation

Any equipment, either new or used, should be assumed to be contaminated and should undergo the level of decontamination appropriate to its intended use and construction. The following sections detail these procedures.

3.2 General Levels of Decontamination

Level 1 procedures apply to all glassware and stainless steel equipment whose construction will tolerate high temperatures encountered in the muffle furnace and that will be used in the collection and storage of organic samples.

1. Thoroughly wash in hot water with nonphosphate detergent.
2. Rinse several times with tap water.

3. Rinse several times with deionized water.
4. Rinse once with methanol.
5. Rinse once with pesticide grade hexane.
6. Place in muffle furnace at 450°C for 15 to 30 minutes.
7. Allow to cool and protect from dust and other contaminants by sealing or covering with aluminum foil.

Level 2 procedures apply to all Teflon equipment and stainless equipment that have components that would be damaged by high temperatures encountered in the muffle furnace should be treated as follows. This procedure is also applicable where a muffle furnace is not available.

1. Thoroughly wash with nonphosphate detergent in hot water.
2. Rinse several times with tap water.
3. Rinse several times with deionized water.
4. Rinse once with methanol.
5. Air dry in a dust free environment.
6. Cap or cover after drying (Teflon bailers and other applicable equipment should be sealed in plastic bags.)

Level 3 procedures apply to sample containers used for metal samples.

1. Wash thoroughly with nonphosphate detergent in hot water.
2. Rinse several times with tap water.
3. Rinse once with methanol.
4. Rinse several times with tap water.
5. Rinse several times with deionized water.
6. Invert and air dry in dust free environment.

Level 4 procedures apply to safety equipment such as respirators, boots, gloves, and equipment susceptible to degradation by solvent rinsing.

1. Brush off loose dirt with soft bristle brush or cloth.
2. Rinse thoroughly with tap water.
3. Wash with nonphosphate detergent in warm water.
4. Rinse thoroughly with tap water.
5. Rinse thoroughly with deionized water.
6. Air dry in dust free environment (avoid direct sunlight exposure).
7. Store in plastic bags.

Level 5 procedures apply to ancillary equipment such as ropes, extension cords, generators, and hand carts.

1. Brush off loose dirt with stiff bristle brush.
2. Rinse off with high pressure water.
3. Air dry.

Once equipment has been allowed to dry, package the equipment to protect it from dust. Plastic bags are appropriate for larger items such as bailers and purging pumps; aluminum foil is preferred for glassware. After packaging the equipment, mark the packaging material with the date and level of decontamination and the initials of the individual certifying the decontamination procedures.

3.3 Procedures for Field Decontamination of Sampling Equipment

3.3.1 General Considerations

Field decontamination of equipment used for well purging, sample collection, and sample compositing is not to be considered a procedure of preference; rather it should be viewed as a last resort where logistical considerations and practical concerns outweigh the preferred use of dedicated equipment.

When field decontamination cannot be avoided, the following general rules should be adhered to:

1. Unless it is absolutely necessary, no equipment should be field decontaminated in the field more than once before it is sent back to the laboratory for decontamination.

2. Equipment used to collect hazardous waste samples prior to decontamination should not be used for collecting subsequent samples. In general, any equipment that has been decontaminated should then be reused to collect samples of "lower quality" than the first sample collected.

3. All decontamination and the subsequent use of decontaminated equipment should be documented in a field logbook. Record item decontaminated, method used, level of decontamination, and time.

4. Never reuse equipment if visual signs such as discoloration indicate that cleaning resulted in inadequate decontamination.

3.3.2 Decontamination of Pumps

1. Submerge pumps in a nonphosphate soap solution (e.g., Alconox).

2. Operate pump for a minimum of 10 minutes; recycle the soap solution to a wash basin through the entire length of hose.

3. Clean all exterior surfaces of both the tubing and the pump with a bristle brush and clean cloth.

4. Submerge pump in tap water.

5. Operate pump for a minimum of 10 minutes. Recycle the water through the entire length of hose to a rinse basin.

6. Submerge pump in deionized water.

7. Pump volume of water equivalent to that in the rinse basin (e.g., do not recycle deionized water).

8. Repeat steps 6 and 7 two additional times.

9. Place pump and hose on rack to air dry.

10. Place pump and hose in a plastic bag or cover them with plastic sheeting to prevent contamination during transport.

3.3.3 Decontamination of Bailers

1. Disassemble both top and bottom check valve assemblies.

2. Clean all components in a nonphosphate soap solution using a bristle brush and a bottle brush on the inside surfaces.

3. Rinse all surfaces five times with tap water.

4. Rinse all surfaces twice with methanol.
5. Rinse all surfaces five times with deionized water.
6. Place all components on a rack and allow them to air dry.
7. Put on clean cotton gloves (powderless) and reassemble bailer.
8. Place bailer in plastic bag, seal the bag, and label the bag indicating date of decontamination.

3.3.4 Decontamination of Compositing Containers

1. Scrub both inside and outside surfaces of container, lid, and Teflon liner with nonphosphate soap solution using a bristle brush.
2. Rinse five times with tap water.
3. Rinse once with methanol.
4. Rinse five times with deionized water.
5. Place containers on drying rack and allow them to air dry.
6. Replace Teflon liner and lid.
7. Place label on lid indicating date of decontamination. When returning used field equipment for thorough decontamination, Level 5 decontamination should first be performed in the field. The equipment should then be sealed in a plastic bag and segregated from unused equipment.

3.4 Procedures for Steam Cleaning Equipment

This section describes the procedures to be used in steam cleaning sampling equipment. Sampling equipment dedicated to a particular well will be cleaned prior to installation and after any maintenance requiring its removal from the well. Other equipment will be cleaned prior to each use. Equipment used in each of several wells or borings will be cleaned prior to use at each individual site.

The procedures described below are intended to be used only when the more rigorous decontamination methods described in section 3.3 are impracticable for technical or logistical reasons:

1. Always wear gloves and safety glasses when operating the steam cleaner.

2. Disconnect any equipment, such as pumps, which cannot be thoroughly cleaned if they remain attached to the unit.

3. Remove any obvious dirt or other foreign substances from all tools and equipment to be cleaned using tap water, a brush, and soap as necessary. Spread the tools and equipment on a clean hard surface.

4. Read the operating instructions for operating the steam cleaner and be certain that you understand them before you proceed. Inspect the steam cleaner to ensure that it is properly fueled and in good working order and to be sure that there are no solvents, detergents, or other foreign substances in the machine. Clean the steam cleaner, if necessary.

5. Thoroughly steam clean all equipment and tools and then rinse them with distilled water. Be certain to measure and record the temperature of the steam cleaner discharge.

6. Use the appropriate equipment (e.g., a bailer or a glass sample container) to take an rinsate blank. Sample by flushing the equipment with distilled, deionized water and collecting the effluent in 2 40-ml septum vials. Close the vials securely, ensuring that no air or headspace remain in the vials. Label, store, transport, and analyze the equipment blanks in the same manner as other samples collected in the program.

7. Wearing clean disposable rubber gloves, reassemble any equipment that was disassembled for cleaning. Transfer all of the cleaned tools and equipment to clean plastic bags and fasten tightly.

8. After cleaning, handle equipment no more than is essential for conducting the sampling procedure. Always wear clean, disposable rubber or cotton gloves when handling the clean equipment.

4.0 REFERENCES

U.S Environmental Protection Agency, 1986, RCRA Ground-Water Monitoring Technical Enforcement Guidance Document, pp. 106-107.

Appendix E

Health and Safety Plan

SITE HEALTH AND SAFETY PLAN

Project Name:	Rexene	**REX27.H&S**	
Site Name:	Brickland Refinery	**Date:**	June 28, 1993
Site Address:	3010 McNutt Road Sunland Park, New Mexico	**Site No:**	N/A
		Work Assignment No.:	N/A
Prepared By:	H⁺GCL, Albuquerque		
Client Name:	Rexene		

[X] Original HSP
[ ] Amendment to Existing HSP, Date Approved

Objectives: Summarize below.

- Interim Remedial Action (if needed)
- Additional Site Investigation (if needed)
- Remedial Design and Remedial Action

Primary project objectives include: site remediation and control of hydrocarbon migration from the property. This involves: limited site assessment activity, installation of trench system to recover free phase floating petroleum products, and storm water drainage control measures.

There is a series of increasing intrusive activities related to the tasks that will be conducted at this site. As the level of intrusive activity increases there is a corresponding increase in the required level of protection.

The anticipated tasks in the order of increasing hazard are:

A) Site Walk Through,(including photography and ground surface surveys)
B) Sampling Activity from: Monitoring Wells, Storm Water Systems and Near Surface Soils
C) Drilling and Monitor Well Installation, and Hydropunch™ Activity, Deep Soil Sampling
D) Intrusive Activity, Surface drainage Improvements, Depths to 5 Feet.
E) Intrusive Activity, Recovery Trench System Installation, Depths greater than 5 Feet.
F) Product Recovery and Materials Handling, from Recovery System

This Health and Safety Plan has been developed around the anticipated tasks listed above. If you are reviewing this H&S plan and the particular task you are about to undertake is not addressed, please consult the site manager for specific guidelines and the proper health and safety procedures.

Please refer to the individual work plans that include specific health and safety procedures pertinent to the particular operation. The work plans will contain health and safety provisions for worker protection and minimization of hazards and contaminant exposure. These guidelines may be appended to this health and safety plan.

Site Type: Check as many as applicable.

[ ] Active
[X] Inactive
[X] Secure
[ ] Unsecured
[X] Enclosed Space, for trench activity

[ ] Service Station
[X] Refinery
[ ] Landfill
[ ] Industrial
[ ] Well Field

[ ] Unknown
[ ] Other: (Specify)

Surrounding Population:

[X] One residential home of J. Canales, north of site
[X] Rural

[X] Industrial
[ ] Urban

Other:

Site Description and Features: Summarize below.

Brickland refinery consists of approximately 33 acres in a narrow band of land that runs north-south. The ground surface is predominantly sand with heavy localized vegetation in the form of brush and small trees. The site is littered with concrete debris from demolition and dumping. Scattered trash consists of partially buried pipe, broken glass and general construction debris. Electrical poles are located on the property with only some being active.

Please refer to the site maps on the following pages to gain an understanding of the site and the surrounding area. General location map is included as figure 1. For simplicity and ease in description the site has been separated into seven sectors areas labeled A-G in figure 2, Site Investigation Sector Plan. Each area has distinct features that separate it from the other sectors.

The following is a description of the surrounding area.

EAST: The Texas-New Mexico border runs adjacent a portion of the east side of the site. The Rio Grande River and flood plain lie adjacent to the east side of the site. A flood-control levee offers protection to the site. Note that the site grade is only several feet above river. Beyond and running adjacent to the river is Paisano Drive, Interstate 10 is about one mile away. Further to the east is the Franklin Mountains. The City of El Paso is about one mile to the east and south.

SOUTH: The US-Mexico border is approximately 2,000 feet to the south. The inactive ASARCO smelter is located about 1/2 mile south with slag heaps visible.

WEST: A railroad alignment, operated by Southern Pacific, runs along the base of a steep hill along the west.

NORTH: The adjacent area is unpopulated except for one residence adjacent to the north side of the site. About one mile further to the north and west residences exist in the Town of Sunland Park which has a small airport and racetrack.

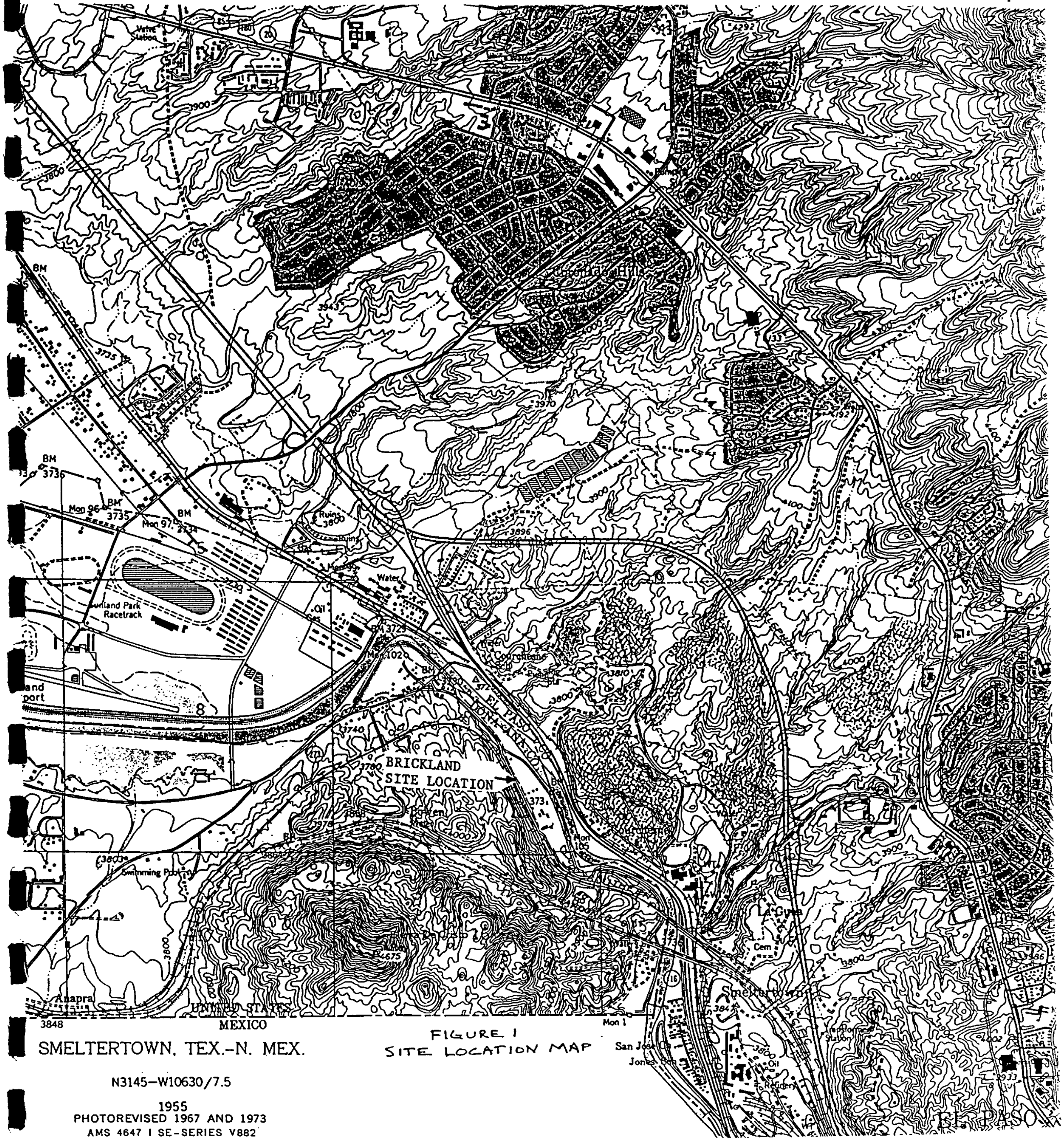

FIGURE 1
SITE LOCATION MAP

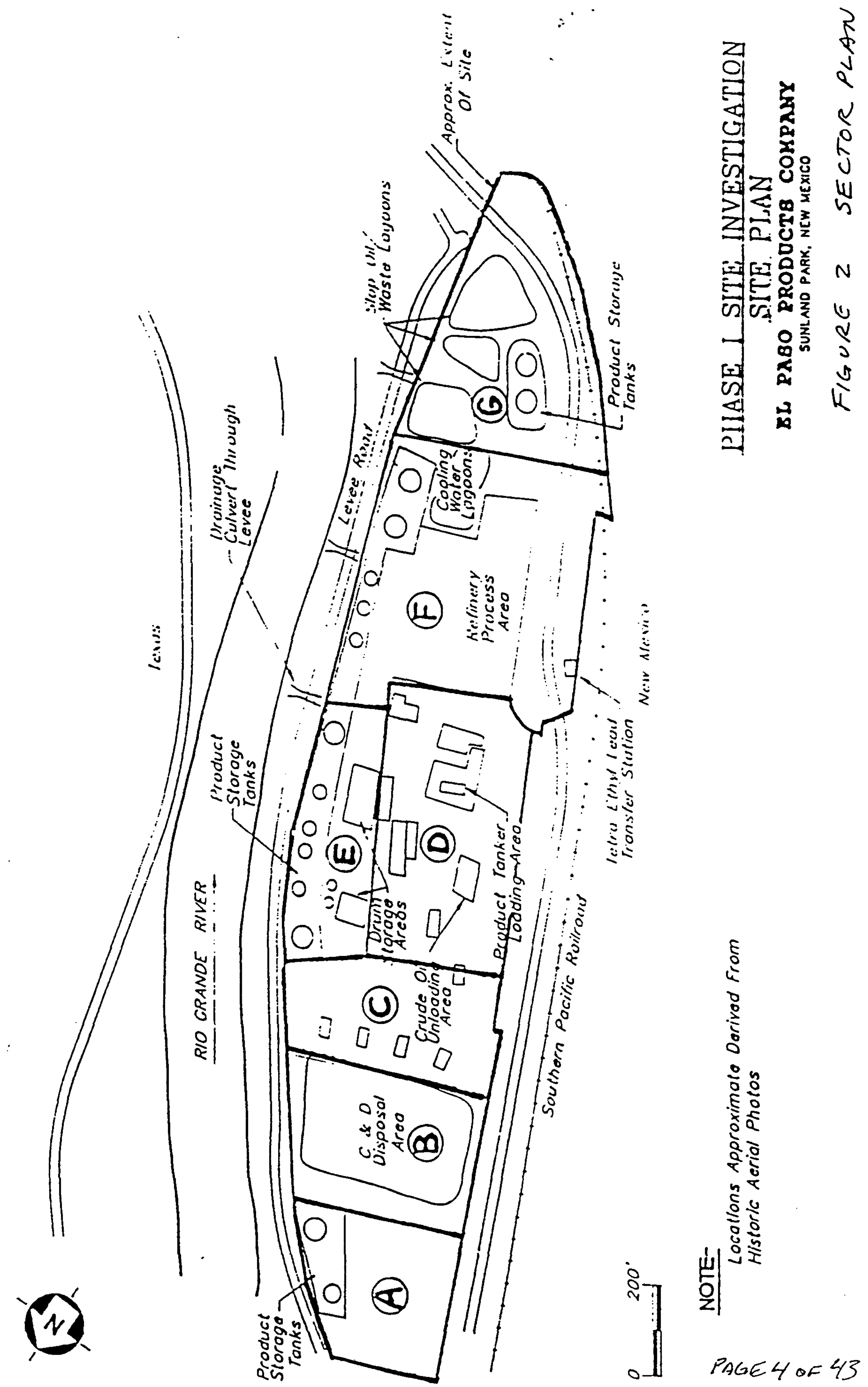

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Figure 2. Site plan showing location of the seven work areas

Site History:
Recent investigative activity starting around June 1989 was initiated when the neighbor, Joe Canales, to the north complained to the NMED that some of his trees had died. This site was once operated as a refinery site that is mainly responsible for the contamination problems. Subsequent operations may have added to the problem. These problems are currently under investigation and the subject of this Health and Safety Plan.

Everyone that has direct involvement with this site should read and be familiar with the summary of previous work activity found in the "Cliff Notes" prepared by Ms. Valda Terauds of H$^+$GCL. Excerpts from her notes appear in various sections of this plan. Please realize that not all data that appear in this Health and Safety Plan has been validated.

CHRONOLOGY

1933-1958:	Brickland Refinery - owned & operated by McNutt family (1933 - 1955). El Paso Natural Gas Products Co. operated the refinery from 1956 until 1958.
1959-1967	Majority of property unused except for refinery products quality control that laboratory operated until 1964.
1967 -	2/3 of property leased to: 1) grocery products transportation 2) auto salvage company
1968-1989:	Leased to: 1) garage and service trucks 2) graze livestock 3) store used bricks
April 1989:	NMED inspection - revealed shallow subsurface and surface contamination that was attributed to former refining operations at the site
June to July 1989:	NMED sampling of soil and groundwater r.e. neighbors compliant that contamination had killed trees. EID and Rexene split samples. EID Draft report sent to EPA VI for review - contained preliminary HRS. Detected VOCs, SVOCs, Pb, Hg, Cu, As, Ag, Cd, Ni, Cr, and Zn.
January 1990:	Work Plan submitted to NMED: compilation of background data on surface water, groundwater, soils, and refinery operations. Field work: soil-gas survey; soil borings; monitoring wells; surficial soil samples; test pits; sediment samples. Analyses: oil & grease, VOCs, semi-VOCs, priority pollutant metals, anions & cations.
3/15/90:	NMED Work Plan Approval
3/21/90:	Field Work begins, activity consists of: magnetometer survey, soil-gas survey, 15 wells, 24 soil borings, 91 backhoe test pits, 20 surface soil & sediment samples
July 1990:	Second round of groundwater samples
August 1990:	Field Investigation (Part I)
October 1990	Analytical Findings (Part II)
Feb 1991	Laboratory Data Sheets (Part IIA)
March 1991:	EID-Requested Information (Part III)
May 1992:	H$^+$GCL is assigned follow up investigative and remediation activities

DESCRIPTION OF PAST REFINERY OPERATIONS:

This Refinery processed approximately 8,000 barrels per day of crude oil. Feedstock likely came from West Texas and New Mexico fields and was trucked to the site. It produced three products: leaded gasoline, kerosene, and platformate (a high octane gasoline).

Refinery of this vintage may have had: steam-heated crude stills, coal-fired boilers, a cooling tower, storage tanks, treatment tanks, oil-water separators, etc. but probably lacked more modern facilities such as dissolved air flotation units and biological wastewater treatment.

Kerosene was treated with a lead-caustic solution to remove sulfur. Waste oils from this operation were placed into a small pit (estimated 15' x 8' x 2'). This material was later excavated and processed to recover lead.

Tank bottoms and other refinery oily wastes were sold to processors in the local area; this seems consistent with general absence of accumulated waste sludges on site. No waste materials are known to have been buried; although this conflicts with aerial photographs show impoundments.

Storage tanks are believed to have had steel bottoms and most, if not all, were horizontal tanks on concrete/brick saddle supports. Water was supplied from the City of El Paso, Texas. Due to a high groundwater table, no process or drinking water wells were drilled. Note: There are no drinking water supply wells on site. Water is supplied from City of El Paso, which draws its water from wells.

- Crude oil delivered to tanker truck unloading racks (central refinery area)
- Petreco de-salting unit used to remove salt & water from crude feedstock
- Single-column distillation unit used to distill crude
- Thermal cracking unit - crack the "heavy" (high B.P.) distillation products
- Polymerization unit - polymerize "light" (low B.P.) cracking products into gasoline boiling range fractions
- Platformate unit (early 1950s) - reform naphtha boiling range products into higher octane products
- Clay tower - filtering
- Treatment units - gasoline & kerosene
- Blending units - tetraethyl lead into gasoline
- Finished product stored on site in tanks
- Process waters pumped from river (S. end of site) - used for cooling; stored in cooling towers and nearby holding ponds

Additives:

- Petreco de-salter: emulsion breaker
- Polymerization unit: clay impregnated with solid phosphoric acid (catalyst)
- Platformer unit: alumina impregnated with platinum (catalyst) and alumina beds as a feed pre-wash
- Gasoline treatment: copper, sulfuric acid, caustic soda solution; tetraethyl lead
- Kerosene treatment: caustic soda, lead, sulfur
- Diesel fuel: unspecified additives
- Cooling water: potassium dichromate (anti-slime agent) liquid phosphoric acid & other acids (inhibit scale & slime)

Volume Refined:
1950: 3,000 barrels per day
1958: 4,000 barrels per day
Thermal cracking unit: 1600 barrels per stream day
Platformer: 480 barrels per stream day
Polymerization unit: 65 barrels per stream day

Principal disposal methods and practices, summarized.

Be aware of recent activity that may have had a minor impact on site environmental conditions:

- Soil contamination from changing truck oil on site
- Disposal of waste hydrocarbons from unknown sources along south fence line.

Historical Known Waste Disposal Practices:

1. De-salting unit: wastewater with brine and emulsifying agents; pumped through underground pipes to holding ponds at southernmost end of property.
2. Gasoline and Kerosene Treatment Wastes: Disposed of in holding ponds at southernmost property.
3. Free product recovered from pits; accumulated residuals shoveled out and disposed of off-site
4. Hard carbon "coke" - accumulated in heat exchange tubes - removed by drills and air chisels and left in a powder form on the ground
5. Polymerization and platformer unit catalysts periodically replaced. Platinum-impregnated alumina sold to recyclers; other catalysts and clays replaced and disposed off-site by truck.
6. Product spills: leaks in product tanks and in underground piping between refinery units. Recovered leaked product by excavating small pits and removing accumulated product with a vacuum pump. Recovered product reprocessed or returned to storage, depending on condition. Small leaks in above ground pipes near tetraethyl lead house.

SITE HEALTH AND SAFETY PLAN

Waste Types:

[X] Liquid
[ ] Solid
[X] Gasoline

[X] Sludge
[ ] Gas
[ ] Unknown

[X] Other: (Specify)
Possible small quantity
Laboratory Chemicals

Waste Characteristics: Check as many as applicable.

[X] Corrosive
[X] Toxic
[X] Flammable

[X] Volatile
[ ] Other: (Specify)

Other Hazards of Concern:

[X] Heat Stress - Attach Guidelines (heatstrs.gid)
[X] Explosion/Flammable
[ ] Oxygen Deficient
[X] Trips and falls
[X] Biological, River Contaminants

[X] Inorganic Chemicals
[X] Organic Chemicals
[X] Noise, Equipment
[X] Other: Bites and stings from insects, snakes and small rodents

Contamination Summary

Visible Evidence of Soil Contamination:

- Oily soils and sludges present throughout the site.
- Small area of black hydrocarbons observed seeping through soil surface in the northeast corner of auto salvage property.
- Oily soil/sludge seen in impoundments near southeast corner of truck trailer repair property.
- Oily soil/sludge bank built up outside south fence line of Tract 3 (truck trailer repair property).
- Hydrocarbons or waste oil on top of soil/sludge bank - appears recent.
- Oily soils/sludges observed at several locations along the river side of the Rio Grande levee.
- Soil contamination associated with truck trailer repair and truck engine operations:

Visible Evidence of Surface Water Contamination:

- Surface water trapped in pools near soil/sludge impoundment was discolored with oils. Not confirmed and may be related to rusty drums in the area.
- Other surface water does not show signs of obvious contamination.
- Two drainage outfalls inspected; no evidence of surface water contamination.

Evidence of Groundwater Contamination:

- No samples collected; however potential noted for tetraethyllead handling and lead treating of kerosene. Hydrocarbons (e.g. gasoline, crude oil, kerosene) may still be detected in groundwater.
- A hydrocarbon recovery well was reported to have been operated in the past.

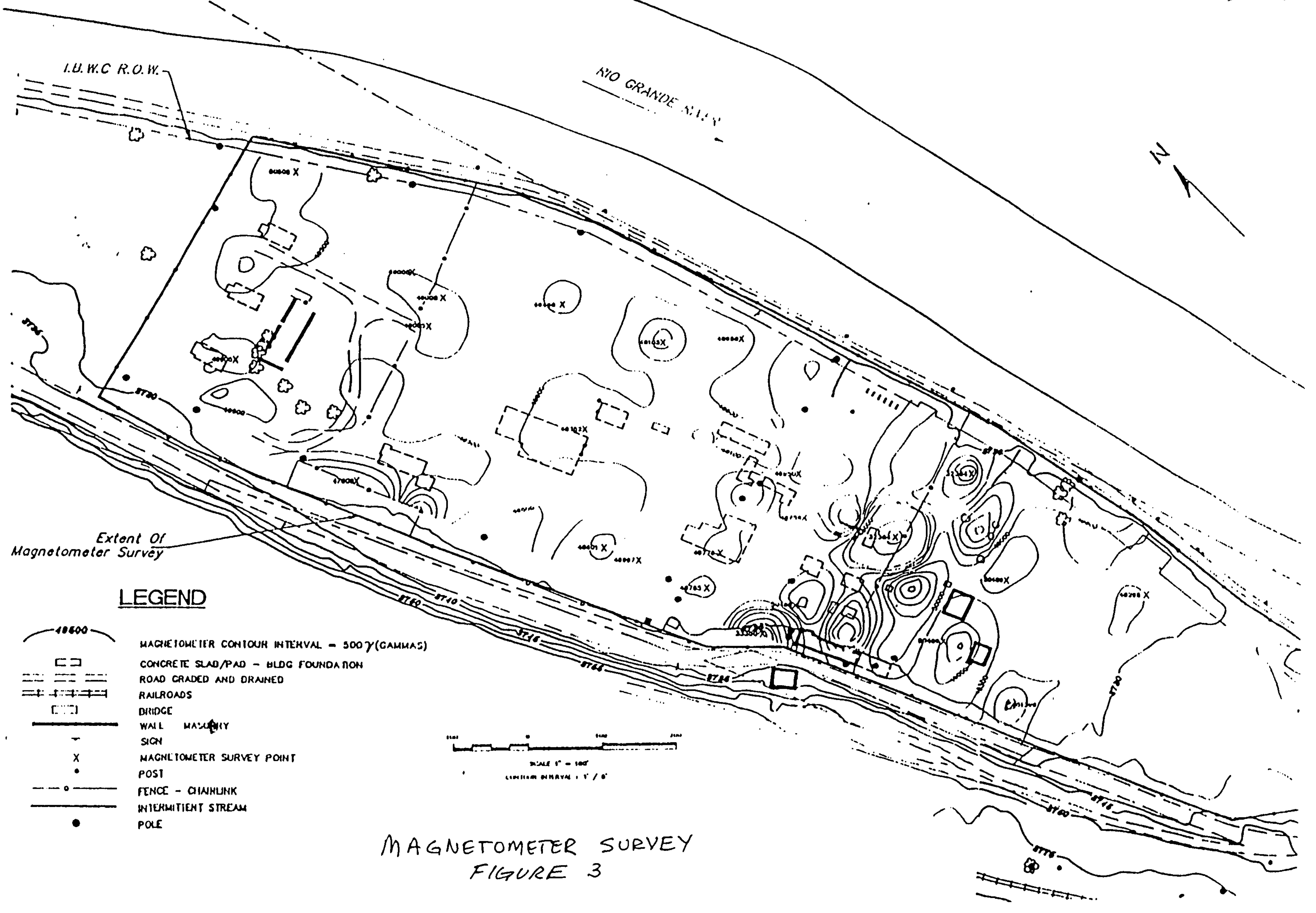
Description of underground tanks and transmission lines.

Underground transmission and pipe lines from refinery operations are still in place in some areas of the site, these pipes may still contain some hydrocarbon products. Metal detection surveys are required prior to intrusive activity such as drilling and trenching. Some wastes were reportedly disposed of in ponds. Waste oil and sludges may be located in old pond areas that occupy low areas. These old ponds may be buried under a varying thickness of surface graded fill material. Surface grading may be thicker over the low areas. Concrete oil separation pits and sumps may contain hydrocarbon products and sludges. Numerous underground structures from previous refinery operations are located in all areas and may be covered by soil and fill. Maps should be checked for specific locations of these structures.

Supplemental General Information from Magnetometer Survey:

EG&G Geometrics Model G-856; Surfer post-processing
50-foot grid; Surveyed areas C, D, E, F, and G.
A & B not surveyed due to debris
Cultural features: concrete pads, posts, poles, walls, cooling tower foundations.
Two product storage tanks situated in areas A & B (mid-1950's); no underground piping or metal anticipated.

Area C:	Anomaly - northernmost concrete slab (nearby cultural object)
Area D/E:	Magnetic low in north-central area - buried object of considerable size Magnetic low between concrete slab & eastern boundary: large area of metal debris or east-west piping (concrete pads & posts may be interferences)
Area F/G:	Anomalies in NW, N-central, and S-central portions. No interpretation of signature.



MAGNETOMETER SURVEY
FIGURE 3

Hazardous Materials Summary: Check waste type.

Chemicals: (Amounts/Units)
[X] Acids
[X] Caustics
[X] Metals
[ ] PCBs
[ ] Other: (Specify)

Solids: (Amounts/Units)
[X] Concrete Rubble
[X] Asbestos
[X] Construction Debris
[X] Non-ferrous Smelter, Coke
[X] Other: Smelter Fallout consisting of Arsenic, Cadmium, Lead and other metal particulate. See below.

ASARCO: Smelter fallout may have contributed to some heavy metal contaminants at the site. Since 1975, the Texas Air Control Board has ordered ASARCO to implement pollution abatement devices to reduce sulfur dioxide and lead emissions. EPA Region VI compliance record.

Soil sampling was done to evaluate heavy metal impacts from ASARCO. Background soil concentrations established for Brickland Refinery were derived from the results of ASARCO's sampling effort and are as follows:

Arsenic: 20 - 40 ppm
Lead: 200 - 400 ppm
Zinc: 200 - 400 ppm
Cadmium: 10 - 20 ppm

Sludges: (Amounts/Units)
[X] Metals Sludges
[X] Aluminum compounds
[X] Lead compounds
[X] Copper compounds

Solvents: (Amounts/Units)
(Not Known)

Oils: (Amounts/Units)
[X] Oily Wastes
[X] Other: Refinery Waste

Other: (Amounts/Units)
[X] Laboratory Chemicals

Overall Hazard Evaluation: **Justification:** Previous sample events
[X] Medium to Variable depending on activity

Fire/Explosion Potential:
[ ] High
[ ] Unknown
[X] Medium
[ ] Low

Justification:
Medium potential for fires and possible explosion depending upon type of activity in conjunction with concentration of organic compounds encountered. Drilling and excavation activity may generate heat and increase possibility of fire and/or explosion. Organic petroleum products used and manufactured on this site have flash points in the flammability range. These organic chemicals normally have a high potential to cause fires. High ambient temperatures will increase volatility and possibility of fires. Fire extinguishers must be on hand for all intrusive activity.

Detailed Background Review: Complete

GENERAL SUMMARY INFORMATION FROM PREVIOUS INVESTIGATIONS

SUBSURFACE CONDITIONS:

Rio Grande River Surface Water Samples:
Surface water samples collected within the river banks upstream and downstream of the site were indistinguishable. Major ion concentrations indicated a high dissolved solids content typical of surface waters in the southwestern U.S.

Groundwater:
Test pits & soil borings: visual evidence of petroleum residues. Groundwater seeps are contaminated with floating product, especially areas D, E, and F, with product extending south in the direction of groundwater flow. Typically SVOCs > VOCs, except in wells MW-5 and MW-8. Dissolved metals were negative for heavy metals of concern (Pb, Cu, and Cr). Common anions and cations were high, but reflect the naturally high TDS.

Storm-Water Outfalls:
The soil samples from CUL-4-1 had detectable SVOCs presumably related to on-site hydrocarbon contamination. Concentrations lower than those detected on-site. Only fluoranthene detected above 1,000 ppb. It drains the northern end of the site along with runoff from an auto salvage yard north of the site.

Soils:

1. Asphalt-like materials - natural soils with high-viscosity petroleum product. High to low plasticity and medium compactness. Black to dark gray w/strong petroleum odor. Ground surface to 120 inches.
2. Coarse-grained organics: Test pits E-TP-42, E-TP-48, and B-HA-4. No plasticity, loose to medium compactness, black color, & slight odor. 7 to 28 inches in depth.
3. Fine-grained organic "coke": F-TP-49. Residues from thermal "cracker". Coke dust reportedly left on ground following cleaning. Compact, not plastic, green-dark gray, slight petroleum odor. 7 to 13 inches.
4. Tar - covers ground surface in some locations. E-TP-25 and E-TP-29. Intermixed w/soils 2 inches to 60 inches.

Off-Site Soil Samples:
Soils collected from four outfalls between site and Rio Grande and from two off-site soil borings. Outfall samples collected 2-8 inches below surface. SVOC samples collected 12-72 inches below surface. The second sample from culvert 1 had significant (<1,000 ppb) concentrations of chrysene. The off-site soil boring MW-6 had ethylbenzene and xylene concentrations above 1000 ppb.

Results of Organic Vapor Survey by Field Gas Chromatograph to Determine Soil-Vapor Concentration

Results: Locations of Heaviest Contamination
1. Western portion of grid D and SW portion of grid C.
2. SW corner of grid F and NW corner of grid G.
3. Grid F - SE, NE, and NW; and southern edge of grid E.

Highest Concentrations
Benzene = 875 ppm
Toluene = 77 ppm
m-Xylene = 51 ppm
o-Xylene = 46 ppm

CONTAMINANT SUMMARY BY SECTOR (refer to figure 2)

Area A: Bulk Petroleum Storage

Above-ground storage tanks & pressure tanks. Undeveloped until 1950; not a production area. Two product storage tanks and two horizontal pressure cylinders removed after refinery shut down. Site covered w/ construction debris, primarily broken concrete rubble.

Small area of contaminated soils suggesting oil-related leak or spill. Not as concentrated soil contamination, extended 24 to 48 inches below grade. No priority pollutant metals above background.

A-TP-65 - Sampling Results

		Background
Xylenes only	500 ug/kg	<0.02 - 0.11
Other VOCs	500 ug/kg	<0.25 - 1.2
Total VOCs	51,000 ug/kg	0.9 - 5.5
Mercury:	0.06 ppm (1 sample)	7.5 - 2.3
Cadmium:	2.9 ppm (1 sample)	6 - 140
Chromium:	13.5 ppm (1 sample)	5 - 10
Copper:	5.9 - 169 ppm (matrix spikes out of acceptable range)	< 1.4 6 - 270
Nickel:	10.2 ppm (1 sample)	
Zinc:	101 ppm (1 sample)	
Arsenic:	19.8 ppm (1 sample)	
Lead:	15.4 - 284 ppm (4 samples)	

This area is relatively free of groundwater contamination.

Space for New Information:

CONTAMINANT SUMMARY BY SECTOR (refer to figure 2) cont'd

Area B: Bulk Petroleum Storage

Product transfer piping crossed this area. Pipeline runs crossed to the storage tanks in Area A. Covered w/debris: broken stone, concrete, bricks, etc. Construction/demolition debris; does not include drums or other containers that could contain contaminants.

Four test pits and four hand auger samples advanced. No semi-VOCs collected because oil and grease data did not exceed sample selection criteria. VC samples not collected because PID readings were low. Metals results indicate lead and copper above background. Oil & Grease in sample collected from 4-inch thick band of soil 44 inches below surface in B-HA-4 at 6100 ppm. Layer of petroleum-contaminated soil encountered in boring, probably related to small leak or spill near east fence line, a former piping route.

		Background
Mercury:	0.41 ppm (1 sample)	<0.02 - 0.11
Cadmium:	4.7 ppm (1 sample)	<0.25 - 1.2
Chromium:	860 ppm (1 sample)	0.9 - 5.5
Copper:	35.5 - 1370 ppm (matrix spikes out of acceptable range)	7.5-23
Nickel:	5.4 ppm (1 sample)	6 - 140
Zinc:	30.9 - 251 ppm (4 samples)	5 - 10
Arsenic:	5.98 ppm (1 sample)	< 1.4
Lead:	60 - 2830 ppm (4 samples)	6 - 270
Silver:	1.4 - 177 ppm (4 samples)	

This area is relatively free of groundwater contamination.

Space for New Information:

CONTAMINANT SUMMARY BY SECTOR (refer to figure 2) cont'd

Area C: Former Residences (4)

Area of former pipelines between main refinery and storage tanks in Area A. Historical photos also show company housing. Piles of demolition debris are also scattered throughout.

PID readings on soil samples from 3 of 10 test pits triggered VC samples. VOCs detected in C-TP-4 included BTEX and non-target VOCs. SVOC readings were triggered by oil & grease sampling. Highest SVOCs at 11% (110,000) in C-TP-8-S. Naphthalene, 2-Methylnaphthalene, phenanthrene, anthracene, dibenzofuran, fluorene, 2,4-dinitrotoluene, pyrene, acenaphthene, chrysene, benzo(a)anthracene, 4-chloroaniline, fluoranthene, benzo(a)pyrene, 4,6-dinitro-2-methylphenol were all detected at above 1 ppm. Northeast corner stained with petroleum constituents. Hydrocarbon contamination along eastern fence line at low to moderate concentrations, with one area of high concentrations. Suggest possible petroleum leak. Lead above background in C-TP-5.

		Background
Mercury:	ND <0.06 ppm (1 sample)	<0.02 - 0.11
Cadmium:	2.9 ppm (1 sample)	<0.25 - 1.2
Chromium:	7.5 ppm (1 sample)	0.9 - 5.5
Copper:	4.8 - 280 ppm	7.5-23
Nickel:	10.2 ppm (1 sample)	6 - 140
Zinc:	17.1 - 367 ppm (8 samples)	5 - 10
Arsenic:	5.0 - 129 ppm (8 samples)	< 1.4
Lead:	5.0 - 683 ppm (8 samples)	6 - 270
Silver:	2.9 ppm (1 sample)	

This area is relatively free of groundwater contamination.

Space for New Information:

CONTAMINANT SUMMARY BY SECTOR (refer to figure 2) cont'd

Area D: Refinery Transportation Center

Loading/unloading areas, vehicle maintenance, warehousing, administration, indoor/outdoor storage, and laboratory facilities. Gasoline pump to fuel vehicles.

Twenty-four soil borings drilled in Area D; four test pits; one soil sample (MW-5). PID field screening found consistent and widespread soil contamination. Highest VOCs in D-TP-53-1, adjacent to crude unloading rack. Oil and Grease > 1,000 ppm throughout southeastern two-thirds of area. Total non-target SVOCs from 0.07 - 2.2%, highest SVOCs in pits adjacent to crude unloading racks and the northernmost storage warehouse. Cadmium, zinc, copper, and arsenic detected. High metals concentrations coincide w/ high SVOC levels found near the warehouse. SVOCs above 1,000 ppb included: naphthalene, 2-methylnaphthalene, phenanthrene, anthracene, dibenzofuran, fluorene, 4-nitrophenol, 4-chloroaniline, o-nitrotoluene, nitrobenzene, 2-chloronaphthalene, and isophorone. Except for near the warehouse, lead concentrations were close to background. No significant contamination detected near former administration/laboratory building.

Heavy petroleum residue contamination in soils; extends deeper than 120 inches. Moderate petroleum hydrocarbon contamination near former loading/unloading racks.

		Background
Mercury:	0.09 ppm (1 sample)	<0.02 - 0.11
Cadmium:	0.2 - 44.4 ppm (8 samples)	<0.25 - 1.2
Chromium:	5.2 ppm (1 sample)	0.9 - 5.5
Copper:	1.28 - 951 ppm (20 samples)	7.5-23
Nickel:	5.4 ppm (1 sample)	6 - 140
Zinc:	11 - 683 ppm (12 samples)	5 - 10
Arsenic:	4.4 - 169 ppm (24 samples)	< 1.4
Lead:	5.9 - 1500 ppm (24 samples)	6 - 270
Silver:	0.56 - 27.8 ppm (16 samples)	

Groundwater contamination present in MW-5. Moderate concentrations of BTEX are present, and may be related to former gasoline pumps in this area. Moderate to high concentrations of the same VOCs were detected in soils and groundwater at MW-4, hydraulically down-gradient of MW-5. Floating phase product has been observed near the western border of Area D.

Space for New Information:

CONTAMINANT SUMMARY BY SECTOR (refer to figure 2) cont'd

Area E: Drum & Tank Storage Area
Petroleum storage tanks, truck loading/unloading racks, drum storage, truck maintenance facilities.

Soils sampled show wide-spread oil & grease contamination, increasing concentrations towards south. Soils adjacent to former truck parking area had 1.9% non-target VOCs. SVOC samples ranged from 17 ppm to 7.5%. SVOCs detected above 1000 ppb included: naphthalene, 2-methylnaphthalene, phenanthrene, anthracene, dibenzofuran, fluorene, 2,4-dinitrotoluene, pyrene, 4-nitrophenol, acenaphthene, chrysene, benzo(a)anthracene, acenaphthylene, 4-chloroaniline, o-nitrotoluene, m-nitrotoluene, nitrobenzene, n-nitrosodiphenylamine, fluoranthene, benzo(a)pyrene, 2-chloronaphthalene, 2,4-dinitrophenol, isophorone, benzo(k)fluoranthene, and benzo(g,h,i)perylene. A tar-like substance covering several hundred square feet had the maximum concentrations. Oil & grease are likely related to storage tank and pipe leaks. Lead was the only metal found above background, limited to two southern-most transects, with the highest concentration (13.9%) found adjacent to the truck loading racks.

Moderate petroleum contamination, with highly contaminated soils along the eastern boundary. Eastern portion (close to area F) contamination extends deeper than 80 inches. Residues not detected beneath cooling water ponds because soils (silts, sands, and clays) were relatively impermeable.

		Background
Mercury:	<0.02 - 0.76 ppm (5 samples)	<0.02 - 0.11
Cadmium:	0.2 ppm (1 sample)	<0.25 - 1.2
Chromium:	5.2 - 75 ppm (4 samples)	0.9 - 5.5
Copper:	9.6 - 300 ppm (10 samples)	7.5-23
Nickel:	17.3 - 22 ppm (3 samples)	6 - 140
Zinc:	48.4 - 69.8 ppm (3 samples)	5 - 10
Arsenic:	5.4 - 33.8 ppm (11 samples)	< 1.4
Lead:	29.5 - 139000 ppm (10 samples)	6 - 270
Silver:	4.2 ppm (1 sample)	

Relatively clean with respect to groundwater contamination.

Space for New Information:

CONTAMINANT SUMMARY BY SECTOR (refer to figure 2) cont'd

Area F: Refinery Process Facilities

Production area w/cracking towers, cooling towers, and other refinery process equipment. Cooling water holding pond.

Widespread oil and grease contamination in soils. Lowest concentrations in cooling pond area. Highest values between two former horizontal tanks. Gasoline-like contamination noted in northwestern side (high BTEX). SVOC contamination in northeastern to southwestern corners, presumably related to crude and intermediates leaking from tanks and pipes on either side of cooling ponds. Significant SVOCs detected above 1000 ppb included: naphthalene, 2-methylnaphthalene, phenanthrene, anthracene, dibenzofuran, fluorene, 2,4-dinitrotoluene, pyrene, 4-nitrophenol, acenaphthene, acenaphthylene, o-nitrotoluene, m-nitrotoluene, n-nitrosodiphenylamine, 2-chloronaphthalene, and isophorone. Highest BTEX (gasoline-type) contamination found on northwestern corner of site adjacent to the retain gas operation and in the area of the thermal cracker.

Metals above background included copper (5 samples at concentrations of 2300 to 34,000 ppm) adjacent to the copper treatment area. Eight zinc samples (252-2370 ppm). Lead concentrations ranged from 1090 to 377000 ppm (37.7%). Cadmium at low levels, but above background near cooling water ponds also noted.

Moderate to high petroleum contamination typically extending deeper than 67 inches. Gasoline-like product in north-western portion. Heavy, oil-like material along eastern border. Central area is relatively clean as it was covered by cooling water ponds which did not contain oil residues.

		Background
Mercury:	0.05 - 10 ppm (13 samples)	<0.02 - 0.11
Cadmium:	0.85 - 17.4 ppm (5 samples)	<0.25 - 1.2
Chromium:	8.7 - 47.2 ppm (12 samples)	0.9 - 5.5
Copper:	6.5 - 34000 ppm (32 samples)	7.5-23
Nickel:	7 - 42.9 ppm (9 samples)	6 - 140
Zinc:	23 - 2370 ppm (17 samples)	5 - 10
Arsenic:	35.3 ppm (1 sample)	< 1.4
Lead:	8.2 - 377000 ppm (27 samples)	6 - 270
Silver:	0.45 - 8.1 ppm (5 samples)	

Groundwater contamination is highest in this area. Highest groundwater concentrations (primarily VOCs - BTEX) were detected in MW-8 and MW-6S, down-gradient of MW-8. Historical land use suggests that gasoline and related hydrocarbons may have been leaked. VC concentrations appear to relate to refining process areas. Semi-VOCs correlate to high VC areas. No lead or copper detected at significant concentrations (high pH of waters cited).

Space for New Information:

CONTAMINANT SUMMARY BY SECTOR (refer to figure 2) cont'd

Area G: Cooling Water Lagoons and Slop Oil Lagoons

Historical information shows a number of impoundments and tanks. Aerial photographs show the area was covered by sand dredged from the Rio Grande by the U.S. Army Corps of Engineers.

Soils from tests pits had moderate to high concentrations of VOCs and SVOCs. Contamination is presumed by both gasoline-related hydrocarbons as wells heavier, oily hydrocarbons present as residuals in wastewater. Significant SVOCs at concentrations greater than 1000 ppb included: naphthalene, 2-methylnaphthalene, phenanthrene, anthracene, dibenzofuran, fluorene, 2,4-dinitrotoluene, pyrene, 4-nitrophenol, acenaphthene, chrysene, benzo(a)anthracene, acenaphthylene, 4-chloroaniline, o-nitrotoluene, m-nitrotoluene, nitrobenzene, benzo(a)pyrene, 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, and 2,6-dinitrotoluene. Highest SVOC concentrations on north side of Area G, near southeastern corner. Remainder of area has lower concentrations, suggestive of cooling water pond environments.

Heavy metal concentrations in soil, primarily lead and copper, do not correlate well with VC samples.

Moderate to high petroleum concentrations. Heterogeneous nature of wastewater in impoundments presumably left a petroleum residual detected in soils. Gasoline-like hydrocarbons detected in localized, northwestern corner of Area G. Contamination extends deeper than 120 inches, max. working depth of backhoe. Depth at which soils encountered generally deeper than 60 inches as result of dredge spoils from Rio Grande placed on Area G by Corps of Engineers dredging operations.

		Background
Mercury:	0.03 - 0.15 ppm (4 samples)	<0.02 - 0.11
Cadmium:	0.3 - 36.7 ppm (8 samples)	<0.25 - 1.2
Chromium:	7 - 97 ppm (15 samples)	0.9 - 5.5
Copper:	7.1 - 20100 ppm (15 samples)	7.5-23
Nickel:	7.7 - 41 ppm (14 samples)	6 - 140
Zinc:	8.5 - 985 ppm (6 samples)	5 - 10
Arsenic:	29.9 ppm (1 sample)	< 1.4
Lead:	14.5 - 34900 ppm (15 samples)	6 - 270
Silver:	2.5 ppm (1 sample)	

Groundwater contamination is highest in this area. A free-phase similar to gasoline was detected in well MW-11 and suggest a local BTEX dissolved phase plume is present in the northwestern corner of the area. Benzene the only VC detected in significant concentrations. Down-gradient wells MW-10 and the MW-9 cluster do not appear to be affected by this BTEX source. VC concentrations may be related to process areas and holding ponds.

Space for New Information:

CONTAMINANTS OF CONCERN

This section contains a list of the contaminants of concern at the site. All site workers need to be aware that these chemicals are known to be present in varying concentrations.

In order to reduce the page count and corresponding reading requirements of this Health and Safety Plan, complete contaminant data has not been assembled. Instead, general data has been assembled for BTEX compounds. This data provides for general information and protection guidelines for all organic compounds. Site workers should read and understand the contaminant data and apply these guidelines to all activity that has the potential to encounter contamination at this site.

Listing of contaminants of concern identified at site:

Listing of Known Major Contaminants:

Soils:

VOCs
- Acetone
- 1-Butanone
- Benzene
- Ethylbenzene
- Xylenes
- 1,1,2-TCA
- 1,1,2,2-PCA
- Methyl Cyclopentane
- Methyl pentane
- Cyclohexene
- Methylene Chloride (1)
- Toluene (1)
- 4 Methyl-2-Pentanone (1)
- 2-Hexanone (1)
- Hexylcyclohexane
- 2-4-Benzene
- Tetrahydronaphthalene (1)
- Dimethylnaphthalene
- 2,3-Dihydro-methyl-IH-Indene
- 2,3-Dihydrotrimethyl-IH-Indene
- Methylcylopentane
- Ethylcyclohexane
- Dimethylhexane
- Anthracene
- 2,4-Dinitrotoluene
- Pyrene
- 4-Nitrophenol
- Butylbenzylphthalate
- Acenaphthene
- Chrysene
- Benzo(a)anthracene
- Acenaphthylene
- 4-Chloroaniline
- o-Nitrotoluene
- m-Nitrotoluene
- n-Nitrosodiphenylamine
- C16 Alkane
- C19 Alkane
- C2-Naphthalene
- C3-Naphthalene

Semi-VOCs
- Naphthalene
- 2-Methylnaphthalene
- Phenanthrene
- Dibenzofuran
- bis (2-ethylhexyl)phthalate
- Fluorene
- Di-n-butyl phthalate
- C14 Alkane
- C13 Alkane
- C16 Alkane
- C12 Alkane
- C11 Alkane
- Methylnaphthalene (isomer)
- Dimethylnaphthalene (isomer)

Contaminants cited as CERCLA hazardous substances: (Note: Not all data has been validated)

Groundwater:		Site Contamination Concentration
2-methylnaphthalene	-	270 ppb
fluorene	-	36 ppb
phenanthrene	-	54 ppb
pyrene	-	28 ppb
trimethyldodecane	-	800 ppb
trimethyldecane	-	600 ppb
benzene	-	80 ppb
toluene	-	30 ppb
ethylbenzene	-	50 ppb
total xylenes	-	100 ppb

Wastes & Soils:

cyanide	-	1.3 - 3.3 ppm
phenolics	-	2.9 - 33 ppm
2-methylphenol	-	0.25 ppm
naphthalene	-	0.30 ppm
2-methylnaphthalene	-	0.71 ppm
di-ethylphthalate	-	0.26 ppm
pentachlorophenol	-	0.25 ppm
phenanthrene	-	0.20 ppm
pyrene	-	0.18 ppm
benzo(k)fluoranthene	-	0.22 ppm
benzene	-	0.12 - 2.6 ppm
toluene	-	0.19 - 16 ppm
ethylbenzene	-	0.23 - 13 ppm
total xylenes	-	0.2 - 11.4 ppm
1,2-dimethylbenzene	-	0.36 - 13 ppm
1,3-dimethylbenzene	-	0.25 - 22 ppm
1,4-dimethylbenzene	-	3.6 - 6.7 ppm
mercury	-	0 - 720 ppm
cadmium	-	1 - 50 ppm
chromium	-	<0.9 - 150 ppm
copper	-	8.4 - 101,000 ppm
lead	-	7 - 4,000 ppm
zinc	-	39 - 924 ppm
arsenic	-	1.3 - 160 ppm

Known Site Contaminant: BTEX Compounds

Contaminant Data: BTEX COMPOUNDS, GENERAL

Fire and Explosion Hazard:
FLAMMABLE. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. (USCG, 1985)

Protective Clothing:
Avoid breathing vapors. Keep upwind. Wear boots, protective gloves, and goggles. Do not handle broken packages without protective equipment. Wash away any material which may have contacted the body with copious amounts of water or soap and water. ((C)AAR, 1986)

Health Hazards:
VAPOR: Irritating to eyes, nose and throat. If inhaled, will cause headache, difficult breathing, or loss of consciousness. LIQUID: Irritating to skin and eyes. Harmful if swallowed. (USCG, 1985)

Fire Fighting Procedures:
Do not extinguish fire unless flow can be stopped. Use water in flooding quantities as fog. Solid streams of water may spread fire. Cool all affected containers with flooding quantities of water. Apply water from as far a distance as possible. Use foam, carbon dioxide or dry chemical. ((C)AAR, 1986)

Spill Cleanup:
Keep sparks, flames, and other sources of ignition away. Keep material out of water sources and sewers. Build dikes to contain flow as necessary. Attempt to stop leak if without hazard. Use water spray to knock-down vapors. Land spill: Dig a pit, pond, lagoon, holding area to contain liquid or solid material. Dike surface flow using soil, sand bags, foamed polyurethane, or foamed concrete. Absorb bulk liquid with fly ash, cement powder, sawdust, or commercial sorbents. Apply fluorocarbon-water foam to diminish vapor and fire hazard. Water spill: Use natural barriers or oil spill control booms to limit spill motion. Use surface active agent (e.g. detergent, soaps, alcohols) to compress and thicken spilled material. Inject "universal" gelling agent to solidify encircled spill and increase effectiveness of booms. If dissolved, apply activated carbon at ten times the spilled amount in region of 10 ppm or greater concentration. Remove trapped material with suction hoses. Use mechanical dredges or lifts to remove immobilized masses of pollutants and precipitates. Air spill: Apply water spray or mist to knock down vapors. ((C)AAR, 1986)

First Aid:
If this chemical comes in contact with the eyes, immediately wash the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention immediately. Contact lenses should not be worn when working with this chemical. If this chemical comes in contact with the skin, promptly wash the contaminated skin with soap and water. If this chemical penetrates through the clothing, promptly remove the clothing and wash the skin with soap and water. Get medical attention promptly. If a person breathes in large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible. If this chemical has been swallowed, get medical attention immediately. (NIOSH, 1987).

Known Site Contaminant: BENZENE **Highest Concentration Observed:** 19,000 μg/Kg

General Description:
Benzene is a clear colorless liquid with a characteristic aromatic odor. It is used to make other chemicals, as a solvent, and as a gasoline additive. Benezene has a flash point of 12 deg F., and solidifies at 42 deg F. It is lighter than water and insoluble in water. Benezene vapors are heavier than air. ((C)AAR, 1986)

Warning Concentration (ppm or mg/m^3): Benzene 4.68 ppm

Exposure Limits/Guidelines: **Photoionization Potential:** 9.24 eV

OSHA PEL:	1 ppm (mg/m^3)
NIOSH REL:	Carcinogenic 0.1 ppm (mg/m^3)
ACGIH TLV-TWA:	10 ppm
IDLH:	2,000 ppm

NIOSH CHEMICAL HAZARD, POCKET GUIDE INFORMATION:

Chemical name, structure/formula, CAS and RTECS Nos., and DOT ID and guide Nos.	Synonyms, trade names, and conversion factors	Exposure limits (TWA unless noted otherwise)	IDLH	Physical description	Chemical and physical properties MW, BP, SOL Fl.P, IP, Sp.Gr, flammability	Chemical and physical properties VP, FRZ UEL, LEL	Incompatibilities and reactivities	Measurement method (See Table 1)
Benzene C_6H_6 71-43-2 CY1400000 1114 27	Benzol, Phenyl hydride 1 ppm = 3.25 mg/m^3	NIOSH Ca See Appendix A 0.1 ppm ST 1 ppm OSHA [1910.1028] 1 ppm ST 5 ppm	Ca [3000 ppm] ACGIH A2	Colorless to light-yellow liquid with an aromatic odor. [Note: A solid below 42°F.]	MW: 78.1 BP: 176°F Sol: 0.07% Fl.P: 12°F IP: 9.24 eV Sp.Gr: 0.88 Class IB Flammable Liquid	VP: 75 mm FRZ: 42°F UEL: 7.9% LEL: 1.3%	Strong oxidizers, many fluorides & perchlorates, nitric acid [Note: Measurements may also be made with a portable GC using NIOSH #3700 (III).]	Char; CS_2; GC/FID; III [#1500, Hydrocarbons]

Personal protection and sanitation (See Table 3)	Recommendations for respirator selection — maximum concentration for use (MUC) (See Table 4)	Health hazards Route	Symptoms (See Table 5)	First aid (See Table 6)	Target organs (See Table 5)
Clothing: Repeat Goggles: Reason prob Wash: Prompt wash soap Change: N.R. Remove: Immed wet (flamm)	NIOSH ¥: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Abs Ing Con	Irrit eyes, nose, resp sys; gidd; head, nau, staggered gait; ftg, anor, lass; derm; bone marrow depres; [carc]	Eye: Irr immed Skin: Soap wash prompt Breath: Resp support Swallow: Medical attention immed	Blood, CNS, skin, bone marrow, eyes, resp sys

SITE HEALTH AND SAFETY PLAN

Known Site Contaminant: TOLUENE **Highest Concentration Observed:** 18,800 µg/Kg

General Description:
Toluene is a clear colorless liquid with a characteristic aromatic odor. Toluene is used in aviation and automotive fuels, as a solvent for many materials, and to make other chemicals. It has a flash point of 40 °F. Toluene is lighter than water and insoluble in water and its vapors are heavier than air. ((C)AAR, 1986)

Warning Concentration (ppm or mg/m^3): Toluene 0.17 ppm

Exposure Limits/Guidelines: **Photoionization Potential:** 8.82 eV

OSHA PEL:	100 ppm
NIOSH REL:	100 ppm
ACGIH TLV-TWA:	100 ppm
IDLH:	2,000 ppm

NIOSH CHEMICAL HAZARD, POCKET GUIDE INFORMATION:

Chemical name, structure/formula, CAS and RTECS Nos., and DOT ID and guide Nos.	Synonyms, trade names, and conversion factors	Exposure limits (TWA unless noted otherwise)	IDLH	Physical description	Chemical and physical properties		Incompatibilities and reactivities	Measurement method (See Table 1)
					MW, BP, SOL Fl.P, IP, Sp.Gr, flammability	VP, FRZ UEL, LEL		
Toluene $C_6H_5CH_3$ 108-88-3 XS5250000	Methyl benzene, Methyl benzol, Phenyl methane, Toluol	NIOSH/OSHA 100 ppm (375 mg/m^3) ST 150 ppm (560 mg/m^3)	2000 ppm	Colorless liquid with a sweet, pungent, benzene-like odor.	MW: 92.1 BP: 232°F Sol(61°F): 0.05% Fl.P: 40°F IP: 8.82 eV	VP(65°F): 20 mm FRZ: -139°F UEL: 7.1% LEL: 1.2%	Strong oxidizers	Char; CS_2; GC/FID; III [#1500, Hydrocarbons]
1294 27	1 ppm = 3.83 mg/m^3				Sp.Gr: 0.87 Class IB Flammable Liquid			

Personal protection and sanitation (See Table 3)		Recommendations for respirator selection — maximum concentration for use (MUC) (See Table 4)	Health hazards				
			Route	Symptoms (See Table 5)	First aid (See Table 6)		Target organs (See Table 5)
Clothing: Goggles: Wash: Change: Remove:	Repeat Reason prob Prompt wet N.R. Immed wet (flamm)	NIOSH/OSHA 1000 ppm: CCROV*/SA*/PAPROV*/ SCBA* 2000 ppm: SA:CF*/SCBAF/SAF/GMFOV §: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Abs Ing Con	Ftg, weak; conf, euph, dizz, head; dilated pupils, lac; ner, musc ftg, insom; pares; derm	Eye: Skin: Breath: Swallow:	Irr immed Soap wash prompt Resp support Medical attention immed	CNS, liver, kidneys, skin

SITE HEALTH AND SAFETY PLAN

Known Site Contaminant: ETHYL BENZENE Highest Concentration Observed: 5,200 μg/Kg

General Description:
Ethyl benzene is a clear colorless liquid with an aromatic odor. It is used as a solvent and to make other chemicals. Ethyl benzene has a flash point of 55°F. Ethyl benzene is lighter than water and insoluble in water and its vapors are heavier than air. ((C)AAR, 1986)

Warning Concentration (ppm or mg/m^3): Ethyl Benzene No Information Available

Exposure Limits/Guidelines: Photoionization Potential: 8.76 eV

OSHA PEL:	100 ppm
NIOSH REL:	100 ppm
ACGIH TLV-TWA:	N/A
IDLH:	2,000 ppm

NIOSH CHEMICAL HAZARD, POCKET GUIDE INFORMATION:

Chemical name, structure/formula, CAS and RTECS Nos., and DOT ID and guide Nos.	Synonyms, trade names, and conversion factors	Exposure limits (TWA unless noted otherwise)	IDLH	Physical description	Chemical and physical properties		Incompatibilities and reactivities	Measurement method (See Table 1)
					MW, BP, SOL FI.P, IP, Sp.Gr, flammability	VP, FRZ UEL, LEL		
Ethyl benzene $CH_3CH_2C_6H_5$ 100-41-4 DA0700000 1175 26	Ethylbenzol, Phenylethane 1 ppm = 4.41 mg/m^3	NIOSH/OSHA 100 ppm (435 mg/m^3) ST 125 ppm (545 mg/m^3)	2000 ppm	Colorless liquid with an aromatic odor.	MW: 106.2 BP: 277°F Sol: 0.01% Fl.P: 55°F IP: 8.76 eV Sp.Gr: 0.87 Class IB Flammable Liquid	VP(79°F): 10 mm FRZ: -139°F UEL: 6.7% LEL: 1.0%	Strong oxidizers	Char; CS$_2$; GC/FID; III [#1501, Aromatic Hydrocarbons]

Personal protection and sanitation (See Table 3)	Recommendations for respirator selection — maximum concentration for use (MUC) (See Table 4)	Health hazards			
		Route	Symptoms (See Table 5)	First aid (See Table 6)	Target organs (See Table 5)
Clothing: Repeat Goggles: Reason prob Wash: Prompt wet Change: N.R. Remove: Immed wet (flamm)	NIOSH ¥: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Abs Ing Con	Irrit eyes, resp sys, skin; [carc]	Eye: Irr immed Skin: Water flush immed Breath: Resp support Swallow: Medical attention immed	Resp sys, eyes, skin

SITE HEALTH AND SAFETY PLAN

Known Site Contaminant: XYLENE **Highest Concentration Observed:** 9,000 μg/kg

General Description:
Xylene is a clear colorless liquid with a characteristic aromatic odor. It is used as a solvent for paints and adhesives, and to make other chemicals. Xylene has a flash point of 81-90 °F. Xylene is lighter than water and insoluble in water and its vapors are heavier than air. ((C)AAR, 1986)

Warning Concentration (ppm or mg/m^3): No information available

Exposure Limits/Guidelines: **Photoionization Potential:** 8.44 eV

OSHA PEL:	100 ppm
NIOSH REL:	100 ppm
ACGIH TLV-TWA:	N/A
IDLH:	100 ppm

NIOSH CHEMICAL HAZARD, POCKET GUIDE INFORMATION:

Chemical name, structure/formula, CAS and RTECS Nos., and DOT ID and guide Nos.	Synonyms, trade names, and conversion factors	Exposure limits (TWA unless noted otherwise)	IDLH	Physical description	Chemical and physical properties		Incompatibilities and reactivities	Measurement method (See Table 1)
					MW, BP, SOL Fl.P, IP, Sp.Gr, flammability	VP, FRZ UEL, LEL		
Xylenes (o-, m-, p-isomers) $C_6H_4(CH_3)_2$ 1330-20-7 ZE2100000 1307 27	o: 1,2-Dimethylbenzene; o-Xylol, m: 1,3-Dimethylbenzene; m-Xylol, p: 1,4-Dimethylbenzene; p-Xylol 1 ppm = 4.41 mg/m^3	NIOSH/OSHA 100 ppm (435 mg/m^3) ST 150 ppm (655 mg/m^3)	1000 ppm	Colorless liquids with an aromatic odor. [Note: Pure p-xylene is a solid below 56°F.]	MW: 106.2 BP: 292/269/ 281°F Sol: Insoluble Fl.P: 63/84/ 81°F IP: 8.56/8.56/8.44 eV Sp.Gr: 0.88/0.86/0.86 Class IB Flammable Liquid (o) Class IC Flammable Liquids (m,p)	VP: 7/9/9 mm FRZ: -13/ -54/56°F UEL: 7.0/7.0/7.0% LEL: 1.1/1.0/1.1%	Strong oxidizers	Char; CS$_2$; GC/FID; III [#1501, Aromatic Hydrocarbons]

Personal protection and sanitation (See Table 3)		Recommendations for respirator selection — maximum concentration for use (MUC) (See Table 4)	Health hazards				
			Route	Symptoms (See Table 5)	First aid (See Table 6)		Target organs (See Table 5)
Clothing: Goggles: Wash: Change: Remove:	Repeat Reason prob Prompt contam N.R. Immed wet (flamm)	NIOSH/OSHA 1000 ppm: CCROV*/PAPROV*/SA*/ SCBA* §: SCBAF:PD,PP/SAF:PD,PP:ASCBA Escape: GMFOV/SCBAE	Inh Abs Ing Con	Dizz, excitement, drow, inco, staggering gait; irrit eyes, nose, throat; corneal vacuolization; anor, nau, vomit, abdom pain; derm	Eye: Skin: Breath: Swallow:	Irr immed Soap wash prompt Resp support Medical attention immed	CNS, eyes, GI tract, blood, liver, kidneys, skin

SITE HEALTH AND SAFETY PLAN

Site Personnel and Responsibilities (Include Subcontractors)

Name	Firm	Health Clearance	Responsibilities	Tasks
W.S. Dubyk	H$^+$GCL	Yes	Work Assignment Manager	A-F
David W. Nee	H$^+$GCL	Yes	Health and Safety Officer, Alternate	A-F
Mike Silva	H+GCL	Yes	Health and Safety Officer, Prime	A-F

LEVELS OF PROTECTION:

Task A: Site Walk Through Activity Level: D Modified Yes

Task Description Specific Technique/Site Location
All areas of the site may be walked with basic level D protection. This includes survey activity, photography and any ground surface activity that <u>does not require</u> intrusive activity.

Specialized Medical Surveillance Required
Monitor personnel for heat stress while on-site. Personnel must have pulmonary function tests and fit tests if upgrading.

Specialized Training Required: No
Type: All personnel <u>should have</u> at a minimum, the basic 24 hour OSHA hazardous waste site workers training.

Level of Protection (Primary) Level D

Contingency Level C upgrade to respirators if ambient volatiles are indicated by > 25% LEL. Personnel that do not have respirator and/or OSHA training should leave site, rather than upgrade.

Schedule
Casual site walking presents only minor hazards. These hazards include trips and falls and possible cuts from glass and debris on the surface of the site. There is a possibility of bites and stings from poisonous insects and snakes. Intrusive activity such as excavation may increase the possibility of chemical hazards. Be aware that "Task A" personnel should be prepared to upgrade to a similar level of protection required by Task B through F if these operations are being conducted nearby.

Respiratory: [X] Not Needed
Contingency for level C upgrade is for air purifying respirator use:
[X] APR: MSA, full or half face
[X] Cartridge: Combo organic vapor + metal particulate

Head and Eye: [ ] **Not Needed**
[X] Safety Glasses Required
[ ] Face Shield:
[ ] Goggles:
[X] Hard Hat recommended:
[ ] Other: Ball Hat, for sun protection

Gloves: [ ] **Not Needed**
[ ] Undergloves: nitrile advisable
[X] Gloves: nitrile
[X] Overgloves Recommended

Prot. Clothing: [ ] **Not Needed**

[X] Tyvek Coverall, recommended
[X] Cotton Coverall:
[ ] Other:

Boots: [ ] **Not Needed**
[X] Boots: Steel Toe Required

Other: Specify below.
[X] Sunscreen Recommended for Sunburn Protection

LEVELS OF PROTECTION: cont'd

Task B: Sampling Activity from Monitoring Wells, Storm Water Systems and Near Surface Soils

Level: D Modified Yes

Task Description Specific Technique/Site Location: As per work plan specifics

Specialized Medical Surveillance Required: Yes
Monitor heat stress, respirator fit test, pulmonary function test. Occasional air monitoring using PID and Draager tubes recommended.

Specialized Training Required: Yes
Type: All personnel must have at a minimum, the basic 40 hour OSHA hazardous waste site workers training. This includes first aid and CPR.

Level of Protection (Primary) Level D [ ] Intrusive [X] Non-Int.

Contingency Level C upgrade to respirators if volatile are indicated by > 25% LEL.

Schedule
Normally sampling can be conducted in Level D protection. However, routine sampling of ground water wells on and nearby the site may encounter floating hydrocarbon product at any time. Heat and high temperatures may increase the volatility of normally high flash point organics.

LEL/combustible gas indicators must be used during every sampling event. The air/vapor should be monitored when the well is first opened, prior to sampling activity. The first sample should also be checked for LEL volatility. Similar procedures should be performed for sampling of near surface soils, and storm water sampling. Upgrades should be done when LEL monitoring exceeds >25% LEL. In hazardous conditions and when operating in confined spaces >25% LEL indicates a mandatory evacuation condition.

Prot. Clothing: As required by activity
Respiratory:
Contingency for level C upgrade is for air purifying respirator use:
[X] APR: MSA, full or half face
[X] Cartridge:Combo organic vapor + metal particulate

Head and Eye: [ ] **Not Needed**
[X] Safety Glasses:
[ ] Face Shield:
[ ] Goggles:
[X] Hard Hat recommended:

Gloves: [ ] **Not Needed**
[ ] Undergloves: nitrile advisable
[X] Gloves: nitrile
[ ] Overgloves:

[X] Apron:
[X] Tyvek Coverall
[X] Saranex Coverall for splash protection
[X] Cotton Coverall:

Boots: [ ] **Not Needed**

[X] Boots:
[ ] Overboots:

Other: Specify below.
[X] Sunscreen

LEVELS OF PROTECTION: cont'd

Task C: Drilling and Monitor Well Installation, Hydropunch^{T}M Activity Level: C Modified Yes

Task Description Specific Technique/Site Location: As per specific work plan

Specialized Medical Surveillance Required: Yes
Heat stress, respiratory fit tests, pulmonary function tests, annual physicals, first aid, CPR. Ambient monitoring using PID, FID with Draager tubes recommended.

Specialized Training Required: Yes
Workers should have 40-hour hazardous site worker training

Type: Training and use of APR, airline and SCBA.

Level of Protection (Primary) Level C

Contingency Level C upgrade to respirators if volatiles are indicated by > 25% LEL.

Schedule
Normally Hydropunch™ activity can be similarly conducted as a Task B operation. However, drilling and Hydropunch™ activity is considered intrusive and protection from splash and vapors must be considered.

At a minimum when drilling holes on site, Level C and possibly Level B conditions should be expected due to hugh vapor concentrations on site. If capacity of APR cartridges are exceeded for Level C, then upgrade to supplied air or SCBA. Please check guidelines on cartridges for permissible vapor concentration loading, duration and contaminants. Combination of CGI, HNu, Dragger monitoring systems should be used by site personnel during intrusive activity. Detector tubes for BTEX should be utilized.

Level: C
Respiratory: [ ] Not Needed
Contingency for level C upgrade is for air purifying respirator use:
[X] APR: MSA, full or half face
[X] Cartridge:Combo organic vapor + metal particulate
[X] Required to upgrade to Supplied air using SCBA or airline if the capacity of the filter cartridge is exceeded, check guidelines on the specific cartridge used.

Head and Eye: [ ] Not Needed
[X] Safety Glasses:
[X] Face Shield: Possible
[ ] Goggles:
[X] Hard Hat recommended:
[ ] Other:

Prot. Clothing: As required by activity
[ ] Apron:
[X] Tyvek Coverall
[X] Saranex Coverall for splash protection
[X] Cotton Coverall:

Boots: [ ] Not Needed
[X] Boots:
[ ] Overboots:

Other: Specify below.
[X] Sunscreen

Gloves: [ ] Not Needed
[ ] Undergloves: nitrile advisable
[X] Gloves: nitrile sample handling
[X] Overgloves: For Drilling

LEVELS OF PROTECTION: cont'd

Task D: Intrusive Activity Surface Drainage Improvements, Depths to 4 Feet

Level: D Modified Yes

Task Description Specific Technique/Site Location
This task in general involves any on site excavation activity up to a depth of 4 feet.

Task: Level: D Modified Yes [X] No [ ]
For possible upgrades to Levels C or B depending on activity.

Task Description Specific Technique/Site Location
Surface drainage improvements may be required to direct and control storm water. Heavy equipment may be used to move site soils and properly grade site. Near surface (depths to 4 feet) excavation and grading may encounter buried debris and pipelines. Deeper excavation may encounter sludges and oil contaminated soil. See Work Plan for additional information.

Specialized Medical Surveillance Required
Monitor personnel for heat stress. Ambient monitoring with PID, FID and Draager tubes recommended.

Specialized Training Required
Heavy equipment operator's knowledge, first aid, and CPR. Preferably all equipment operators should hae 40-hour OSHA training.

Level of Protection (Primary) Level D
Contingency: Level C upgrade to respirators if volatiles are encountered during excavation or > 25% LEL is exceeded. Also, upgrade if excessive dust cannot be controlled using water.

Schedule
Most excavation on site to depths of 4 feet will encounter site fill materials. In some cases, the excavations may encounter buried debris or pipelines. Operators should be aware that debris and buried pipes may exist. Most operations can be performed in Level D. Upgrade may be required to Level C APR if volatiles are encountered or if excessive dust is generated. Heat generated during earth moving has the possibility of starting fires. Fire extinguishers must be present on all earth moving equipment.

Respiratory: Contingency for level C upgrade is for air purifying respirator use:
[X] APR: MSA, full or half face
[X] Cartridge:Combo organic vapor + metal particulate

Head and Eye: [ ] **Not Needed**
[X] Safety Glasses:
[ ] Face Shield:
[ ] Goggles:
[X] Hard Hat recommended:

Gloves: [ ] **Not Needed**
[ ] Undergloves: nitrile advisable
[X] Gloves: leather

Prot. Clothing: As required by activity
[ ] Apron:
[X] Tyvek Coverall
[X] Saranex Coverall for splash protection
[X] Cotton Coverall: Permissible

Boots: [ ] **Not Needed**
[X] Boots: Steel Toe
[ ] Overboots:

Other: Specify below.
[X] Sunscreen

LEVELS OF PROTECTION: cont'd

Task E: Trench Installation, Excavation Depths Greater than 4 feet Level: C Modified Yes [X]

Level C may require upgrade to Level C Modified with supplied air if excessive volatiles are encountered.

Task Description Specific Technique/Site Location
This task involves excavation of trenches to recover free-floating phase product. See Work Plan for specific information.

Task Level: C Modified Yes [X] No [ ]

Task Description Specific Technique/Site Location

Specialized Medical Surveillance Required
Heat stress monitoring. Ambient monitoring using PID, FID or Draager tubes recommended. 40-hour OSHA training mandatory.

Specialized Training Required
Use of APR and supplied air units, equipment, operator's training.

Level of Protection (Primary) Level C

Contingency Level C APR upgrade to supplied air respirators (Level B) if excessive volatiles are encountered and exceed filter capacity as indicated by Dragger detector tubes.

Schedule
Excavation into product bearing strata may encounter volatiles. Site workers should anticipate Level C conditions. If excessive volatiles are encountered and they exceed APR cartridge capacity, then upgrade to Level C with supplied air should be implemented. Heavy equipment generating heat may cause fires in excavations. Fire extinguisher should accompany all equipment. Excavation depths greater than 4 feet are considered a confined space and personnel should not enter trenches without proper shoring. Flowing sands may be encountered and trenches may cave in.

Respiratory: Contingency for level C upgrade is for supplied air
[X] APR: MSA, full or half face
[X] Cartridge:Combo organic vapor + metals particulate
[X] Supplied Our Upgrade

Head and Eye: [ ] **Not Needed**
[X] Safety Glasses:
[ ] Face Shield:
[ ] Goggles:
[X] Hard Hat recommended:
[ ] Other:

Gloves: [ ] **Not Needed**
[X] Gloves: nitrile
[X] Overgloves: leather

[X] Splash Suit:
[ ] Apron:
[X] Tyvek Coverall
[X] Saranex Coverall for splash protection
[X] Cotton Coverall:
[ ] Other:

Boots: [ ] **Not Needed**
[X] Boots:
[X] Overboots: Rubber

Other: Specify below.
Fire extinguisher
[X] Sunscreen

LEVELS OF PROTECTION: cont'd

Task F: Product Recovery and Material Handling from Recovery Systems

Level: D Modified Yes [X]

Task Description Specific Technique/Site Location
Handling of petroleum products recovered from recovery system. See Work Plan description.

Specialized Medical Surveillance Required: Heat Stress
If open containers, monitor work zones with PID, FID and Draager tubes recommended.

Specialized Training Required:
Proper waste handling proceduress. 40-hour OSHA training mandatory.

Level of Protection (Primary) Level D

Contingency: Level C upgrade to respirators if volatiles are indicated by > 25% LEL.

Schedule
Product recovered in drums and tanks need to be handled for recycling. This involves pumping or pouring of product into containers or tanks and transported to a recycling facility. All handling done in closed system can be done in Level D. If open system is involved, upgrade to Level C with splash protection should be implemented.

Respiratory:
Contingency for level C upgrade is for air purifying respirator use:
[X] APR: MSA, full or half face
[X] Cartridge: Organic vapor

Head and Eye: [ ] **Not Needed**
[X] Safety Glasses:
[X] Face Shield:
[ ] Goggles:
[X] Hard Hat recommended:
[ ] Other:

Gloves: [ ] **Not Needed**
[ ] Undergloves: nitrile advisable
[X] Gloves: nitrile
[X] Overgloves:

Prot. Clothing: As required by activity
[X] Splash Suit:
[ ] Apron:
[X] Tyvek Coverall
[X] Saranex Coverall for splash protection
[X] Cotton Coverall:

Boots: [ ] **Not Needed**
[X] Boots: Steel Toe
[ ] Overboots:

Other: Specify below.
[X] Sunscreen

Monitoring Equipment: Specify by task. Indicate type as necessary.

Instrument	Task	Action Guidelines	
Combustible Gas Indicator	B-F	0-10%LEL	No explosion hazard.
		10-25% LEL	Potential explosion hazard; notify SHSC.
		>25%LEL	Explosion hazard; interrupt task/evacuate.
		21.0%O_2	Oxygen normal.
		<21.0%O_2	Oxygen Deficient; notify SHSC.
		<19.5%O_2	Interrupt task/evacuate.

Comments (Includes schedules of use) Continuously monitor work zone areas.

Instrument	Task	Action Guidelines
Photoionization Detector	B-F	A PID should be used to monitor work activity. If >1,000 ppm is indicated then IDLH for xylene has been exceeded.
[ ] 11.7 ev [X] 10.2 ev or [X] 9.8 ev [ ] ev		Site workers should also be aware of NIOSH/OSHA exposure limits (TWA) Note: Toluene, ethyl benzene, xylene is 100 ppm Benzene TWA is 1 ppm with short term limit of 5 ppm

Comments (Includes schedules of use) Continuously monitor work zone areas.

Instrument	Task	Action Guidelines
Flame Ionization Detector	B-F	As required by work plans, may be substituted for PID

Comments (Includes schedules of use) Continuously monitor work zone areas.

Instrument	Task	Action Guidelines
Detector Tubes/ Air Monitor System (Draager tubes)	B-F	As required by work plans for detection of specified contaminants especially BTEX compounds To monitor ambient contaminants for possible upgrades for respiratory protection. Use to determine if filter capacity of respirators is exceeded.

Comments (Includes schedules of use) See work plan guidelines. Monitor work zones for BTEX.

Instrument	Task	Action Guidelines
Hamby Kit	B-F Soils Handling	Use Hamby Kit for oil content determination and for proper disposal of soils

Decontamination Procedures: Decon will occur in designated areas only. See work plans for specific guidelines.

Personal Decontamination

Personnel should not eat or drink while conducting site activities. Smoking will be limited to designated areas. Wash hands prior to leaving site. If water is not available, wash hands prior to eating or drinking. Showers are recommended at the end of every work day. Personnel should insure that boots are thoroughly and properly cleaned before leaving site, otherwise leave footwear on site. Disposable Gloves and coveralls should be placed in plastic bags. If severely contaminated the bags continuing PPE should be handled as hazardous.

Summarize below.
Decon areas will be established near site entrance on an as needed basis.

Containment and Disposal Method:

PPE used on site should be visibly inspected prior to disposal. Contaminated material should be separated for disposal as hazardous material. All disposable PPE should be rendered useless by cutting or ripping. Rinse water should be controlled and evaporated.

Sampling Equipment Decontamination
Clean with alconox, rinse with de ionized water or equivalent. See work plan for specified requirements.

Summarize below.
See specified work plan for sampler decontamination procedures.

Containment and Disposal Method:
Containerize or evaporate rinse water

Heavy Equipment Decontamination

Summarize below and/or attach diagram.
All surfaces in contact with ground surface, i.e., blades and tires should be cleaned. Dust on equipment should be rinsed off.

Contaminated Soil: Containment and Disposal Method:
(When using Oil & Grease as Indicator of Contamination)

Soil should be separated into the following categories: (During Excavation Activity)
Low = < 1,000 mg/kg
Moderate = 1,000 - 100,000 mg/kg
High = > 100,000 mg/kg

During hazardous waste site investigations, good work habits are important to the prevention of undue exposure to contaminants and to maintain a safe working environment. One of the simplest methods of preventing undue exposures is the development of good personal hygiene habits. These should include the though washing of hands and face upon leaving the contamination reduction zone and before eating, drinking, or smoking, all of which should take place only in the support zone. Personnel should change clothes and shower immediately following each work shift.

The following general safety rules will be obeyed during H^+GCL field activities:

- In the event of intrusive activities, utility companies shall be informed of proposed work prior to the initiation of the actual operation. Determinations shall be made of the existence of underground installations, and if these are near the area to be drilled, the concerned utility shall clearly delineate their locations.
- Plan site activities thoroughly ahead of time: Enter the site only to get to a designated point by a designated route for a specific purpose.
- No contact lenses are to be worn. Contact lenses can absorb chemicals and can become coated with low concentrations dust which may irritate the eye.
- Always observe the buddy system: Never enter or exit a site alone, and never work alone in an isolated area.
- All individuals must go through specified decontamination procedures.
- Always maintain contact with site health and safety personnel.
- Decontaminate clothing (such as gloves and boots) which has contacted known sources of contamination at the site.
- Keep track of weather conditions and wind direction.
- Never climb over or under refuse or obstacles.
- Never assume that a situation is as safe as it appears to be.
- Be alert to any unusual behavior on the part of other team members which might indicate distress, disorientation, or other ill effects.
- Any open wounds must be covered with an air-tight bandage; ideally, someone with an open wound should not enter the site.
- If possible, excessively dusty conditions will be kept to a minimum by the use of a waster spray. However, the use of a full face air purifying respirator with particulate cartridge for both dust and organic vapors during soil intrusive activities may be necessary. See Site Health and Safety Plan for details on protective equipment.
- No one shall be permitted to eat, drink, or smoke on the site and all personnel shall thoroughly wash hands with soap and water before doing any of these activities off site.
- Wet weather operations will require that disposable rainsuits be worn by all personnel.
- At the end of each day, disposable clothing shall be removed and disposed of in a doubled heavy duty plastic bags. These will be placed in a secure contaminated waste storage area.
- All work operations on site shall cease at sunset unless proper auxiliary light has been provided and approved.
- All personnel shall attend a daily tailgate health and safety meeting prior to beginning work on site. They will sign a form stating their understanding of site hazards and agreement to abide by provisions of the Site Health and Safety Plan.

SITE HEALTH AND SAFETY PLAN

Emergency Contacts

Site Water Supply	N/A
Site Telephone	269-5076
Site Radio	N/A
Site Other (Specify)	N/A
New Mexico Response Team	(505) 827-5277

Emergency Contacts

Regional Health and Safety Supervisor	Randy Hicks
Project/Site Manager	Steve Dubyk
Site Health and Safety Coordinator	David Nee, Mike Silva
EPA Contact	
H$^+$GCL Home Office	(505) 842-0001; 1-800-388-8945
H$^+$GCL Health and Safety Manager	(617) 589-0660
Other (Specify)	Mike Silva (505) 881-7552 (Home)
State Environmental Agency	NMED Santa Fe (505) 827-2898
State Spill Contractor	
Fire Department	(915) 886-2101
Police Department	
State Police	(915) 886-3838
Health Department	
Poison Control Center	1-800-432-6866

Medical Emergency

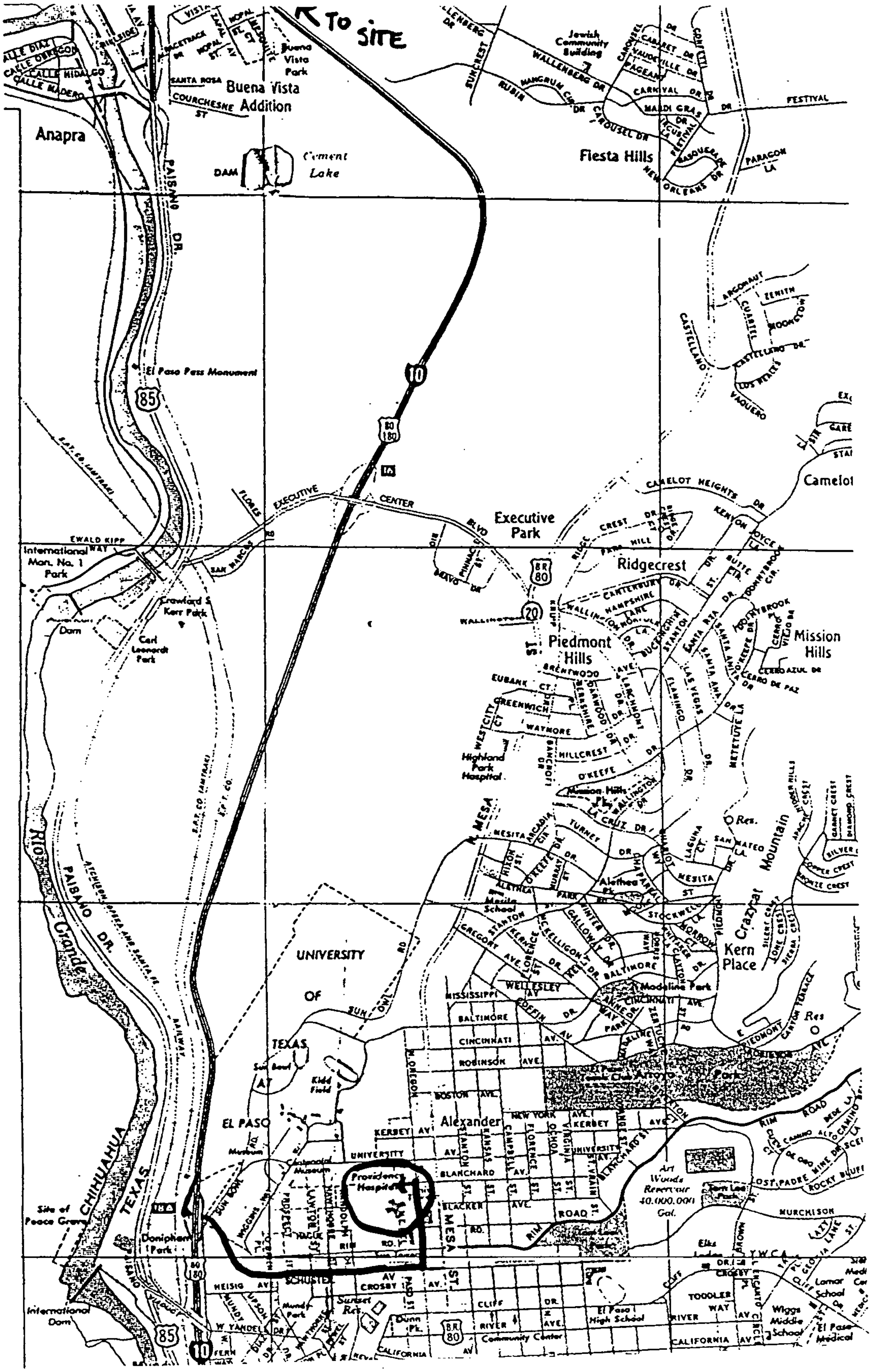
Hospital Name: Providence Memorial Hospital **Phone:** (915) 542-6011

Hospital Address: 2001 N. Oregon, El Paso, Texas 79902

24-Hour Ambulance: EMS **Phone:** (915) 564-6943

Route to Hospital: Head south from site and use Executive Center interchange to enter I-10 south. Follow I-10 highway south into El Paso for about 4 miles. Use Schuster Avenue interchange off ramp take a left, follow Schuster Avenue for 1/2 mile then take a left on Oregon to the Providence hospital.

Distance: (Attach Map) Approximately 5 Mi.



SITE HEALTH AND SAFETY PLAN

Contingency Plans: Summarize below.

Site Health and Safety Plan Approvals

Prepared By: MIKE SILVA **Date:** AUG 18 1993

Signature: Mike Silva **Date:** AUG 18 1993

SHSC Signature: ______ **Date:** ______

HSM Signature: ______ **Date:** ______

Signature Page

This Health and Safety Plan is to be read by all site workers, including subcontractors and visiting regulatory personnel.

I have read, understand, and agree to comply with the provisions of the attached Health and Safety Plan and agree to comply with the provisions the Health and Safety Plan for work activities on this project.

PRINTED NAME	SIGNATURE	DATE
MIKE SILVA	Mike Silva	AUG 18 1993

Employee Injury/Exposure Incident Report

In the event of an injury or incident:

- decontaminate the individual as much as possible without inflicting further injury
- if decontamination is not possible, wrap the individual in a tarp to limit the contamination of the vehicle and medical treatment facility
- transport the victim to a medical treatment facility

The decision to use an ambulance or to use a vehicle from the site will depend upon the nature and severity of the injury. Minor injuries can usually be treated faster at a free- standing medical emergency center (Lovelace Urgent Care Center, Family Medical Center, etc.) than at a hospital emergency room. A more serious injury will often be referred to a hospital emergency room from a free-standing emergency center, this will of course result in additional delay, discomfort for the victim, and cost.

This form should be filled out by the site supervisor as soon as they have knowledge of a potential over-exposure or injury. Return the completed form to the Health and Safety Manager as soon as possible.

Employee Injury/Exposure Incident Report

Name: ______________________________ SSN: ______________________

Site Name/Client: ____

Date of Report: __________________ Task/Phase: _________________________

Incident Type: [ ] Possible Excessive Exposure [ ] Excessive Exposure [ ] Injury

Date of Incident: __________________ Time of Incident: ____________________

Site Conditions at the Time of the Incident

Temperature: ________ Relative Humidity: ________ Precipitation: ______

Cloud Cover %: ______ Wind Speed & Direction: ____________________

Other Factors That May Have Impacted the Site: ____________________________

Nature of Exposure/Injury

Material Exposed To: _________________________ Concentration: __________

Matrix: _________________________ Physical State: _______________

Part(s) of Body Exposed or Injured: __________________________________

Type or Extent of Injury or Exposure: ________________________________

Medical Care Received

When: ____________ Where: __________________________________

Name of Physician: ____

Result of Exposure/Injury

[ ] Death [ ] Permanent Disability [ ] Temporary Disability [ ] Loss of Work Time

[ ] Other Explain: ____

Was Operation Conducted According to an Approved Health and Safety Plan

[ ] yes [ ] no Explain: _______________________________________

Who Witnessed the Injury/Incident: ____________________________________

Was the Injury/Incident due to the Failure of Protective Equipment [ ] yes [ ] no

Possible Cause of Injury/Incident: ___________________________________

Possible Prevention of the Injury/Incident: ____________________________

Signature of Person Completing Report: ______________________________

Name of Person Completing Report: __________________________________

Appendix F

Chain-of-Custody Seal

CORE LABORATORIES
1300 S. Potomac St., Suite 130
Aurora, Colorado 80012
303/751-1780

OFFICIAL SAMPLE SEAL

SAMPLE NO.

DATE

SIGNATURE

PRINT NAME AND TITLE (Inspector, Analyst or Technician)

SEAL BROKEN BY

DATE

Appendix G

Chain-of-Custody Record

GCL
Environmental Science and Engineering
A BDM International Company

☐ Albuquerque
505 Marquette NW, Ste. 1100
Albuquerque, NM 87102
(505) 842-0001
FAX: (505) 842-0595

☐ Mid Atlantic Region
4221 Forbes Blvd., Ste. 240
Lanham, MD 20706-4325
(301) 459-9677
FAX: (301) 459-3064

☐ NASA-WSTF
PO Drawer MM
Las Cruces, NM 88004
(505) 524-5353
FAX: (505) 524-5315

№ 9001

Chain of Custody

Date________________Page________Of________

Lab Name ______________________________
Address ______________________________
____
Telephone ______________________________

Samplers (SIGNATURES)

Analysis Request

Sample Number	Matrix	Location	Halogenated Volatiles 601/8010	Aromatic Volatiles 602/8020	Phenols, Sub Phenols 604/8040	Pesticides/PCB 608/8080	Polynuclear Aromatic Hydrocarbons 610/8310	Volatile Compounds GC/MS 624/8240	Base/Neu/Acid Compounds GC/MS 625/8270	Total Organic Carbon (TOC) 415/9060	Total Organic Halides (TOX) 9020	Petroleum Hydrocarbons 418.1	TPH/BTEX Modified 8015	TCLP- Vol., Semi-Vol. Herbicides, Pesticides	TCLP- Metals	RCRA Metals(8)	Priority Pollutant Metals (13)	CAM Metals (18) TTLC/STLC	Flash Point	Corrosivity	Reactivity	Oil & Grease	Cyanide Total/Amenable	Chemical Oxygen Demand (COD)					Number of Containers

Project Information	Sample Receipt	
Project	Total No. of Containers	
Project Director	Chain of Custody Seals	
Charge Code No.	Rec'd Good Condition/Cold	
Shipping ID. No.	Conforms to Record	
	Lab No.	
Via:		

Special Instructions/Comments:

Relinquished By 1.	Relinquished By 2.	Relinquished By 3.
(Signature) (Time)	Signature) (Time)	(Signature) (Time)
(Printed Name) (Date)	(Printed Name) (Date)	(Printed Name) (Date)
(Company)	(Company)	(Company)

Received By 1.	Received By 2.	Received By (Laboratory) 3.
(Signature) (Time)	(Signature) (Time)	(Signature) (Time)
(Printed Name) (Date)	(Printed Name) (Date)	(Printed Name) (Date)
(Company)	(Company)	(Laboratory)

Distribution: White, Canary-Laboratory • Pink, GCL

LEGEND

******	FENCE
⊗	EXISITING WELL POINT
●	EXISTING MONITOR WELL
X	PROPOSED SOIL BORING
◎	ADJUST EXISTING WELL POINT UPWARD
▣	ADJUST EXISTING WELL POINT DEEPER
■	PROPOSED SOIL BORING CONVERSION TO MONITOR WELL
⊠	PROPOSED SOIL BORING CONVERSION TO WELL POINT
△	PROPOSED NEW WELL POINT LOCATION
>—<	PROPOSED TEST TRENCH
(MW-01)	LOCATION IDENTIFIER
- - -	EDER ASSOCIATES, 1990 ESTIMATE OF MOST SIGNIFICANT SOIL CONTAMINATION

GCL

PLATE A

PROPOSED SUBSURFACE REMEDIAL INVESTIGATION FOR THE FORMER BRICKLAND REFINERY SITE

CLIENT: REXENE

DATE: 3/21/94

DRAWN BY: HCC

CHECKED BY: BAS

DWG. NO.: \REXENE\RMDLINVS.DWG