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May 5, 1998

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Reference: Contract No. 68-W4-0006; Work Assignment R06022; Sparton
Technology, Albuquerque, New Mexico; EPA I.D. No. NMD083212332;
Transmittal of Groundwater Monitoring Plan

Dear Mr. Will:

Enclosed please find the Draft Ground Water Monitoring Plan that TechLaw, Inc. prepared for EPA for the Sparton Technology site. Tables to be included in the plan will follow. Please review the plan with respect to specific New Mexico regulations and requirements. If possible, please provide comments to Mike Hebert, EPA Region 6 by May 7, 1998. Mr. Hebert's phone number is (214) 665-8315.

Please contact me or the TechLaw Work Assignment Manager, Phebe Davol, at 254/793-3419 if you have any questions.

Sincerely,

Debra Pandak
Regional Manager

cc: McClurg, EPA Region 6 RPO
M. Hebert, EPA
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GROUND-WATER MONITORING PROGRAM PLAN

**SPARTON TECHNOLOGY, INC.
COORS ROAD FACILITY
ALBUQUERQUE, NEW MEXICO**

MAY 4, 1998

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TABLE OF CONTENTS

1.0	INTRODUCTION	1-1
1.1	FACILITY BACKGROUND	1-1
1.1.1	Site Description	1-1
1.1.2	Facility History	1-2
1.2	REGULATORY HISTORY	1-3
1.2.1	Interim Measure	1-4
1.2.2	RCRA Facility Investigation	1-4
1.2.3	Corrective Measures Study	1-5
1.3	SELECTED REMEDY AND ASSOCIATED MONITORING REQUIREMENTS	
1.3.1	Selected Remedy	1-6
1.3.2	Ground Water Monitoring Requirements	1-7
2.0	GROUNDWATER MONITORING SYSTEM	2-1
2.1	SITE GEOLOGY AND HYDROGEOLOGY	2-1
2.2	STATE MONITORING PROGRAM	2-1
2.3	RFI MONITORING PROGRAM	2-1
2.4	SUPPLEMENTARY GROUNDWATER MONITORING PROGRAM	2-2
2.5	GROUND WATER MONITORING, AS MANDATED IN THE FINAL AOC	2-3
2.6	DESCRIPTION OF THE CONTAMINANT PLUME	2-4
3.0	GROUNDWATER EXTRACTION SYSTEM	3-1
3.1	Existing On-Site Groundwater Extraction and Treatment System	3-1
3.1.1	System Description	3-1
3.1.2	Ground Water Monitoring Requirements	3-1
3.1.3	Hydraulic Performance of the Existing On-Site Groundwater Extraction and Treatment System	3-2
4.0	FIELD PROCEDURES	4-1
4.1	INDEX OF FIELD PROCEDURES	4-1
5.0	SAMPLING AND ANALYSES	5-1
5.1	GROUNDWATER SAMPLING PARAMETERS AND FREQUENCY	5-1
5.1.1	Existing On-Site Groundwater Extraction and Treatment System	5-1
5.1.2	Monitoring Well Network	5-1
5.2	GROUNDWATER SAMPLING PROCEDURES	5-2
5.2.1	Decontamination	5-2
5.2.2	Water Level Measurements	5-2
5.2.3	Well Purging	5-3
5.2.4	Sample Collection	5-3
5.2.5	Sample Handling	5-3
5.2.6	Sample Packaging and Shipping	5-5
5.3	ENVIRONMENTAL SAMPLES	5-6

	5.3.1 Field-Generated QC Samples	5-7
	5.3.2 Sample Containers and Preservation Methods	5-7
5.4	SAMPLE CUSTODY AND FIELD DOCUMENTATION	5-7
	5.4.1 Chain of Custody	5-8
	5.4.1.1 Sample Labels	5-8
	5.4.1.2 Custody Seal	5-8
	5.4.1.3 Chain-of-Custody Record	5-8
	5.4.1.4 Transfer of Custody	5-9
	5.4.1.5 Laboratory Chain-of-Custody	5-9
	5.4.2 DOCUMENTATION	5-9
5.5	CALIBRATION PROCEDURES OF ANALYTICAL INSTRUMENTS ...	5-10
	5.5.1 Organic, Inorganic, and Wet Chemistry Analyses	5-11
	5.5.2 Field Analyses	5-11
5.6	ANALYTICAL PROCEDURES	5-12
	5.6.1 Standard Analytical Methods	5-12
	5.6.2 Project-Specific Detection Limits	5-12
5.7	QUALITY ASSURANCE OBJECTIVES OF ANALYTICAL DATA	5-12
	5.7.1 Accuracy	5-12
	5.7.2 Precision	5-13
	5.7.3 Completeness	5-14
	5.7.4 Representativeness	5-14
	5.7.5 Comparability	5-14
	5.7.6 Procedures for Data Assessment	5-14
5.8	INTERNAL DATA REDUCTION, VALIDATION AND REPORTING PROCEDURES	5-15
	5.8.1 Data Reduction	5-15
	5.8.2 Data Validation	5-15
5.9	FIELD GENERATED QC SAMPLES	5-17
	5.9.1 Trip Blank	5-17
	5.9.2 Equipment Blank	5-18
	5.9.3 Field Duplicates	5-18
	5.9.4 Documentation and Review of Quality Control Activities	5-18
5.10	LABORATORY GENERATED QC SAMPLES	5-18
	5.10.1 Laboratory Control Standard	5-18
	5.10.2 Method Blank	5-19
	5.10.3 Laboratory Replicates	5-19
	5.10.4 Matrix Spike/Matrix Spike Duplicates	5-19
	5.10.5 Surrogate Spikes	5-19
	5.10.6 Documentation and Review of Quality Control Activities	5-20
5.11	PREVENTIVE MAINTENANCE	5-20
5.12	DATA ASSESSMENT PROCEDURES	5-20
	5.12.1 Evaluation Of Analytical Precision and Accuracy	5-21
	5.12.2 Evaluation of Completeness	5-21

5.12.3	Review of Data Quality	5-21
5.12.3.1	Evaluation of Analytical Precision	5-21
5.12.3.2	Evaluation of Analytical Accuracy	5-22
5.12.4	Evaluation of Field Data	5-24
5.13	CORRECTIVE ACTION PROCEDURE	5-24
5.14	REFERENCES	5-25
6.0	REPORTING AND SCHEDULING	6-1
6.1	Monthly Progress Reports	6-1
6.2	Analytical Data Packages	6-1
6.3	CORRECTIVE ACTION REPORTS	6-3

LIST OF FIGURES

TO BE PROVIDED IN FINAL VERSION

LIST OF TABLES

TO BE PROVIDED IN FINAL VERSION

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SECTION ONE INTRODUCTION

This Ground Water Monitoring Program Plan (GWMPP) has been developed for the Sparton Technology, Inc. Coors Road facility located in Albuquerque, New Mexico. Pursuant to Section VII, Task I, Item 2 (and Task I.B. of Attachment I - Corrective Action Plan) of the Final Administrative Order (FAO) RCRA-VI-001(h)-96-H (USEPA, February 1998), Sparton Technology, Inc. must continue operation of an existing on-site ground water extraction and treatment system and continue monitoring existing ground water monitoring wells.

The GWMPP is separated into six sections, including this introduction which describes the facility background and history. A groundwater monitoring system is described in Section Two consistent with the FAO to monitor the nature and extent of hazardous waste constituents in ground water and the potentiometric surface. Although a number of monitoring wells exist, additional wells may be added to this plan as necessary to meet the requirements of the FAO and objectives of this GWMPP. Section Three of this GWMPP describes a preliminary monitoring plan to evaluate the performance of the groundwater extraction and treatment system to monitor changes in the plume configuration and concentrations. Field procedures used in the routine monitoring of ground water are described in Section Four and the sampling and analyses procedures described in Section Five. The schedule for implementation and reporting is described in Section Six.

1.1 FACILITY BACKGROUND

1.1.1 Site Description

The Sparton Technology, Inc., Coors Road Plant located at 9621 Coors Road, NW, consists of a 64,000-square-foot building on a 12-acre parcel of land on the northwest side of Albuquerque, New Mexico (Figure 1). The facility is located on the edge of a terrace approximately 60 feet above the adjacent Rio Grande floodplain, and approximately 0.5 mile west of the Rio Grande. The Corrales Main Canal, a man-made hydraulic structure used for irrigation, is located approximately 300 feet east of the facility, and reportedly contains flowing water eight months out of the year. The Calabacillas Arroyo is located about 1,000 feet north of the site. West of Irving Boulevard (Figure 1-1), the elevation rises 250 feet from the terrace to form the surrounding hills.

Currently, land use in the area immediately adjacent to the facility consists of commercial developments and undeveloped tracts along the west side of Coors Road. Further south and west of the facility along Irving Boulevard, residential developments are present or are being constructed. Residential developments, such as Paradise Hills, are approximately 1/4 - 3/4 mile west of the facility. Agricultural operations are present east of the facility and Coors Road.

The subsurface soils across the facility consist of sand-rich clay, sand, and gravel. The depth to ground water varies from approximately 65 feet at the facility to approximately 200 feet in the areas to the west. The depth to ground water can vary as much as three feet during the year as a result of

recharge from irrigated fields and the Corrales Main Canal. Ground water flow is generally to the southwest across the facility, changing to the west-northwest between the facility and Irving Boulevard.

Local ground water supplies both drinking water for the City of Albuquerque and process water for industrial purposes. New Mexico Utilities, Inc. owns nearby property and operates the nearest downgradient municipal water supply well (Well No. 2) approximately 2.6 miles northwest of the facility (Figure 2). There have been no identified private water supply wells immediately downgradient from the facility.

1.1.2 Facility History

Manufacturing operations began in 1961 with commercial, industrial, and military electronic components, including printed circuit boards. As of 1994, Sparton discontinued manufacturing operations at the facility. Other than routine maintenance activities, the facility is currently inactive.

The printed circuit board manufacturing process at the facility generated an aqueous plating waste which was classified as hazardous waste due to heavy metals and a low pH. Waste solvents were generated primarily from cleaning of electronic components. From 1961 to 1975, the plating wastes were stored in an in-ground concrete basin. This basin was replaced by a lined surface impoundment in 1975, termed the "West Pond" and a second lined surface impoundment in 1977 termed the "East Pond" (Figure 3). The "West" and "East" Ponds remained in use until 1983, when Sparton ceased discharging to either pond and removed the remaining plating wastes. The ponds are approximately 20 feet by 30 feet in surface dimension and 5 feet deep. The impoundments were constructed of concrete block or cast-walls with a natural sand base and a 30-mil, two-ply hypalon liner.

From 1961 to 1980, waste solvents were accumulated in an on-site sump (Figure 3). The sump was constructed of concrete blocks and measured approximately 5 feet by 5 feet in surface dimension by 2 feet deep. Sparton ceased discharging to the sump in October 1980 by removing the remaining wastes and filling the sump with sand.

Drums of hazardous waste were stored on the ground surface prior to May 1981, when a drum storage area was constructed for storage of drummed hazardous waste. The new drum storage area consists of a covered concrete pad and a spill collection system.

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1.2 REGULATORY HISTORY

In response to a Consent Agreement and Final Order signed by Sparton and EPA in 1983, Sparton installed a ground water monitoring system for the RCRA-regulated hazardous waste management units at the facility (East and West ponds). Analyses of the samples collected from the ground water monitoring system revealed that hazardous waste had been released to the ground water as a result of previous and ongoing hazardous waste management practices. During the period from 1983 to 1984, Sparton installed 17 ground water monitoring wells at the facility. These monitoring wells were screened predominately across the top of the aquifer. Analyses of ground water samples collected from the monitoring wells detected ranges of the following contaminant concentrations: trichloroethylene (27 ug/L - 90,900 ug/L), 1,1,1-trichloroethane (7 ug/L - 54,900 ug/L), methylene chloride (11 ug/L - 78,400 ug/L), 1,1-dichloroethylene (18 ug/L - 31,600 ug/L), tetrachloroethylene (17 ug/L - 953 ug/L), toluene (5 ug/L - 4,720 ug/L), benzene (20 ug/L - 193 ug/L), and chromium (22 ug/L - 32,100 ug/L).

Sparton ceased discharging to the ponds in 1983, and removed the remaining plating wastes from the ponds for shipment to a permitted off-site disposal facility. On June 16, 1986, the New Mexico Environmental Improvement Division (NMEID), the predecessor agency to the New Mexico Environmental Department (NMED), approved the closure plan for the "East" and "West" Ponds and Sump. The ponds and sump were certified closed by Sparton on December 18, 1986, and closure was acknowledged by NMEID on May 18, 1987. Sparton removed the solvent sump and sand backfill, and placed the wastes in the two remaining lined impoundments. The impoundments and sump area were capped by a 6-inch thick asphaltic base overlain by a 3-inch asphaltic concrete layer (Figure 4).

Sparton performed a soil investigation during 1986 through 1987. Soil borings were used to evaluate the contaminant migration within the unsaturated subsurface soils as a result of past operations at the facility. Total metals analyses indicated that chromium was the primary inorganic contaminant exceeding 3,000 mg/kg underneath the former pond and sump area. The chromium concentration decreases to approximately 20 mg/kg outside of the waste management area, but is still above the background levels (2-3 mg/kg). Field screening conducted for the organic contaminants indicated the presence of volatile chemicals throughout the soil profile. Additional investigations included surface soil gas surveys conducted in 1984 and 1987. Trichloroethylene and trichloroethane were detected in the soil gas across the facility and the general area of the ground water contamination.

On October 1, 1988, the EPA and Sparton Technology, Inc. entered into an Administrative Order on Consent (Order), Docket No. VI-004(h)-87-H, pursuant to Section 3008(h) of the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §6928(h). The Order specified the legal and technical requirements for Sparton to follow in performing corrective action at the facility. Under the terms of the Order, Sparton was required to complete the following three actions under a Corrective Action Plan (CAP): 1) install and operate a ground water extraction and treatment system at the Coors Road facility as an interim measure; 2) conduct a RCRA Facility Investigation (RFI) to determine the nature and extent of contamination resulting from past facility operations; and 3)

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perform a Corrective Measures Study (CMS) to evaluate the various clean-up alternatives.

1.2.1 Interim Measure

In an effort to begin the recovery of contaminated ground water in 1988, Sparton was required to install and operate a ground water extraction and treatment system at the facility. The system consists of 8 extraction wells pumping contaminated ground water from the upper 10 feet of the aquifer. Figure 5 illustrates the well locations and approximate capture zones. The total volume of recovered ground water is approximately 1,300 gallons per day. The annual ground water withdrawal rate is regulated under the New Mexico State Engineer's office permit No. RG-50161 (expiration date is December 31, 1999). The recovered ground water is piped to a 550-gallon collection tank prior to treatment. The piping system consists of discharge lines encased in secondary piping to provide leak detection and containment. The collection tank is a fiberglass-coated, double wall, steel tank with a leak detection system connected to a visual and audible alarm in the control building.

Water from the collection tank is piped to the top of a 20 gallon per minute (gpm) packed tower air stripper. Approximately ___ (to be supplied by Sparton) million gallons of water have been recovered and treated in the air stripper. The demonstrated efficiency of the system is 99 percent for the contaminant indicators of trichloroethylene, 1,1,1-trichloroethane, methylene chloride, and 1,1-dichloroethylene. Contaminant concentrations in the treated water are in the range of ___ ug/L (to be supplied by Sparton) for each contaminant. The volatile organic contaminants which are removed from the ground water in the air stripper are released to the atmosphere. The emissions are permitted by the City of Albuquerque Environmental Health Department (Air Quality Permit Number 187). The average daily air emission from the air stripper is ___ (to be supplied by Sparton) pounds, which is below the maximum allowable of 9.1 pounds per day in the permit.

Treated water from the air stripper is discharged to a 15,000-gallon fiberglass-coated, double wall, steel tank for storage. The tank has a leak detection system with a visual and audible alarm in the control building. During previous plant operations, treated water from the storage tank was used in the main plant building as cooling and flushing water, and eventually discharged into the sewer system. Since facility operations have been discontinued, the treated water is utilized in the sanitary system prior to discharge into the sewer system.

Operation of the ground water extraction system continues through the present date. Specific details and documentation of performance will be presented in the Ground Water Investigation Report pursuant to Task V, Item B(1) of the Final Administrative Order.

1.2.2 RCRA Facility Investigation

Sparton was required to investigate the nature and extent of contaminant releases to the ground water. Monitoring wells installed in the aquifer were used to monitor the concentration and migration of contaminants in the ground water. Of these monitoring wells, 24 are located on-site

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at the facility and 23 are installed off-site to a distance of approximately ½ mile west-northwest of the facility. The wells are installed to monitor discrete intervals of the aquifer from 0-10 feet (upper flow zone), 30-40 feet (upper-lower flow zone), 50-60 feet (lower-lower flow zone), and 70-80 feet (third flow zone) below the top of the water table.

Analyses of samples collected from the monitoring wells have shown both organic and inorganic contaminants using EPA approved methods. Trichloroethylene is the major ground water contaminant and has been used to define the extent of the contaminant plume. Concentrations of trichloroethylene in the ground water ranged from 7,600 ug/L on-site to less than 5 ug/L at a distance of at least ½ mile from the facility in 1996. Of the inorganic contaminants, hexavalent chromium has the highest frequency of occurrence with concentrations up to 500 ug/L.

Trichloroethylene is a chlorinated organic compound which, if present as a dense, nonaqueous phase liquid (DNAPL), would sink to the bottom of the water column. While a DNAPL has not been identified in the monitoring wells, existing concentrations of trichloroethylene indicate the possible presence of a DNAPL in the upper flow zone of the aquifer on-site at the facility. Remaining DNAPL in the soil and ground water may produce a zone of contaminant vapors above the water table, and a plume of dissolved contaminants below the water table. Both residual and migrating DNAPLs dissolve slowly, supplying potentially significant concentrations of contaminants to ground water over a long period of time.

Based on available data, the horizontal extent of the ground water contaminant plume is greatest in the upper flow zone. Contaminant concentrations are the highest on-site at the facility, decreasing off-site to the west-northwest. As of June 1991, the contaminant plume had migrated more than ½ mile west-northwest of the facility. During sampling activities from 1993 through April 1996, analyses of the ground water indicated that the leading edge of the contaminant plume (<5 ppb) has continued to move further northwest along Irving Boulevard. As shown in Figures 6 through 11, the boundary and concentrations of the contaminant plume are approximate, and the maps are intended for illustration purposes only. The plume boundary and relative concentrations may be revised based on additional data. For 1991, the approximate boundary and concentration profiles for trichloroethylene at three separate depths in ground water is illustrated in Figures 6 through 8.

- ◆ While the organic contaminant concentrations have decreased with time in the on-site and certain off-site monitoring wells, other off-site monitoring wells have shown an increase in concentrations related to the continued migration of the contaminant plume beyond the boundary defined during the RFI. Based on available data, the contamination extends at least 60 feet below the potentiometric surface. The existing monitoring system does not completely define the horizontal and vertical extent of the contamination. Additional wells will be necessary and will be added to this GWMPP as necessary.

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1.2.3 Corrective Measures Study

In November 1992, Sparton presented the results of a Draft Corrective Measures Study which summarized the findings of the RFI and identified, developed, and evaluated corrective measures necessary to protect public health and the environment. This document was revised in response to comments received from USEPA and was resubmitted as a Final Corrective Measures Study Report (Black & Veatch, March 1997). The CMS included screening of the following alternatives:

- ◆ No Further Action
- ◆ Continuation of Interim Measure Corrective Action
 - Expansion of Interim Measure
 - Infiltration gallery or injection wells to contain plume (per Consent Order)
 - Large-scale ground water extraction combined with either air stripping, granular activated carbon, advanced oxidation, or aerobic bioreactors to treat the ground water organic contamination and chemical precipitation/ion exchange to remove inorganics (pump and treat system)
- ◆ Vapor extraction to remove soil gas and eventually VOCs from ground water through phase equilibrium
- ◆ In situ bioremediation to treat the ground water in place

Sparton recommended continuation of the Interim Measure Corrective Action to address the release of contamination from the facility which consisted of: 1) continued operation of the existing ground water extraction and treatment system to remove contaminants from the ground water; and 2) natural attenuation of the off-site contaminant plume.

1.3 SELECTED REMEDY AND ASSOCIATED MONITORING REQUIREMENTS

1.3.1 Selected Remedy

In 1996, USEPA determined the selected remedy for the Sparton facility (USEPA, Final Decision, RCRA Corrective Action, June 1996). USEPA stated that under Section 3008(h) of RCRA, 42 U.S.C. §6928(h), corrective action is required to protect human health or the environment because: 1) ground water currently supplies the sole source of drinking water for the City of Albuquerque; 2) the aquifer is potentially useable as a source of drinking water; and 3) the aquifer is currently used outside of the contaminant plume for this purpose. Therefore, USEPA determined that the protective goal at this site is the restoration of potentially drinkable ground water to levels safe for drinking throughout the contaminated plume, regardless of whether the water is in fact currently being consumed. Restoration refers to the reduction of contaminant concentrations to the more stringent of either: 1) the Maximum Contaminant Levels (MCLs) for drinking water established under the Safe Drinking Water Act; or 2) the maximum allowable contaminant concentrations in ground water set by the State of New Mexico Water Quality Control Commission (WQCC). MCLs

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were established to reduce the risk of adverse health effects to users of public water supply systems. Protection of the ground water as a source of drinking water and as a natural resource is protected under 20 NMAC 6.2.3101. Table 1 lists the specific contaminants present in the ground water and the corresponding Federal MCL and State WQCC standard.

USEPA established the following corrective action objectives for the facility as protective of human health and the environment: 1) prevent further migration of the contaminant plume; 2) restore the contaminated aquifer to the more stringent of Federal or State standards; and 3) reduce the quantity of source material in the soil and ground water, to the extent practicable, to minimize further release of contaminants to the surrounding ground water, and ensure no further contaminant migration to the ground water above the existing cleanup goals established for ground water. USEPA's selected remedy included: 1) continued operation of the existing on-site ground water extraction and treatment system; 2) further characterization of the extent of contamination in the ground water and vadose zone; 3) installation and operation of additional ground water extraction well(s); and 4) installation and operation of an on-site soil vapor extraction (SVE) system. Subsequently, Sparton amended their proposed remedy to include: 1) the installation of an additional extraction well; 2) sampling of contaminant vapor concentrations and installation of a soil vapor extraction system, if warranted; and 3) installation of five additional ground water monitoring wells.

For the contaminant plume beneath the facility, the initial phase consists of adding at least one additional ground water extraction well to the existing extraction system. Since the existing ground water extraction system removes contaminants from a limited area beneath the facility, the objectives for the additional well(s) will be to maximize contaminant removal and prevent further migration from the Facility to off-site areas. Additional monitoring wells may be necessary to further define the extent of contamination beneath the facility and properly locate the extraction well(s).

For the off-site ground water contaminant plume, the initial phase includes the installation of additional monitoring wells to define the extent of the ground water contaminant plume, in particular the leading edge of the contaminant plume. While the current estimate is for 20 wells, the final number of monitoring wells will be determined during the site characterization. In addition, data on the aquifer characteristics near the leading edge of the contaminant plume will be collected. These data will be used to design and install a ground water extraction system to prevent further migration of the contaminant plume. While the current estimate is for one (1) to three (3) wells, the final location and number of extraction wells will be determined during the remedial design phase.

Following these initial actions, additional extraction wells will be installed as necessary to restore the aquifer for use as a source of drinking water, in addition to controlling further plume migration. Restoration is defined as attainment of the chemical-specific interim ground water cleanup goals in the aquifer, over the entire contaminant plume. Cleanup levels for each ground water contaminant are specified in Table 1. Implementation of this phase of the ground water restoration will be expedited in order to meet the anticipated future demand on the aquifer as a water supply.

1.3.2 Ground Water Monitoring Requirements

The length of time and ability to achieve cleanup goals at all points throughout the contaminant plume, cannot be determined until the extraction system has been implemented, modified as necessary, and plume response monitored over time. After construction of the ground water extraction system is completed, performance of the system will be carefully monitored on a regular basis as presented in this Ground Water Monitoring Program Plan, and adjusted as warranted by the collected data. Further refinement of the extraction system may be necessary to prevent further migration of the contaminant plume. Quarterly sampling and analyses of selected monitoring wells will be implemented to evaluate the design and monitor the performance of the extraction system.

TABLE 1

<u>Chemical</u>	<u>MCL (ppb)</u>	<u>WQCC (ppb)</u>
Trichloroethylene	5	100
1,1,1-Trichloroethane	200	60
Methylene Chloride	NA*	100
1,1-Dichloroethylene	7	5
Tetrachloroethylene	5	NA*
Toluene	5	10
Benzene	1000	750
Chromium (total)	100	50

* Not Available

WQCC = State of New Mexico Water Quality Control Commission

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SECTION TWO GROUND WATER MONITORING SYSTEM

Since 1983, Sparton has conducted groundwater monitoring activities under a variety of programs. A summary of the site geology and hydrogeology and the relation of the contaminant plume is presented below. A summary of the monitoring wells, their screened intervals, survey coordinates, the program under which it is sampled, frequency of analysis, and current status is presented in Table 2 (to be supplied by Sparton). The ground water monitoring conducted to date is presented below.

2.1 SITE GEOLOGY AND HYDROGEOLOGY

A summary of the site geology and hydrogeology, as interpreted under the RFI and subsequent investigations that incorporates comments and revisions by regulatory agencies is to be supplied by Sparton. Included in this summary is to be: a discussion of the relation of the site hydrogeology to the contaminant plume and potential receptors; geologic and hydrogeologic cross sections; and, a map of sufficient scale so as to clearly depict the location of all on-site and off-site monitoring, production, and extraction wells and their relation to manmade features and plume limits. An Appendix to this document shall be supplied by Sparton that contains all of the boring logs, well construction diagrams, and abandonment records for the site. This Appendix shall be organized chronologically by record type; i.e., all of the geologic logs will be presented in chronological order.

2.2 STATE MONITORING PROGRAM

In 1983, Sparton began ground water monitoring activities at the Coors Road Plant in conformance with New Mexico Environment Department's Hazardous and Radioactive Materials Bureau (NMED-HRMB) requirements. A total of 27 wells were installed (MW-1 through MW-25, PW-1, and P-1). The required State sampling protocol conducted by Sparton is referred to as the Alternate Ground Water Monitoring Program (AGMP). Per the AGMP sampling protocol, eight on-site wells (MW-9, MW-14, MW-15, MW-16, MW-19, MW-20, MW-21, and MW-22) were sampled on a quarterly basis. In the 1st, 2nd, and 4th Quarters, these wells are sampled for the following parameters: VOC by EPA Method 8010, TOX, TOC, pH and specific conductivity (starting in the 2nd Quarter in 1993, NMED approved changing analytical methods for VOC analysis from 8240 to 8010 for the aforementioned quarterly events). In the 3rd Quarter, the same AGMP wells were sampled for the following parameters: VOC by EPA Method 8240 (now Method 8260), TOX, TOC, pH, specific conductivity, TKN, chloride, sulfate, Nitrate as N, sodium, boron, manganese, nickel, chromium, and hexavalent chromium.

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2.3 RFI MONITORING PROGRAM

In response to the USEPA Administrative Order on Consent dated October 1988, Sparton installed 40 ground water monitoring wells (MW-26 through MW-64, and PZ-1) and implemented an on-site ground water extraction and treatment Interim Measure (IM) in December 1988. Using both new (RFI) and existing wells, sampling and analyses of PW-1, MW-18, MW-23, MW-24, MW-25, MW-26, MW-27, and MW-28 were conducted in accordance with the RFI workplan (originally submitted on December 28, 1988, revised March 3, 1989, and approved by USEPA on March 6, 1998) and USEPA guidance.

Including the wells installed prior to the AOC, a combined total of 67 wells were installed through June 1991. Ten wells were plugged and abandoned (**MW-? to be supplied by Sparton**), resulting in an active network of 57 ground water monitoring wells located both on-site and off-site. Eight of the wells (PW-1, MW-18, MW-23, MW-24, MW-25, MW-26, MW-27, and MW-28) are used for IM recovery purposes. A total of 45 wells have dedicated bladder pumps. The remaining four wells (**MW-?, to be supplied by Sparton**) are used for static water level measurements.

The RFI monitoring program terminated with the June 1991 sampling event included in the August 13, 1991 revised RFI Report submitted in final form and approved by USEPA on July 1, 1992.

2.4 SUPPLEMENTARY GROUNDWATER MONITORING PROGRAM

Sparton unilaterally initiated its own ground water monitoring program in the 4th Quarter of 1991, called the Supplementary Ground Water Monitoring Program (SGMP). Originally, this program involved sampling 11 off-site wells (**MW-? to be supplied by Sparton**) and four on-site wells (**MW-? to be supplied by Sparton**) on a quarterly basis for VOC analysis using EPA Method 8240. The SGMP was expanded to sample 18 off-site wells (**MW-? to be supplied by Sparton**) and four on-site wells (**MW-? to be supplied by Sparton**) on a quarterly basis. Analytical methodology was changed from Method 8240 to 8260 as of the 1st Quarter of 1998. The SGMP was designed to compliment the ongoing on-site State Ground Water Monitoring Program (i.e., the AGMP) and to track results of the IM.

Sparton also monitored eight on-site wells (MW-9, MW-14, MW-15, MW-16, MW-19, MW-20, MW-21, and MW-22) under the AGMP quarterly over the same time period. The sampling procedure under the SGMP consisted of (**to be supplied by Sparton**) for (**to be supplied by Sparton**) under USEPA Method (**to be supplied by Sparton**).

On an annual frequency (approximately), USEPA/State of New Mexico split samples under the SGMP and AGMP with Sparton. During two of the annual events (December 1993 and January 1996), monitoring wells (**MW-? to be supplied by Sparton**) were also sampled.

In the ___ Quarter of 1996, Sparton's SGMP indicated that the TCE plume limits extended beyond several of the downgradient monitoring wells (**MW-60 and MW-61, MW-? to be supplied by**

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Sparton) in concentrations >5 ug/l. Sparton voluntarily installed five additional downgradient “sentinel” ground water monitoring wells to further define plume limits and rates of movement. The new wells, with subsequent sampling and analysis, were added to the SGMP well network (current total of 27? **monitoring wells to be supplied by Sparton**).

From July 1996 through January 1998, an additional six quarters of ground water constituent data were obtained. Over the last six quarters, all but one of the “sentinel” wells (**MW-? to be supplied by Sparton**) and all of the other wells with TCE concentrations <5 ug/l have remained below the MCL as presented in Table 3 (**to be supplied by Sparton**). Of the (**35? Number to be confirmed by Sparton**) wells in the SGMP and AGMP, only a single well (MW-60) has shown a distinct increasing trend. Wells MW-58 and MW-65 have shown increases in constituent concentration since initial sampling, but no trend is apparent. Wells sampled on a less than quarterly frequency (**MW-? to be supplied by Sparton**) show concentrations below the MCL or decreasing trends.

In February 1998, a deeper “sentinel” well (MW-70) was added to on-site well cluster #4 (MW-15, MW-41, and MW-32). **Tentatively**, this well has confirmed the shallow depth of the plume downgradient of the original source area. **Additional samples were collected on April 22, 1998 to confirm that the vertical extent of contamination has been clearly defined. (Based on data which should be available by May 15, 1998, this paragraph may require modification)** Monitoring well MW-70 is screened approximately twenty feet below MW-32.

2.5 GROUND WATER MONITORING, AS MANDATED IN THE FINAL AOC

The requirements specified in the Corrective Action Plan for the Sparton facility, presented as Attachment I of the Final Administrative Order (FAO) RCRA-VI-001(h)-96-H (USEPA, February 1998) stipulate that the monitoring well network consists of all on-site wells (**MW-? to be supplied by Sparton**) and off-site wells (**MW-? to be supplied by Sparton**). The FAO specifies that Sparton will conduct quarterly sampling and analyses of all the wells for the following constituents:

Volatile organic constituents as listed in 40 CFR Part 264, Appendix IX;

- Total metals as listed in 40 CFR Part 264, Appendix IX; and
- Hexavalent Chromium

Sparton will collect ground water elevation data at each of the monitoring wells on a quarterly basis. Coupled with the sample analyses results, these data will be utilized by Sparton to prepare potentiometric surface maps and contaminant concentration contour maps for each of the flow zones in the aquifer (e.g., upper, upper lower, etc.) on a monthly basis.

Table 2 presents the monitoring network set forth in the Final Administrative Order.

(Table 2 is to be provided by Sparton and is to include the following information:

well designation

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- **well status (plugged or operational)**
- **location (coordinates on the State Planar Coordinate System, as well as a designation as to if each well is on-site or off-site)**
- **diameter**
- **ground elevation**
- **top of casing elevation (TOC)**
- **total depth**
- **screen interval**
- **sand pack interval**
- **screen construction and slot size**
- **dedicated sampling equipment? (presence and type)**
- **pump setting depth/elevation (if more than one pump provide data for each)**
- **well packer(s) depth and elevation (top and bottom of each packer within each well)**

This table is to be updated and redistributed by Sparton with the addition of each additional well on- or off-site.)

2.6 DESCRIPTION OF THE CONTAMINANT PLUME

The Final Decision/Response to Comments (USEPA, June 24, 1996) included as Exhibit A of the Final Administrative Order RCRA-VI-001(h)-96-H (USEPA, February 1998), presents the following summary of the contaminant plume. Trichloroethylene (TCE) is the major ground water contaminant and has been used to define the extent of the contaminant plume. Concentrations of TCE in the ground water ranged from 7,600 ug/L to less than 5 ug/L at a distance of at least ½ mile from the facility in 1996. Of the inorganic contaminants, hexavalent chromium has the highest frequency of occurrence with concentrations of up to 500 ug/L.

TCE is a chlorinated organic compound which is denser than water and thus if present as a dense, nonaqueous phase liquid (DNAPL) would sink to the bottom of the water column. While a DNAPL has not been identified in the monitoring wells, existing concentrations of trichloroethylene indicate the possible presence of a DNAPL in the upper flow zone of the aquifer on-site at the facility. Remaining DNAPL in the soil and ground water may produce a zone of contaminant vapors above the water table, and a plume of dissolved contaminants below the water table. Both residual and migrating DNAPLs dissolve slowly, supplying potentially significant concentrations of contaminants to ground water over a long period of time.

Based on available data, the horizontal extent of the ground water contaminant plume is greatest in the upper flow zone. Contaminant concentrations are the highest on-site at the Facility, decreasing off-site to the west-northwest. As of June 1991, the contaminant plume had migrated approximately ½ mile west-northwest of the Facility, and the boundary of the plume had shown no significant changes between 1989 and 1991. However, during sampling activities from 1993 through April 1996, analyses of the ground water indicated that the leading edge of the contaminant plume (<5 ug/L) has continued to move further northwest along Irving Boulevard.

DRAFT

While the organic contaminant concentrations have decreased with time in the on-site and certain off-site monitoring wells, other off-site monitoring wells have shown an increase in organic concentrations related to the continued migration of the contaminant plume beyond the boundary defined during the RFI. Based on the available data, the contamination extends at least 60 feet below the water table. However, the existing monitoring system does not completely define the horizontal and vertical extent of the contamination.

The selected remedy proposed by the USEPA in the Final Decision/Response to Comments (USEPA, June 24, 1996) included as Exhibit A of the Final Administrative Order RCRA-VI-001(h)-96-H (USEPA, February 1998) addresses the data gaps in the existing monitoring well network. Additional ground water monitoring wells are to be installed to define the extent of the off-site ground water plume. This phase of the selected remedy is to be included in the site characterization. During this phase, additional data on the aquifer characteristics at the leading plume edge will be collected to aid in the design of the ground water extraction system. Following the construction and implementation of the ground water extraction system, performance of this system will be carefully monitored on a regular basis. In addition, additional on-site monitoring wells may be added to provide better monitoring of both the contaminant plume as well as the remedial actions at the Facility.

SECTION THREE GROUND WATER EXTRACTION SYSTEM

The following section describes the ground water extraction system mandated as part of the Corrective Action Plan for the Sparton facility, presented as Section VII, Task I, 1. of the Final Administrative Order RCRA-VI-001(h)-96-H (USEPA, February 1998).

3.1 Existing On-Site Groundwater Extraction and Treatment System

3.1.1 System Description

Section VII, Task I, 1. of the Final Administrative Order RCRA-VI-001(h)-96-H (USEPA, February 1998) states that Sparton shall maintain continuous operation of the existing ground water recovery well network and treatment system at the Facility. The existing groundwater recovery well network consists of the following recovery wells: PW-1, MW-18, MW-23, MW-24, MW-25, MW-26, MW-27, and MW-28. All of these extraction wells are pumping contaminated ground water from the upper 10 feet of the aquifer (upper flow zone). The total volume of recovered ground water is approximately 1,300 gallons per day. The annual withdrawal rate is regulated under the New Mexico State Engineer's office permit No. RG-50161 (expiration date is December 31, 1999). The recovered ground water is piped to a 550-gallon collection tank prior to treatment. The collection tank is a fiberglass-coated, double wall, steel tank with a leak detection system connected to a visual and audible alarm in the control building.

Water is piped from the collection tank to the top of a 20 gallon per minute (gpm) packed tower air stripper. Approximately _____ gallons (**to be supplied by Sparton**) of water have been recovered and treated in the air stripper. The demonstrated efficiency of the system is 99 percent for the following contaminant indicators: trichloroethylene; 1,1,1-trichloroethane; methylene chloride; and, 1,1-dichloroethylene. Contaminant concentrations in the treated water are reported in the range of 1 ppb for each contaminant. The volatile organic contaminants which are removed from the ground water in the air stripper are released to the atmosphere. The emissions are permitted by the City of Albuquerque Environmental Health Department (Air Quality Permit Number 187). The average daily emission from the air stripper is 0.02 pounds, which is below the maximum allowable of 9.1 pounds per day in the permit.

Treated water from the air stripper is discharged to a 15,000 gallon, fiberglass-coated, double wall, steel tank for storage. The tank has a leak detection system with a visual and audible alarm in the control building. During previous plant operations, treated water from this storage tank was use in the main plant building as cooling and flushing water, and eventually discharged into the sewer system. Since Facility operations have been discontinued, the treated water is utilized in the sanitary system prior to discharge into the sewer system.

3.1.2 Ground Water Monitoring Requirements

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SECTION FOUR FIELD PROCEDURES

The following sections describe field procedures related to the collection and analysis of groundwater and treatment system samples and the measurement of water levels. The field procedures comply with the requirements specified in the Corrective Action Plan for the Sparton facility, presented as Attachment I of the Final Administrative Order RCRA-VI-001(h)-96-H (USEPA, February 1998).

4.1 Index of Field Procedures

<u>PROCEDURE:</u>	<u>DESCRIPTION:</u>
P-1	Soil Sampling
P-2	Geologic Logging
P-3	Monitoring Well Installation
P-4	Well Purging
P-5	Ground Water Sampling
P-6	Turbidity, Redox-Potential, Dissolved Oxygen, Temperature, pH, and Conductivity Measurements
P-7	Influent and Effluent Water Sampling from the Treatment System
P-8	Measurement of Depth to Water, Total Depth, and Nonaqueous Phase Liquids
P-9	Decontamination of Sampling Equipment
P-10	Nonaqueous Phase Liquid Determination in Soil by Visual Determination
P-11	Well Development
P-12	Soil Sampling for Volatile Organic Compounds
P-13	Calculation of Borehole and Purge Volumes
P-14	Borehole and Well Abandonment
P-15	Surveying

DRAFT

As stated in Section VII, Task I, 1. of the Final Administrative Order RCRA-VI-001(h)-96-H (USEPA, February 1998), Sparton will conduct monthly sampling and analyses of the recovered ground water both prior to treatment, and following treatment, for the following constituents:

Volatile organic constituents as listed in 40 CFR Part 264, Appendix IX; and
Hexavalent Chromium

Sparton is required to determine the total volume of recovered ground water from each recovery well on a monthly basis. Sparton is required to document the efficiency of the treatment system (as measured by the percent reduction of hazardous waste constituents) on a monthly basis. Operation of the existing ground water recovery well network and treatment system shall be incorporated into, and modified as necessary to be consistent with the operation of the Ground Water Extraction Measure set forth in Task V of the CAP.

3.1.3 Hydraulic Performance of the Existing On-Site Groundwater Extraction and Treatment System

(This section to be provided by Sparton.)

Procedure P-1 SOIL SAMPLING

1.0 PURPOSE

The purpose of this procedure is to outline the requirements for soil sampling. Soil sampling aids in defining both the hydrogeological character of the substrata and the nature and extent of contamination. Soil samples are collected over an aerial distribution as well as different depths to characterize the on-site features.

2.0 SCOPE

Soil sampling is potentially applicable to any site where an investigation is conducted. A variety of sampling techniques are available for collecting soil samples. These include split-spoon sampling, collecting auger cuttings, Shelby tube sampling and continuous coring. Split-spoon sampling is the most commonly used technique.

3.0 REQUIREMENTS

The collection point shall be within two feet horizontally of the identified sample location. The accuracy of the soil sampling point location will be determined by the data quality objectives. Sample logging is to be conducted in accordance with Field Procedure P-13.

4.0 EQUIPMENT

The following equipment may be needed to collect soil samples.

- 4.1 Drilling Equipment Capable of Collecting Depth Specific Samples
- 4.2 Stainless Steel Bowls and Mixing Spoons
- 4.3 Organic Monitoring Device (HNu or OVA)
- 4.4 Shelby Tube Sampling Equipment
- 4.5 Split-Spoon Sampling Equipment
- 4.6 Sample Containers
- 4.7 Cooler

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- 4.8 Blue Ice
- 4.9 Tape
- 4.10 Boring Logs
- 4.11 Field Logbook

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5.0 PROCEDURE SOIL SAMPLING

Samples Collected for Chemical Analysis

Soil samples shall be collected according to the following procedure.

1. A split-spoon sampler shall be driven into the undisturbed soil below the lead auger per ASTM D1586. After the split-spoon has been driven 2 feet it shall be withdrawn from the borehole and, taken to a sample processing area and opened. Split-spoon sample samples shall be collected continuously throughout the entire depth of the boring. Blow counts shall be recorded on the boring log per ASTM D1586.
2. The soil in the sampler shall immediately been scanned with an HNu or OVA and the readings recorded in the field logbook.
3. Immediately after the sample has been scanned, sample containers for VOCs analysis shall be completely filled to ensure that no head space is present. The sample shall be sealed, labeled, and immediately placed in a cooler containing ice to ensure a temperature of 4 degrees Celsius.
4. Visually examine the sample for lithology and physical characteristics and log the sample per Field Procedure P-2. The sample shall be classified using the Unified Soil Classification System (USCS), and either the Munsell Soil or Geological Society of America (GSA) Rock Color Charts.
5. If SVOCs and Metals are to be collected, place the remaining soil into a stainless steel mixing bowl and mix the soil with a mixing spoon. Place the soil into the appropriate sample jars and fill the jars completely full. The jars shall be sealed, labeled and immediately placed in a cooler containing ice to maintain a temperature of 4 degrees Celsius.
6. Chain-of-Custody forms shall be completed, placed in zip-loc bags, and taped to the inside of the cooler lid. The cooler shall then be closed, sealed with tape and shipped to the laboratory for analysis.

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Procedure P-2 GEOLOGIC LOGGING

1.0 PURPOSE

This procedure provides a uniform set of guidelines to aid in developing consistency among sample descriptions and sample techniques. The importance of accurate, complete, clear, and concise logs cannot be overemphasized.

2.0 SCOPE

This procedure applies to the geologic description of both soil and rock samples.

3.0 REQUIREMENTS

Geologic logging should be performed by a geologist. Soil sampling should be performed in accordance with field procedure P-1.

4.0 EQUIPMENT

- 4.1 Boring Log
- 4.2 Log Book
- 4.3 Munsell Color Chart
- 4.4 Tape Measure
- 4.5 Acid Bottle
- 4.6 Pocket Penetrometer
- 4.7 Sand Gauge
- 4.8 Rock Hammer
- 4.9 Trowel or Putty Knife
- 4.10 Water Level Indicator

DRAFT

4.11 Portable Organic Vapor Analyzer (HNu, OVA, or equivalent)

4.12 Distilled Water in a Spray Bottle

5.0 PROCEDURE

1. Borehole and drilling information is to be documented in the field log book.

2. In addition to information recorded in the field log book, a preprinted geologic log sheet will be completed.

3. Logging Guidelines:

For accuracy and consistency, material descriptions should generally be completed in the following order:

a. composition, texture, sorting, and sphericity-- Major soil components should be in CAPITAL LETTERS;

b. color-- sample should be wet before describing color, note: differences between weathered and native, gleying, staining, mottled, banded, streaked, etc.

c. consistency, plasticity, density

d. structure, fabric-- include shape and degree of structure, slickenslides, laminations, bedding, stylolites, etc.

e. mineralogy, cementation, fossils

f. moisture content

g. presence of contamination-- odors, sheen on pore water, free product, etc.

DRAFT

h. geologic interpretation, stratigraphic name

Boring logs will also be completed with the following information per sample:

sample time

sample recovery

- RQD (if rock coring)
- headspace results

applicable drilling information, e.g. time and depth of loss of drilling circulation , will be recorded in the field log book.

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Procedure P-3

MONITORING WELL INSTALLATION

1.0 PURPOSE

The purpose of this procedure is to install a groundwater monitoring well that is representative of the source of concern.

2.0 SCOPE

This procedure provides information on how the monitoring wells for the Sparton site will be installed.

3.0 REQUIREMENTS

The wells shall be placed in the areas of concern in accordance with the Ground Water Monitoring Program Plan and the Final Administrative Order RCRA-VI-001(h)-96-H (USEPA, February 1998).

4.0 SAMPLING EQUIPMENT

The following pieces of equipment may be needed to install groundwater monitoring wells.

- 4.1 Drilling Rig
- 4.2 Well Screen
- 4.3 Casing
- 4.4 Sand Packs
- 4.5 Bentonite Pellets
- 4.6 Bentonite Powder
- 4.7 Portland Type I Cement
- 4.8 Locks for Wells above Grade or Off-site
- 4.9 Protective Casing
- 4.10 PVC Pipe

DRAFT

- 4.11 Bumper Posts
- 4.12 Well Cap
- 4.13 Field Logbook
- 4.14 Well Construction Diagram

5.0 PROCEDURE

5.1 General

To be useful and accurate, a groundwater monitoring well must be installed properly so that groundwater can be monitored in the appropriate manner. The following procedures shall be adhered to when installing the monitoring wells.

1. Once the desired monitoring depth is reached by drilling, the well screen and casing will be set in place inside the augers or drill casing.
2. Once the screen and casing are in place, a sand pack will be placed around the screen by slowly adding sand into the annular space and simultaneously removing the augers or casing. The sand pack will not extend more than 2 feet above the top and below the bottom of the screen.
3. Once the sand pack is in place, the annular space above the sand pack will be sealed with a minimum 2-foot thick bentonite seal using bentonite pellets. The bentonite seal will be allowed to hydrate for a minimum of two hours prior to proceeding.
4. The annular space above the bentonite seal will be grouted with cement/bentonite grout. The grout will consist of seven gallons of water mixed with 94 pounds of Portland type I cement to which three to five pounds of bentonite powder is added. The grout will be installed using a side discharging tremie line placed immediately above the bentonite seal and extend from the bentonite seal to three feet below the ground surface.
5. The riser casing will extend approximately two feet above the ground surface or flush with the surface depending on the surface conditions.

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6. Wells completed above grade will use a 6-inch ID locking protective casing five feet in length set in concrete approximately two and one-half feet below grade and extending above the riser casing. The surface of the concrete will be fashioned so water will drain to the sides. A weep hole will be drilled near the ground surface to prevent water accumulation between the protective casing and riser casing.
7. Wells completed at grade will consist of a flush-mount well cover installed into a concrete anchor/pad. The concrete anchor will slope away from the well to promote drainage away from the wellhead.
8. Install bumper posts around monitoring wells in such a manner that the well is protected from damage by vehicles, tractors, etc.
9. The Ground Water Monitoring Program Plan will be updated to reflect the installation of any monitoring wells.

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Procedure P-4

WELL PURGING

1.0 PURPOSE

The purpose of this procedure is to provide general information on well purging by the pumping method prior to the sampling of groundwater wells. The methods and equipment described are for the purging prior to the collection of water samples from the saturated zone.

2.0 SCOPE

This procedure applies to purging relatively large volumes of water in shallow to medium depth wells. The wells need to be properly purged prior to sampling to obtain a representative sample from the well location.

3.0 REQUIREMENTS

Methods for purging from completed wells include the use of pumps, bailers, and various types of samplers. The primary considerations in obtaining a representative sample of the groundwater are to avoid collection of stagnant (standing) water in the well and to avoid physical or chemical alteration of the water due to purging and sampling techniques.

4.0 EQUIPMENT

The following equipment may be needed to purge the groundwater wells.

- 4.1 Electric Purge Pump
- 4.2 Generator
- 4.3 Water Level Indicator
- 4.4 Portable Tank to contain the Development Water
- 4.5 Field Logbook
- 4.6 Calculator
- 4.7 Groundwater Sampling Form

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- 4.8 Plastic Sheeting
- 4.9 Disposable Latex or Nitrile Gloves
- 4.10 Teflon Tubing
- 4.11 HNu or OVA
- 4.12 Turbidity Meter
- 4.13 Dissolved Oxygen Meter
- 4.14 pH Meter

5.0 PROCEDURE

The groundwater wells shall be purged according to the following procedure. Details regarding the ground water sampling procedure and field data will be recorded in both a bound field log book and on the ground water sampling form. All purging equipment shall be decontaminated prior to and after use per procedure P-9.

1. The wells shall be unlocked and the caps removed. An HNu or OVA shall be used to screen the well for any organic vapors. Any readings shall be recorded in the field logbook.
2. Procedure P-8 should be followed to determine the presence of immiscible layers and to determine the depth of water and total depth of the well.
3. The volume of water to be purged from the well is determined using procedure P-13.
4. Once the volume of water to be removed is calculated, the pump shall be submersed into the well. The tubing from the pump shall be placed into the portable tank. The pump shall be turned on at a rate of approximately 100 mL per minute. The portable tank shall be graduated so that the amount of water purged from the well can be measured.
5. To document that the wells have been adequately purged, specific conductance, temperature, pH turbidity, redox potential, and dissolved oxygen (See Procedure P-6) shall be measured in the well ahead of the pump until these parameters have stabilized. Once the well has been purged the water will be collected as described in Procedure P-5.

DRAFT

Procedure P-5

GROUND WATER SAMPLING

1.0 PURPOSE

The purpose of this procedure is to obtain ground water samples that are representative of the source from which they are taken and minimize sampler exposure to groundwater contaminants.

2.0 SCOPE

This procedure provides information on proper equipment and techniques for groundwater sampling. The techniques described should be followed whenever applicable, noting that site-specific conditions, may require adjustments in methodology.

3.0 REQUIREMENTS

Generally, wells should be sampled within three hours of purging. However, wells with poor recharge should be sampled within 24 hours of purging. Poor recharge wells are those that cannot recharge 80 percent of the original volume within 8 hours. If the well is evacuated of water during purging prior to removal of the required volume, the well may be sampled once the well has recharge to a water level that allows for the required samples to be obtained.

Applicable preservatives must be added to the sample containers before the sample is added to the container. All sampling equipment must be decontaminated in accordance with the Field Procedure P-9, before commencement of sampling.

4.0 SAMPLING EQUIPMENT

The following pieces of equipment may be needed to collect groundwater samples.

- 4.1 Sample Containers
- 4.2 Submersible Pump
- 4.3 Coolers for sample shipping and cooling

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- 4.4 Labels
- 4.5 Appropriate Packing Cartons and Filler
- 4.6 Chain-of-Custody Documents
- 4.7 Camera and Film
- 4.8 Appropriate Keys (for locked wells)
- 4.9 Water Level Indicator
- 4.10 Field Logbook
- 4.11 Well Sampling Form
- 4.12 Indelible Marking Pens
- 4.13 Plastic Trash Bags
- 4.14 Latex Disposable Latex or Nitrile Gloves
- 4.15 Blue Ice
- 4.16 Teflon Tubing
- 4.17 55-gallon drums

5.0 PROCEDURE

5.1 General

To be useful and accurate, a groundwater sample must be representative of the particular saturated zone of the substrata being sampled. Wells will be purged prior to sampling by the use of a dedicated submersible pump as described in Procedure P-4. Water produced during purging shall be collected in 55-gallon containers. Details regarding the ground water sampling procedure and field data will be recorded in both a bound field log book and on the ground water sampling form. The following procedures shall be adhered to when sampling the monitoring wells.

1. The well shall be purged as described in Procedure P-4.
2. Samples shall be collected by pumping the water directly into the required containers.
3. The samples for VOCs analysis shall be collected first in 2-40 mL vials with Teflon-lined lids. The vials shall be completely filled so that no headspace is present. If samples are to be collected for SVOCs these samples shall be obtained next in a 1 L amber glass jar. Samples for metals analysis shall be collected last in a 500 mL or 1 L polyethylene bottle

DRAFT

pre-preserved with nitric acid (HNO₃).

4. The samples shall be labeled and immediately be placed in a cooler containing ice to maintain a temperature of 4 degrees Celsius. The label on the sample container shall contain the following information.

Project name and number

Sample identification

Analysis

Sampler's Initials

Sample Date and Time

Preservatives

5. The cooler shall be sealed and shipped to the laboratory for analysis.

TURBIDITY, REDOX-POTENTIAL, DISSOLVED OXYGEN, TEMPERATURE, pH, AND CONDUCTIVITY MEASUREMENTS

1.0 PURPOSE

The purpose of this procedure is to provide information on how to perform the measurements of turbidity, redox-potential, dissolved oxygen, temperature, pH, and conductivity in the field.

This information is used to determine

2.0 SCOPE

This procedure addresses the field measurement of turbidity, redox-potential, dissolved oxygen, temperature, pH, and conductivity using a flow-through cell water quality logger, pH meter, conductivity meter, and temperature thermometer.

3.0 REQUIREMENTS

The field measurements of turbidity, redox-potential, dissolved oxygen, temperature, pH, and conductivity, should be stabilized prior to sampling groundwater from a monitoring well. If the parameters have not stabilized, then additional water will need to be removed until stabilization occurs. Stabilization will occur when the parameters measurements are within $\pm 3\%$. The field measurements will be made either in the well ahead of the pump intake or "in-line" prior to the purge water container. Readings collected with the pH meter, conductivity meter, and thermometer shall be obtained three times at the same time or until stabilization occurs.

4.0 EQUIPMENT

- 4.1 Disposable Latex or Nitrile Gloves
- 4.2 Field Logbook
- 4.3 Teflon® Tubing
- 4.4 Drums to Collect Purge Water
- 4.5 Plastic Cups
- 4.6 pH Meter/Buffer Solutions

DRAFT

- 4.7 Conductivity Meter/Calibration Solutions
- 4.8 Temperature Thermometer
- 4.9 Flow-through Cell Water Quality Logger

5.0 PROCEDURE

A flow-through cell water quality logger, pH meter, conductivity meter, and temperature thermometer, will be used to take the measurements of turbidity, Redox potential, dissolved oxygen, temperature, pH, and conductivity. The logger, pH meter, and conductivity meter will be calibrated by the following general procedures:

Calibration for Dissolved Oxygen

The oxygen probe should be calibrated daily. The oxygen probe will be calibrated in water. The following steps will be performed to calibrate the oxygen probe:

1. The probe shall be rinsed with deionized water and the excess water shall be shaken off. The probe shall then be inserted into a solution where the dissolved oxygen content is known.
2. Press the Function Group Key until the calibration display appears. Next, press the function button until the dissolved oxygen calibration function is obtained. Use the Select button to move the cursor under "mg/l", and then press the Set/Confirm button.
3. Set the desired limit for dissolved oxygen by pressing the Set/Confirm button.
4. Press Select and move cursor under the "C" in CAL. Once the dissolved oxygen and temperature readings are stable, press Set/Confirm. Take your reading.

Calibration for pH with Water Quality Logger

The pH probe and logger must be calibrated using a buffer solution with a known value. A two point calibration curve will be used. The following steps will be followed to calibrate the pH probe.

1. Rinse the pH probe with distilled water.

DRAFT

2. Press the Function Group button until the calibration display appears. The cursor will appear under the 7. Use the Select button to move the cursor under the pH value desired. Place the probe in the pH 7 buffer solution. Press the Set/Confirm button.
3. To set another calibration point, follow Step 2.
4. Once the two calibration points have been set, press the Set/Confirm button and take the pH reading.

Calibration for pH with pH Meter

The pH meter must be calibrated using buffer solutions with known values. A two point calibration will be used. The following steps will be followed to calibrate the pH meter and obtain readings.

1. The probe on the pH meter shall be rinsed with distilled water.
2. Gently remove any water droplets from the probe before using the buffer solutions.
3. Place the meter into the 7.0 buffer solution. Turn the meter on. If the meter does not read 7.0, the meter will need to be adjusted.
4. Adjust the meter by taking a screwdriver and turning the button on the back of the meter clockwise until 7.0 appears on the meter. Lock the button in place.
5. Remove the meter from the 7.0 buffer solution. Rinse the probe with distilled water.
6. Gently remove any water droplets.
7. Place the meter into the 10.0 buffer solution. Turn the meter on. If the meter does not read 10.0, adjust the meter as discussed in Step #4.
8. Remove the meter from the 10.0 buffer solution. Rinse the probe with distilled water.
9. Pump some water from the well into a plastic cup. Turn the pH meter on and place it in the

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water. Record the reading.

10. A total of three pH readings shall be taken during the purging of the well. Additional readings may be needed if the pH readings do not stabilize ($\pm 3\%$) of each other.

Calibration for Turbidity

Before calibration, the turbidity probe must be enabled in the Optional Probe Selection. Three turbidity solutions, 0, 200, and 800 NTU, are used. The following steps will be followed to calibrate the logger for turbidity:

1. Place the probe into the 0 NTU solution. Using the Select button, move the cursor to 0. Press the Set/Confirm button.
2. For calibration with the 200 and 800 NTU solution, follow Step 1.

The meter does not need calibrated for temperature, conductivity, or redox potential. These values will be displayed automatically. Follow the procedures below to begin readings:

1. Attach the outlet hose from the Grundfos pump to the top of the flow-through cell chamber.
2. Attach another piece of 3/8" Teflon® hose to the bottom of the flow-through cell chamber.
3. Press the on/meter button to the on position.
4. Begin pumping of water through pump into the flow-through cell chamber.
5. Press the read button. The measurements of each parameter will be displayed.
6. Turn on/meter button to off position.

DRAFT

Calibration for Conductivity with Conductivity Meter

The conductivity meter must be calibrated using buffer solutions with known values. The buffer solutions to be used will have values of 600 and 1440, allowing a two point calibration. The following steps will be followed to calibrate the conductivity meter and obtain readings.

1. The probe on the meter shall be rinsed with distilled water.
2. Gently remove any water droplets from the probe before using the buffer solutions.
3. Place the meter into the 600 buffer solution. Turn the meter on. If the meter does not read 600, it will need to be adjusted.
4. Adjust the meter by taking a screwdriver and turning the screw on the back of the meter clockwise to the solution value of 600.
5. Remove the meter from the 600 solution. Rinse the probe with distilled water.
6. Gently remove any water droplets.
7. Place the meter into the 1440 solution. Turn the meter on. If the meter does not read 1440, adjust the meter as described in Step #4.
8. Remove the meter from the solution and rinse the probe with distilled water.
9. Pump some water from the well into a plastic cup. Turn the conductivity meter on and place it in the water.
10. Record the reading.
11. A total of three conductivity readings shall be taken during purging of the well. Additional readings may be needed if the conductivity readings do not stabilize ($\pm 3\%$) of each other.

DRAFT

Temperature Readings

Temperature readings will be taken with an alcohol-filled scientific thermometer. The temperature readings shall be recorded in degrees Celsius. The following steps should be followed when obtaining temperature readings.

1. Rinse the thermometer with distilled water.
2. Gently remove any water droplets.
3. At the same time pH and conductivity readings are collected, a third cup shall be filled with water from the well. The thermometer shall be placed into the cup and a temperature recorded.
4. Remove the thermometer and rinse it with distilled water.
5. A total of three temperature readings shall be collected. The readings should be stabilized ($\pm 3\%$) of each other.
6. Additional readings shall be collected if the first three readings do not stabilize.

DRAFT

Procedure P-7

INFLUENT AND EFFLUENT WATER SAMPLING FROM THE TREATMENT SYSTEM

1.0 PROCEDURE

The purpose of this procedure is to provide information on the proper method to collect water samples from the influent and effluent valves on the treatment system.

2.0 SCOPE

This procedure address the influent and effluent sampling from the treatment system.

3.0 REQUIREMENTS

To ensure that the treatment system is effectively treating the water, influent and effluent water samples are collected to measure the parameters entering and leaving the system. The system must be running properly before the samples can be collected.

4.0 EQUIPMENT

The following equipment may be needed to collect the influent and effluent water samples from the treatment system.

- 4.1 Sample Containers
- 4.2 Field Logbook
- 4.3 Cooler
- 4.4 Blue Ice
- 4.5 Chain-of-Custody Forms
- 4.6 Tape
- 4.7 Zip-Loc Bags
- 4.8 Disposable Latex or Nitrile Gloves
- 4.9 5-gallon Plastic Bucket

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5.0 PROCEDURE

1. Sample containers shall be labeled prior to sample collection.
2. The influent samples shall be collected first. A 5-gallon bucket shall be placed under the influent valve. The valve shall be opened so that the water is running like it would from a kitchen sink faucet. This shall be done for approximately 1-2 minutes so that the influent port is flushed. After 2 minutes the valve shall be turned back so that the water trickles out of the valve.
3. VOCs sample shall be collected first. The 40 mL vials shall be completely filled so that no headspace is present. Once the VOCs samples are collected, they shall immediately be placed in a cooler with ice.
4. The valve on the influent port shall be opened so that the water is running like a kitchen faucet. Samples for SVOCs and Metals can now be collected if necessary.
5. The jars for SVOCs and metals shall be completely filled. The jars shall be sealed and placed into a cooler with ice.
6. Procedures 1-5 shall also be followed for the effluent samples which are obtained from the effluent port.
7. Once both the influent and effluent samples are collected, a chain-of-custody form shall be completed and placed in a zip-loc bag and taped to the inside of the cooler lid. The lid shall be closed and sealed with tape.

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Procedure P-8

MEASUREMENT OF DEPTH TO WATER, TOTAL DEPTH, AND NON AQUEOUS PHASE LIQUIDS

1.0 PURPOSE

The purpose of this section is to provide information on the proper measurement of piezometric head levels, total depth of monitoring wells, and determining the presence and measurement of immiscible liquids.

2.0 SCOPE

This section provides guidance for obtaining water level measurements, total depth measurements and determination of well volumes. These procedures are frequently conducted in conjunction with ground water sampling and the preparation of potentiometric surface maps.

3.0 REQUIREMENTS

Ground water level measurements can be determined in monitoring wells, private or public water supply wells, extraction wells, and open boreholes. Ground water level measurements should generally not be made through drilling augers, rods, or casing. Ground-water level measurements should precede ground-water purging or sampling.

4.0 EQUIPMENT

The following equipment may be needed to measure the depth to water, total depth and thickness (if present) of immiscible layers.

- 4.1 Disposable Latex or Nitrile Gloves
- 4.2 Water Level Indicator
- 4.3 Oil-Water Interface Probe
- 4.3 Appropriate Keys (for locked wells)
- 4.4 Field Logbook

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4.5 Ground Water Sampling Form

5.0 PROCEDURE

1. Wells that have a water tight or pressure cap should be unsealed at least 24 hours prior to measurement to allow for water levels to stabilize. The protective casing will remain locked during this time period to prevent vandalism.
2. Check operation of water level indicator above ground. All water level indicators must be decontaminated before and after each use per Procedure P-9.
3. All information shall be recorded in the field log book and on the ground water sampling form (if sampling is to occur).
4. The presence of non-aqueous phase liquids (LNAPL and DNAPL) will be determined using an interface probe by first checking the surface of the ground water and then slowly taking continuous readings till the bottom of the well is reached. If the interface probe indicates the a change in potential (most meters have an audible alarm and/or light system; see specific meter operating manual), the depth shall be recorded per step five of this procedure.
5. Measurements should be taken from a surveyed reference mark on the top edge of the well casing. All measurements are to be accurate to the nearest 0.01 foot.
6. Measurements of depth to water, total depth and depth to top and bottom of all immiscible layers are to be recorded along with the date and time of measurement, well number, diameter of the well, and visual condition of the well.

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Procedure P-9

DECONTAMINATION OF SAMPLING EQUIPMENT

1.0 PURPOSE

The purpose of this section is to provide information on the proper decontamination of sampling equipment used to perform field investigations.

2.0 SCOPE

This procedure addresses decontamination of all field sampling equipment.

3.0 REQUIREMENTS

To ensure that chemical analysis results are reflective of the actual concentrations present at sampling locations, equipment used in sampling activities must be properly cleaned and decontaminated prior to and following each use. This will minimize the potential for cross-contamination between sampling locations and the transfer of contamination off-site.

4.0 DECONTAMINATION EQUIPMENT

The following equipment may be needed to properly decontaminate sampling equipment.

- 4.1 Disposable Latex or Nitrile Gloves
- 4.2 Laboratory Grade Non-Phosphate Detergent
- 4.3 Tap Water
- 4.4 Deionized Volatile-Free Water
- 4.5 Aluminum Foil
- 4.6 Pesticide-Grade Methanol
- 4.7 Nitric Acid
- 4.8 Scrub Brushes
- 4.9 Four to six 55-gallon Drums

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4.10 Pressure Washer

5.0 PROCEDURE

5.1 Decontamination of Groundwater Sampling Equipment

A decontamination pad large enough to hold a drill rig will be utilized on-site. The pad shall be constructed with berms around the perimeter and plastic sheeting, covering the entire bermed pad. A low sump area will be constructed on one of the bermed sides of the pad to facilitate the collection of water within the pad. Any water collected in the sump area shall be pump into a portable polyethylene tank. All decontamination water shall be disposed in the treatment system located on-site. Prior to and after the collection of groundwater samples, sampling equipment shall be decontaminated by the following procedure.

Water Level Meter Tape

1. Wash and scrub the tape with tap water and non-phosphate detergent.
2. Rinse several times with tap water.
3. Spray the tape with pesticide-grade methanol.
4. Rinse several times with deionized volatile free water.
5. Allow to air-dry.

Submersible Pumps

1. Three separate 55-gallon drums shall be used for decontaminating the submersible pumps. One of the drums shall contain tap water, one shall contain a tap water, non-phosphate free detergent mixture, and the remaining drum shall contain deionized volatile-free water.
2. The pump shall be submersed into the drum containing the tap water. The tap water shall be allowed to flow through the pump for approximately 5-10 minutes. The pump shall then

DRAFT

be place in the drum containing the mixture of water and detergent. The detergent water mixture shall flow through the pump for approximately 5-10 minutes. The pumps shall then be submersed into the drum containing the deionized volatile free water. Water shall flow through the pump for approximately 15 minutes.

3. Allow the pumps to air-dry.

Drill Rig and Hollow Stem Augers

1. The drill rig and associated tooling shall be steam cleaned by a high pressure washer upon arrival, in between boring locations, and before leaving the site. All water from the cleaning of the rig and augers shall be collected in the portable tank.

Split-Spoons, Bowls, and Mixing Spoons

1. Wash and scrub all split spoons, bowls, and mixing spoons with tap water and non-phosphate free detergent.
2. Rinse several times with tap water.
3. Rinse with pesticide-grade nitric acid.
4. Rinse several times with deionized volatile free water.
5. Rinse several times with pesticide-grade methanol
6. Allow to air-dry.
7. Wrap in aluminum foil.

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Procedure P-10

**NAPL DETERMINATION IN SOIL
BY VISUAL DETERMINATION**

1.0 SCOPE AND APPLICATION

Direct visual determination of colorless, non-homogeneously distributed NAPL contained in soil samples is improved by using fluorescence, centrifugation, and addition of hydrophobic dye. The sample is visually observed after each step to determine the presence of NAPL, its density and quantity.

2.0 SUMMARY OF METHOD

Soil samples placed in a polyethylene zip-lock bag and examined for organic vapors with an OVA (organic vapor analyzer). The soil samples, with enough water added to achieve a fluid level of 35 mLs, are examined visually by scanning the liquid against the surface of the sample container with ultraviolet light to determine if any fluorescence is detected indicating a presence of non-aqueous phase liquid (NAPL) which can be attributed to petroleum products, especially those with high concentrations of aromatics, unsaturated hydrocarbons, and polyaromatic hydrocarbons. A subsample is then shaken with water to determine if separate fluid phases, or layers, exists between the water, soil, and NAPL. Following the shake-test, the subsample is centrifuged to produce a clear supernate with the lighter organic layer on the surface. Sudan IV, a non-volatile hydrophobic dye, is added to the subsample and the sample is mixed by shaking and the wall of the sample container is visually inspected for NAPL presence. The subsample container with the hydrophobic dye is then centrifuged and the surface of the supernate and the container walls are examined for visual evidence of NAPL, its relative density and quantity. Visually determined NAPL results are indicated by an A, B, or C classification corresponding to present, suspected presence, and not present, respectively.

3.0 INTERFERENCES

The UV/fluorescence examination is much more effective in identifying NAPL presence in darker brown and black soils than with pale-yellow or sandy colored soils.

DRAFT

UV/fluorescence examination is limited in the number of compounds with functional groups which will produce fluorescence.

False positives due to the mineral presence in the soil may occur on the UV/fluorescence examination.

A glass sample jar can be used for the shake-test of the soil water suspensions; however, the visual contrast between the soil, water, and NAPL may not be distinct enough for the examiner to determine the NAPL presence. Shake-tests (with and without dye) are more effective in plastic containers because hydrophobic NAPLs wet plastic better than glass. This improves the visual determination of NAPL at the surface of the sample container.

Centrifugation is effective for determining the LNAPL (lighter than water NAPL) presence, but not as effective for the detection of DNAPL (denser than water NAPL).

Subsamples may contain more or less NAPL saturations than the parent sample.

4.0 APPARATUS AND MATERIALS

- 4.1 OVA with FID probe
- 4.2 Polyethylene zip-lock bags. (Two per sample.)
- 4.3 Battery-powered UV light which emits wavelengths of 2356 Å and long wavelengths of 3000 to 4000 Å, simultaneously.
- 4.4 50 mL polypropylene centrifuge tube with caps.
- 4.5 Centrifuge.
- 4.6 Toothpicks.
- 4.7 Sudan IV, CAS No. 85-83-6 (Aldrich Chemical Co.)
- 4.8 Methane gas for OVA calibration.
- 4.9 Top-loader balance (0.1 grams).
- 4.10 Spoon or spatula.
- 4.11 Type II Deionized Water.
- 4.12 Syringe - 10 mL gas tight.
- 4.13 Kerosene, CAS No. 8008-20-6 (Aldrich Chemical Co.).
- 4.14 Tetrachloroethene, CAS No. 127-18-4 (Aldrich Chemical Co.).

DRAFT

4.15 Chlorobenzene, CAS No. 108-90-7 (Aldrich Chemical Co.).

5.0 PROCEDURE

5.1 Soil Preparation

Place 172 grams of soil in the inner of two polyethylene zip-loc bags. Add enough water to attain a total fluid volume of 35mL.

5.2 OVA Determination

Calibrate the OVA with methane according to manufacturers instruction. Three minutes after sample preparation, measure the organic vapor concentration by inserting the FID (flame ionization detector) probe of the OVA into an opened corner of the inner bag. Record the vapor concentration. Close the bag.

5.3 Unaided Visual Examination

Examine the sample in the polyethylene bag while manipulating the fluid to the bag surface by squeezing the sample. Characterize samples using the following classification:

- A = NAPL presence apparent;
- B = NAPL presence suspected;
- C = No visual evidence of NAPL presence.

5.4 UV/Fluorescence Examination

In a dark room, scan the sample bag with the UV light while manipulating the bag to press fluid against the surface of the bag under the light. Characterize the sample and record result using the A, B, or C classification in Section 5.3.

5.5 Soil Water Shake-Test

Place approximately 20 mL (assume soil particle density of 2.65 g/mL unless known) of the soil

DRAFT

sample into a 50 mL centrifuge tube. Add 20 mL of water to the centrifuge tube. Close centrifuge tube and shake manually for 10 seconds. Inspect the sample through the tube walls and at the fluid air surface for NAPL. Characterize the sample and record the results using the A, B, or C classification given in Section 5.3.

5.6 Centrifugation Test

Using the subsample from Section 5.5, centrifuge the sample at 1250 rpm for one minute. Inspect the sample for NAPL as in Section 5.4. Characterize the sample and record the results using the A, B, or C classification given in Section 5.3. Also inspect the sample for LNAPL and DNAPL and record results.

5.7 Hydrophobic Dye Shake-Test

Sudan IV is a reddish-brown, hydrophobic dye which is practically insoluble in water at ambient temperatures. Sudan IV is a solvent dye and will colorize the NAPL if present in the sample. Place 0.2 mg (the amount that will rest on the edge of a toothpick) of Sudan IV in the centrifuge tube containing the sample from Section 5.6. Shake the tube for approximately 30 seconds. Examine the centrifuge tube for fluid which is colored indicating the NAPL presence. Estimate the density of NAPL present. Characterize the sample and record the results using the A, B, or C classification given in Section 5.3. Also record if the NAPL is LNAPL or DNAPL. Indicate the density and quantity of the NAPL in the sample as follows:

g = few NAPL globules observed;

m = moderate volume of NAPL observed (estimated < 1 mL NAPL);

a = Abundant volume of NAPL observed (estimated 1-2 mL NAPL).

Note: The dye Oil Red O, CAS No. 1320-06-5 (Aldrich Chemical Co.) may also be used to indicate NAPL.

5.8 Centrifugation of Hydrophobic Dye Shake Test Sample

Using the sample from Section 5.7, centrifuge the dyed sample at 1250 rpm for one minute. Examine the tube walls and at the fluid surface for NAPL. Characterized the sample using the A,

DRAFT

B, or C classification given in Section 5.3. Also note if LNAPL or DNAPL is present. Assess the density and quantity and report as stated in section 5.7.

5.9 Report Format

See Figure 5-1 for report form.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

Samples should be performed in duplicate at a frequency of 5%.

Subsamples may contain NAPL saturations which are higher or lower than the parent sample depending upon the homogeneity of the parent sample.

A blank sample containing no NAPL should be analyzed at the beginning and end of each batch of analyses. If the blank analysis produces positive results for NAPL, the source of contamination should be identified and eliminated.

As a method check sample, a blank sample spiked with 1 mL kerosene, chlorobenzene, and tetrachloroethene shall be analyzed prior to each batch of analyses. Perform each step in section 5.0 on the check sample. Results for the check sample will be recorded on the report form. If the check sample does not produce positive NAPL results, the sample should be prepared again and reanalyzed. If a problem is confirmed by the reanalysis, the method should be discontinued until the problem can be identified and solved.

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Procedure P-11

WELL DEVELOPMENT

1.0 PURPOSE

The purpose of this procedure is to attempt to remove fine particulate matter from the formation near the well intake. The methods and equipment discussed are for the development of a well following installation and prior to purging and sampling.

2.0 SCOPE

This procedure applies to removing fine particulate matter from the geologic formation near the well intake. The wells need to be properly developed so that the water sampled will not be turbid and so that the viability of the water quality analysis will not be impaired.

3.0 REQUIREMENT

Methods for well development include the use of surge blocks and pumps. The primary consideration in well development is to remove fine particulate matter from the well so that the analyses of samples is not impaired.

4.0 EQUIPMENT

The following equipment may be needed to develop wells:

- 4.1 Surge Block
- 4.2 Electric Submersible Pump
- 4.3 Water Level Meter Tape
- 4.4 Portable Tank to Contain the Development Water
- 4.5 Field Logbook
- 4.6 Plastic Sheeting
- 4.7 Disposable Latex or Nitrile Gloves
- 4.8 Teflon Tubing

DRAFT

- 4.9 pH Meter
- 4.10 Turbidity Meter
- 4.11 Thermometer
- 4.12 Specific Conductance Meter
- 4.13 HNu or Ova

5.0 PROCEDURE

The groundwater wells will be developed according to the following procedure:

1. The wells will be unlocked and the caps removed. An HNu or OVA will be used to screen air space in the well opening for any organic vapors. Any readings will be recorded in the field logbook.
2. Field Procedures P-8 and P-13 will be performed to determine the minimum amount of water to be removed during development.
3. A surge block will then be lowered into the top of the well intake and operated in a pumping action with a typical stroke of three feet to agitate the sediment into suspension within the water column.
4. After the water column has been thoroughly agitated, the surge block will then be removed from the well intake.
5. An electric submersible pump will be placed into the well intake and lowered to just below the water table and pumped until the water has cleared up. Field procedure P-6 will be followed during development to document the change of water quality during well development.
6. The electric submersible pump will then be removed from the water table.
7. The well will be agitated once again.
8. The surge block will be removed from well intake.

DRAFT

9. The electric submersible pump will be lowered into the well intake and pumped until sample is free and clear of suspended sediment. Steps 4 through 9 will be repeated as necessary to remove a minimum of 3 well volumes and the water quality parameters measured in procedure P-9 have stabilized (plus or minus 3%) over 3 consecutive measurements.

SOIL SAMPLING FOR VOLATILE ORGANIC COMPOUNDS**1.0 PURPOSE**

The purpose of this procedure is to minimize the loss of volatile organic compounds during the collection of samples.

2.0 SCOPE

This procedure applies to minimizing the loss of volatile organic compounds during the collection of soil samples. This is performed in such a way so that minimal volatile organic compounds will be lost during collection.

3.0 REQUIREMENTS

The split-barrel core sampler will be fitted with liners for the collection of the volatile organic samples.

4.0 EQUIPMENT

The following equipment may be needed to collect soil samples for volatile organic compounds.

- 4.1 Drilling Equipment Capable of Collecting Specific Samples
- 4.2 Split-Spoon Sampling Equipment
- 4.3 Split-Spoon Liners
- 4.4 Cooler
- 4.5 Blue Ice
- 4.6 Tape
- 4.7 Boring Logs
- 4.8 Field Logbook
- 4.9 Aluminum Foil
- 4.10 Polyethylene Caps

5.0 PROCEDURE

1. A split-spoon core sampler will be lined with a liner and driven into the undisturbed soil below the lead auger. After the split spoon has been driven to the required depth, it shall be withdrawn from the borehole and taken to a sample processing area.
2. The split-spoon sample shall be opened and the liner removed. The liner will immediately be capped with Teflon® sheeting or aluminum foil covered by polyethylene caps.
3. Capped samples will be sealed with Teflon® tape, labeled with the appropriate sample identification, enclosed in a resealable plastic bag, and stored in ice-cooled chests until delivered to the laboratory.
4. Chain-of-custody forms shall be completed, placed in Zip-loc® (or equivalent) bags, and taped to the inside of the cooler lid. The cooler shall be closed, sealed with tape, and shipped to the laboratory for analysis.

Procedure P-13

CALCULATION OF BOREHOLE AND PURGE VOLUMES

1.0 PURPOSE

The purpose of this procedure is to calculate the standing volume of water within a well, accounting for water stored within the filter pack, and to determine the requisite volume of water to be removed during well purging or development.

2.0 SCOPE

This procedure applies to ground water purging prior to sampling. This procedure is intended to ensure that standing water within the well is removed prior to sampling.

3.0 REQUIREMENTS

Procedure P-8 (Measurement of Depth to Water, Total Depth, and Non Aqueous Phase Liquids) should be completed prior to initializing this procedure.

4.0 EQUIPMENT

The following equipment may be needed to determine the standing and purge volumes of a well.

- 4.1 Well Construction Log
- 4.2 Ground Water Sampling Form
- 4.3 Field Logbook
- 4.4 Calculator

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5.0 PROCEDURE

1. Complete the following form and attach to Ground Water Sampling Form.

WELL ID: _____

DATE: _____

CALCULATION OF BOREHOLE AND WELL VOLUMES

<u>Parameter Definitions:</u>	<u>Parameter:</u>	<u>Symbol:</u>
Depth to water from TOC:	_____ ft.	D
Total Depth of well from TOC:	_____ ft.	TD
Height of water column in well:	_____ ft.	TD - D = h
Top of sand pack:	_____ ft.	TSP
Bottom of well Screen:	_____ ft.	BWS
Thickness of sand pack:	_____ ft.	BWS - TSP = t
Radius of borehole	_____ ft.	r_B
Assumed Porosity of sand pack:	30 %	n
Volume per lineal foot given a diameter:		c

<u>diameter:</u>	<u>gal./linear ft.:</u>	<u>diameter:</u>	<u>gal./linear ft.:</u>
2 in.	0.17	7.25 in.	2.14
3 in.	0.38	7.75 in.	2.45
4 in.	0.66	8.25 in.	2.78
6 in.	1.5	10.25 in.	4.29
8 in.	2.6	12.25 in.	6.13

VOLUME CALCULATIONS:

volume of water in casing, v_c :

$$v_c = c \times r_c^2 \times h \quad \text{_____} \times \text{_____}^2 \times \text{_____} = \text{_____} \text{ gal.}$$

volume of borehole, v_B :

$$v_B = c \times r_B^2 \times t \text{ or } h \text{ (whichever is less)} \quad \text{_____} \times \text{_____}^2 \times \text{_____} = \text{_____} \text{ gal.}$$

DRAFT

volume in annular space, vA:

$$v_A = (v_B - v_c) n \quad (\quad - \quad) 0.30 = \quad \text{gal.}$$

TOTAL VOLUME TO BE REMOVED:

$$v_R = 3 (v_C + v_A) \quad 3 (\quad + \quad) = \quad \text{gal.}$$

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Procedure P-14 **BOREHOLE AND WELL ABANDONMENT**

1.0 PURPOSE

This section describes the methods of securing a borehole from external contamination after testing is completed.

2.0 SCOPE

This procedure applies to the abandonment of test holes and wells.

3.0 REQUIREMENTS

The potential for a borehole or well to act as a migratory pathway for contaminants into groundwater is large.

4.0 EQUIPMENT

- 4.1 Well Construction Log
- 4.2 Field Logbook
- 4.3 Drill Rig equipped with the appropriate tooling
- 4.4 Bentonite Powder
- 4.5 Bentonite Chips or Pellets
- 4.6 Portland Type I Cement
- 4.7 Clean, Potable Water

DRAFT

5.0 PROCEDURE

1. Boreholes that have been damaged to such an extent that they are no longer functional shall be identified to the regulatory agencies.
2. Boreholes that have served their intended purpose and are no longer required, shall be identified to the regulatory agencies.
3. Abandonment of boreholes or wells on or off-site, shall not be initiated until written notification has been received from the regulatory agencies. This notification shall include a specific location or unique identification number for each borehole or well to be abandoned.
4. The bore hole shall be over-drilled such that any casing and well materials are removed. Any well materials recovered during the abandonment will be treated in the same manner as borehole cuttings and disposed of per applicable local, state, and federal regulations.
5. Once the well materials have been removed from borehole a side discharge tremie will be used to inject a cement-bentonite grout. This grout will consist of seven gallons of water mixed with 94 pounds of Portland type I cement to which three to five pounds of bentonite powder is added.
6. The grout shall be placed in such a fashion as to prevent voids or air pockets from forming.
7. Soil borings that do not penetrate the water table may be abandoned by filling the bore hole with bentonite pellets. The pellets shall be hydrated in one-foot lifts with clean, potable water. Extreme care shall be taken so as to avoid bridging the pellets.

DRAFT

8. Any test holes or soil pits dug with a backhoe or equivalent and/or penetrate an engineered cap will be backfilled with a neat cement-bentonite mixture.

9. Hand-augered or hand dug holes shall be backfilled with either bentonite powder or bentonite pellets. This bentonite will be hydrated in on-foot lifts with clean, potable water.

10. A written abandonment report shall be sent to all authorizing agencies stating what abandonment occurred and how it was performed.

11. The Ground Water Monitoring Program Plan will be updated to reflect the abandonment of any monitoring wells.

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Procedure P-15

SURVEYING

1.0 PURPOSE

The purpose of this procedure is to outline the requirements for performing engineering measurements and other land surveying for the purposes of establishing benchmarks, baselines, and mapping of sampling locations and altitudes.

2.0 SCOPE

This procedure describes the minimum standards for surveying procedures and required results associated with determining sampling locations and altitudes. These measurements will rely primarily on the use of pre-established benchmarks, baselines, or monuments. This procedure does not take precedence over detailed site specific surveying needs that may be required for engineering design or construction.

3.0 REQUIREMENTS

Surveying operations may be performed before or after sampling locations are established. The altitude of wellheads (top of inner casing) must be measured by the surveyor after the well has been installed. All surveying is to be performed by a licensed surveyor who is Registered in the State of New Mexico.

4.0 EQUIPMENT

The equipment utilized for surveying shall be of types which are appropriate for obtaining the results and accuracies specified within this procedure. All measuring devices must be recently calibrated in accordance with the particular manufacturer's recommendations and, where appropriate, calibrated against a comparable National Bureau of Standards calibrated device.

DRAFT

5.0 PROCEDURE

The required survey accuracy and precision depends on the intended purpose of the survey work. Such requirements could range from gross estimation to determination of monitoring well heads to 0.01 feet in order to evaluate ground water gradients. However, no more than Third Order Accuracy would generally be required for sampling station location and altitude measurement.

Leveling Accuracy: Order of accuracy for leveling is determined by comparing the two differences of altitude obtained by running levels I both directions over a line, and comparing the difference in feet against the following standard:

First Order	i.e. $0.017 \times (M)$
• Second Order	i.e. $0.035 \times (M)$
Third Order	i.e. $0.05 \times (M)$
Fourth Order	0.1 to $0.5 \times (M)$

Traverse Accuracy: Order of accuracy for measured distances in a traverse are determined by comparing the closure error in position of the traverse as a portion of the total traverse distance measured against the following standard:

First Order	1 in 25,000
Second Order	1 in 10,000
• Third Order	1 in 5,000
Fourth Order	1 in 1,500

5.1 Borings and Test Pits

Horizontal locations should be staked out to the nearest foot and ground surface elevations measured to 0.1 feet. If surveyed and staked prior to sampling, the stake should be labeled with boring number, grid coordinates, and ground surface altitude. If surveying occurs following the sampling event, care should be taken to measure the original surface altitudes accurately as possible; e.g., a mound or depression may remain in a test pit area.

5.2 MONITORING AND PUMPING WELLS OR PIEZOMETERS

In general, horizontal location and ground surface altitude criteria for wells and piezometers are similar to those of test pits or borings. The surveyor will measure and mark the altitude of the top of the inner casing (well head) to 0.01 feet as this point will be used as a reference to measure precise ground water altitudes. The wellhead elevation and the well designation shall be permanently recorded directly on the protective casing.

5.3 SURFACE WATER SAMPLING LOCATIONS

When obtaining grab samples from a shoreline, samplers should install a location stake at the shoreline marked with the station number. This stake will be surveyed for horizontal and ground surface altitude along with the corresponding water surface altitude (if different from staked ground surface elevation). In general, locations do not require great location accuracy (within several feet horizontally and altitude to 0.1 feet) when compared to a well location.

When samples are to be taken within the surface water body away from the shoreline, better horizontal control is required. Sampling locations are determined by the sampler using on-shore baselines or ranges.

5.4 SURFACE SOIL/WASTE SAMPLING LOCATIONS

Measurement and layout requirements for obtaining a single grab sample of soil or waste are comparable to those for obtaining surface water grab samples from the shoreline. When a composited sample is collected from a sampling grid, the surveyors should stake out the grid and indicate the stain number(s), coordinates or orientation of the grid, and ground altitude(s) on the stakes. Generally, a precision of no better than the nearest foot for location, and 0.1 feet for altitude will suffice for grab or grid sampling.

DRAFT

5.5 AIR SAMPLING STATIONS

Survey of air sampling stations should follow the precision required of surface soil/waste sampling locations.

5.6 REPORTS AND DOCUMENTATION

The Registered Surveyor shall submit a report to the Project Manager at the completion of each survey assignment. This report should contain the following information: the activity, personnel involved, survey approach used, and any technical evaluations that were made in the performance of the work. Installed benchmarks, baselines and monuments shall be appropriately documented on a base map to indicate their relative locations with respect to each other, and with respect to other site features. Benchmarks will be described regarding their construction, location (on map), altitude and reference datum plane. Baselines will be indicated on the map and will show the bearing, length, and coordinates and/or stationing of the ends of each baseline segment. Monuments will also be described regarding their construction and location (on map), in addition to grid coordinates.

DRAFT

SECTION FIVE SAMPLING AND ANALYSES

The following sections describe the procedures for the collection and analysis of groundwater and treatment system samples and the measurement of water levels. The sampling and analyses procedures comply with the requirements specified in the Corrective Action Plan for the Sparton facility, presented as Attachment I of the Final Administrative Order RCRA-VI-001(h)-96-H (USEPA, February 1998). **[NOTE TABLES AND FIGURES REFERRED TO IN THIS SECTION WILL BE PROVIDED FOR THE FINAL VERSION DUE TO FILE CORRUPTION]**

5.1 GROUNDWATER SAMPLING PARAMETERS AND FREQUENCY

As previously stated in Sections 2 and 3, eight extraction and treatment system recovery wells and **#? (to be provided by Sparton)** on-site and off-site monitoring wells will be monitored on a monthly and quarterly basis, respectively, as listed in Table 5-1 **(to be provided by Sparton)**. Table 5-2 provides a list of the monitoring parameters and detection limits.

5.1.1 Existing On-Site Groundwater Extraction and Treatment System

The existing groundwater recovery well network consists of the following recovery wells: PW-1, MW-18, MW-23, MW-24, MW-25, MW-26, MW-27, and MW-28. Sparton will conduct monthly sampling and analyses of the recovered ground water both prior to treatment, and following treatment, for the following constituents:

Volatile organic constituents as listed in 40 CFR Part 264, Appendix IX; and
Hexavalent Chromium

Sparton will determine the total volume of recovered groundwater from each recovery well on a monthly basis. Sparton will document the efficiency of the treatment system (as measured by the percent reduction of hazardous waste constituents) on a monthly basis.

5.1.2 Monitoring Well Network

The existing monitoring well network consists of all on-site wells **(MW-? to be supplied**

DRAFT

by Sparton) and off-site wells (MW-? to be supplied by Sparton). Sparton will conduct quarterly sampling and analyses for each of the wells the following constituents:

Volatile organic constituents as listed in 40 CFR Part 264, Appendix IX;

Total metals as listed in 40 CFR Part 264, Appendix IX; and

- Hexavalent Chromium

Sparton will collect groundwater elevation data at each of the monitoring wells on a quarterly basis. Coupled with the sample analyses results, these data will be utilized by Sparton to prepare potentiometric surface maps and contaminant concentration contour maps for each of the flow zones in the aquifer (e.g., upper, upper lower, etc.) on a quarterly basis.

5.2 GROUNDWATER SAMPLING PROCEDURES

5.2.1 Decontamination

To reduce the possibility for cross contamination, dedicated pumps or bailers will be placed in the wells. All non-dedicated measuring, purging, and sampling equipment will be decontaminated prior to purging and sample collection. Decontamination will include washing all purging and sampling equipment with a non-phosphate laboratory detergent, potable water rinse, nitric rinse, a methanol rinse as necessary (not used for pump decontamination), followed by a triple laboratory grade deionized water rinse in accordance with Field Procedure P-9 presented in Section Four.

5.2.2 Water Level Measurements

During all sampling events and hydraulic performance evaluations, groundwater elevations will be determined in all available wells in accordance with Field Procedure P-8 presented in Section Four. If groundwater sampling will be performed, a complete circuit of water levels will be measured before purging and sampling. Water level measurements will be recorded beginning with the uncontaminated wells and ending with the wells showing the highest constituent levels. Measurements will be made consecutively in a minimal amount of time. Groundwater levels will be measured with respect to surveyed reference points. Water levels will be obtained using either an electrical water level tape and probe or a chalked, weighted surveyor's tape. The measuring device will be rinsed with deionized water prior to each use.

5.2.3 Well Purging

The wells will be evacuated and sampled using dedicated pumps or bailers. Wells will be purged of a minimum of three well volumes in accordance with Field Procedure P-4 presented in Section Four, and sampled as soon as possible thereafter. Purging will continue until the pH, conductivity, and temperature have stabilized. The purged water will be contained in a graduated container to monitor volume removed. All purge water will be disposed in the treatment system holding tank.

5.2.4 Sample Collection

Samples will be obtained with dedicated pumps or bottom filling/discharging bailers. If a pump is used, the pumping rate will be reduced before sampling to provide a flow of approximately 100 mL per minute to minimize agitation. Samples will be collected by pumping directly into each of the required containers. If a bailer is used, the bailer will be slowly lowered and raised into the well to minimize agitation. The contents of the bailer will also be slowly poured into the sample bottles through a bottom discharging device. Sampling bottles will have been filled with the proper preservatives by the analytical laboratory.

Bottles will be filled completely, but will not be overflowed. The VOC bottles will be filled so that no headspace exists. The samples for VOC analyses will be collected in 40 mL glass septum vials with Teflon-lined lids and preserved with hydrochloric acid. The maximum holding time for VOCs is 14 days.

A detailed field data sheet for each well will be completed during each sampling event. The field data sheet will document actual sampling and purging procedures and observations. The integrity of all monitor wells will be checked and noted during each sampling event.

5.2.5 Sample Handling

To prevent misidentification of samples, a label will be securely fixed to each sample container. These will be waterproof and carry the following information:

Project name and number

DRAFT

Sample identification and number

- Analytical parameter(s) and method and preservatives used
- Initials of collector
- Date and time of collection

The labels will be affixed to the appropriate sample containers at the laboratory, prior to shipment to the site, and completed in the field.

5.2.6 Sample Packaging and Shipping

Following sample collection, all samples will be brought to an on-site location for batching and paperwork checks. At this location, like sample types are matched with similar sample types from all sample locations. Label information is checked to ensure there is no error in sample identification. The samples are packaged to prevent breakage and/or leakage, and the shipping containers are labeled in accordance with DOT regulations and International Air Transport Association (IATA) regulations for transport.

Sample packaging and shipment requirements will vary depending on the expected concentration of contaminants and whether or not the samples are expected to constitute hazardous materials. For those samples expected to be non-hazardous in nature, packaging and shipping criteria are designed only to maintain chain-of-custody protocol as well as to prevent breakage of the sample containers. The packaging and shipping procedures for liquid samples will be as follows:

Approximately a 3-inch layer of cushioning material will be placed in the bottom of water-tight, insulated metal or equivalent strength plastic shipping containers.

Bottles will be enclosed in clear plastic bags, through which the labels are visible, and the bag sealed. Bottles will be placed upright into the shipping container so they do not touch and will not touch during shipment.

Using the necessary packing material, the sample bottles will be packed to ensure that they do not shift during shipment.

- Sealed plastic bags of ice cubes or chips will be placed around and on top of the

samples bottles to keep the samples cool during delivery.

The appropriate chain-of-custody form(s) will be placed in a zip-lock plastic bag, and taped securely to the inside of the shipping container lid.

The shipping container will be closed and locked/hatched. If the shipping container used is a picnic cooler, the drain plug will be taped closed to prevent any leakage of water as the ice packs melt during transport. The lid will be secured by taping. The cooler will be wrapped completely with strapping tape at a minimum of two location. Labels will not be covered. A completed shipping label will be attached to the top of the cooler. Figure 5-1 shows a correctly completed shipping label. Signed custody seals will be affixed on the cooler. The seals will be covered with wide, clear tape. Appropriate labeling will be affixed to the sides of cooler (i.e., "Class 9" and "This end up" labels).

As soon as field personnel are ready to transport samples from the field to the laboratories, the laboratory Point of Contact (POC) at each laboratory will be notified by telephone of the shipment along with the estimated time of arrival. A breakdown of required analyses by matrix and concentration level will be included. Samples will either be shipped to the laboratory via overnight carrier, delivered directly to the laboratory or maintained at the site so as not to exceed sample holding times and then delivered to the laboratory. Upon arriving at the laboratory the samples and chain-of-custody records will be placed into a walk-in cold room until they can be logged in by the laboratory sample custodian.

5.3 ENVIRONMENTAL SAMPLES

During implementation of this Groundwater Monitoring Program Plan, Sparton will collect and submit for laboratory analysis groundwater and groundwater treatment system samples. A detailed description of the sampling locations and procedures that will be used during the field investigation program are presented in previous sections of this document.

5.3.1 Field-Generated QC Samples

As a part of the project QA objectives, field-generated QC samples (i.e., equipment blanks, field duplicates, and trip blanks) will be collected throughout each sampling event. Technical judgment will be used to determine the days on which equipment blanks and

DRAFT

locations at which field duplicates will be collected. One equipment blank will be collected at a frequency of approximately 5% of the samples collected for each type of sampling equipment. One field duplicate sample will be collected at a frequency of approximately 5% of the samples collected. In addition, one set of trip blanks will accompany every shipment of samples submitted for volatile organic analysis.

5.3.2 Sample Containers and Preservation Methods

Table 5-3 summarizes the sampling parameters, containers, and preservation requirements for the aqueous samples collected during the monitoring program. Sample containers, including those necessary for field QC samples, will be obtained from the laboratory or a commercial bottle supplier.

5.4 SAMPLE CUSTODY AND FIELD DOCUMENTATION

An overriding consideration essential for the validation of environmental measurement data is the necessity to demonstrate that samples have been obtained from the locations stated and that they have reached the laboratory without alteration. Evidence of the sample traceability from collection to shipment, laboratory receipt, and laboratory custody (until proper sample disposal and the introduction of field investigation results as evidence in legal proceedings when pertinent) will be documented. A sample will be considered to be in a person's custody if the sample is:

In a person's actual possession

In view after being in a person's possession

- Locked so that no one can tamper with it after having been in physical custody
- In a secured area, restricted to authorized personnel

The field team leader (or designee) will be responsible for overseeing and supervising the implementation of proper sample custody procedures in the field. The field team leader or a designee will also be responsible for ensuring sample custody until the samples have been transferred to a courier or directly to the laboratory. Once received by the laboratory, the samples will be processed through an orderly sequence specifically designed to ensure continuous integrity of both the sample and its documentation.

DRAFT

5.4.1 Chain of Custody

The chain of custody procedures will be initiated in the field following sample collection. The procedures will consist of: 1) preparing and attaching a unique sample label to each sample collected; 2) completing the chain of custody (COC) record; and 3) preparing and packing the samples for shipment. These procedures are briefly described in the following sections.

5.4.1.1 Sample Labels

Field personnel will be responsible for uniquely identifying and labeling all samples collected during the monitoring program. All labeling will be completed in indelible/waterproof ink and securely affixed to the sample container.

5.4.1.2 Custody Seal

Custody seals will be secured across the shipping container openings to ensure content integrity. The custody seals will contain both the date and the signature of the person affixing them and will be completed in indelible/waterproof ink. The custody seals will be covered with clear plastic tape.

5.4.1.3 Chain-of-Custody Record

The COC record as shown in Figure 5-2 will be completed for each sample set submitted for off-site analyses. These forms will be maintained as a record of sample collection, transfer, shipment, and receipt by the laboratory. These forms will also contain pertinent information concerning sampling location, date, and times; signatures of at least one team member; types of samples collected along with a unique sample identification number; the number of samples collected and shipped for analysis in each lot; the project number, and the name of the laboratory to which the samples are being sent. The chain-of-custody records will be completed to ensure proper transfer of custody. The appropriate copies will be sent to the laboratory and the Project QA Manager.

DRAFT

5.4.1.4 Transfer of Custody

Samples will be accompanied by an approved COC form during each step of custody, transfer, and shipment. When physical possession of samples is transferred, both the individual relinquishing the samples and the individual receiving them will sign, date, and record the time on the chain of custody form. In the case of sample shipment by an overnight courier, a properly prepared air bill will serve as an extension of the COC form while the samples are in transit.

5.4.1.5 Laboratory Chain-of-Custody

Upon receipt at the laboratory, the designated sample custodian will inventory the sample cooler, log in the samples, and generate an internal COC or custody transfer record. The samples will then be stored in an appropriate secured sample storage area (freezer, refrigerator, etc.). Samples will remain in locked sample storage until removal for sample preparation or analysis. All transfers of samples from storage to the laboratory until sample disposal will be documented on a laboratory sample tracking/custody form that is dated and signed by each person using or transferring the samples.

5.4.2 DOCUMENTATION

The program designed to ensure that field samples and field data are valid and useful is summarized in Table 5-4. In all cases, the field team will maintain a concise, detailed field logbook containing accounts of all field activities and actions taken as well as documentation of observations made.

All sampling procedures, instrument calibration, and information pertinent to sampling conditions, progress, and field data collection will be documented following a prescribed set of guidelines. The documentation will serve as a permanent and traceable record of all activities related to a specific field investigation program. The record will be legible and accessible for verifying sampling activities and addressing future questions that may arise concerning such issues as sample integrity, and sample traceability.

All documentation will be recorded in permanent ink. Corrections to errors in field documentation or recorded calculations will be made by the first striking out the error with

DRAFT

a single line so as not to obliterate the original entry. The person originating the change will initial each separate change. All revisions, deletions, and changes will be made in indelible ink.

5.5 CALIBRATION PROCEDURES OF ANALYTICAL INSTRUMENTS

Instruments and equipment used for the laboratory analyses are controlled the method selected used to perform the analyses. The calibration procedures verify that equipment is of the proper type, range, accuracy, and precision to provide data compatible with specified requirements. All instruments and equipment which measure a quantity, or whose performance is expected at a stated level, are subject to calibration.

Before any instrument is used as a measurement device, the instrumental response to known reference materials will be determined. The manner in which various instruments are calibrated will be dependent on the particular type of instrument and its intended use. All sample measurements will be made within the calibrated range of the instrument. Preparation of all reference materials used for calibration will be documented in a standards preparation notebook.

Instrument calibration typically consists of two types: initial calibration and continuing calibration. Initial calibration procedures establish the calibration range of the instrument and determine instrument response over that range. Typically, three to five analyte concentrations will be used to establish instrument response over a concentration range. The instrument response over the range is generally absorbance, peak height, etc., which will be expressed as a linear model with a correlation coefficient (i.e., as a response factor), or as an amount vs. response plot. Continuing calibration may be used within an analytical sequence to verify stable calibration throughout the sequence and/or to demonstrate that instrument response did not drift during a period of non-use of the instrument.

Method detection limits (MDLs) achievable by the laboratory will be based on in-house instrument capabilities. Estimated quantitation limits (EQLs) are the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The EQLs are generally five to ten times higher than published MDLs, which are generally determined using clean matrixes (e.g., deionized

DRAFT

water) free of interferences and are analyzed under optimal laboratory conditions. For actual sample analysis, these MDLs may not be routinely achievable and the EQLs are employed.

Individual sample detection limits may vary from the MDLs or EQLs reported by the laboratory. These variances may be due to sample dilution requirements, variability in the sample weight or volume used relative to that specified in the analytical procedure, dry weight adjustments for solid samples, the presence of interfering analyte contaminants, or other conditions related to sample matrix or instrumental analysis.

5.5.1 Organic, Inorganic, and Wet Chemistry Analyses

All organic and inorganic analyses will be performed using EPA methods.

Gas Chromatograph/Mass Spectrometer (GC/MS)

Gas Chromatograph (GC)

Inductively Coupled Argon Plasma (ICP)

Inductively Coupled Argon Plasma/Mass Spectrometer (ICP-MS)

Graphite Furnace Atomic Absorption (GFAA) Spectrophotometer

Cold Vapor Mercury Analysis by Atomic Absorption (CVAA) Spectrophotometer:
Flameless

Spectrophotometer (absorption wavelength of 540 nm)

5.5.2 Field Analyses

Prior to the use of any test equipment in the field, such as a pH probe, thermometer, conductivity meter, or PID, proper calibration will be ensured. Specific calibration procedures and frequencies for various instruments are described in the Field Procedure P-6 presented in Section Four.

5.6 ANALYTICAL PROCEDURES

The analytical procedures to be used for samples collected during the groundwater monitoring activities will consist of EPA-approved methods. These procedures will provide project-specific detection limits as well as QC requirements.

5.6.1 Standard Analytical Methods

Samples collected during the monitoring program will be analyzed for chemical parameters by EPA methods. The analytical methods that will be used are summarized in Tables 5-5. **[This table will either be provided by Sparton or will be provided by EPA and included in the final version]**

5.6.2 Project-Specific Detection Limits

In order to produce data capable of meeting the data use objectives, project-specific reporting limits for individual parameters have been determined. Metals data will be reported using current quarterly instrument detection limits, which must be lower than the project-specific maximum allowable reporting limits to be acceptable. It should be noted that the detection limits specified by any method may not be attained for all samples because of such factors as matrix effects or volume dilution.

5.7 QUALITY ASSURANCE OBJECTIVES OF ANALYTICAL DATA

The five major characteristics of data quality that have been addressed in the development of the monitoring program are defined below. Specific QA objectives pertinent to this field investigation program are presented in Tables 5-6 and 5-7. **[These tables will be provided in the final version]**

5.7.1 Accuracy

Accuracy is defined as the degree of agreement of a measurement (or measurement average) with an accepted reference or true value. It is a measure of system bias and is usually expressed as a percentage of the true value. An evaluation of accuracy incorporates both laboratory and field sampling variables.

Accuracy will be determined in the laboratory through the use of matrix spike and matrix spike duplicate (MS/MSD) analyses for most VOC and inorganic analyses. Accuracy criteria for the laboratory methods chosen for this project are defined in the method protocols and are listed in Tables 5-6 and 5-7. **[These tables will be provided in the final version]**

DRAFT

The field team will select one environmental sample in 20 to be analyzed for accuracy for each matrix being submitted. The resulting MS/MSD analyses will be used to evaluate accuracy and precision for both organic and inorganic analyses. Matrix effects may affect the analyte recoveries of the spiked compounds. The percent recoveries of the target compounds will be calculated and used as an indication of the accuracy of the analyses performed.

Sampling accuracy will be maintained by the implementation and adherence to strict procedural protocols. Trip blanks will be collected and analyzed to ensure that no cross-contamination of samples by VOCs occurs during sampling or transportation to the laboratory. Equipment blanks and ambient blanks will also be collected and analyzed to monitor cross-contamination. One trip blank will be included in each cooler containing samples to be analyzed for VOCs. Equipment blanks will be collected at a frequency of 20% of samples collected for each matrix.

5.7.2 Precision

Precision is a measure of agreement among individual measurements of the same property under similar conditions. It is expressed in terms of relative percent difference (RPD) between replicates or in terms of the standard deviation when three or more replicate analyses are performed. Laboratory precision will be determined through the use of MS/MSD analyses (as described in section 5.10) for organic compounds and inorganic analytes. The RPD between the two results will be calculated as a measure of analytical precision. Specific criteria for precision are listed in Tables 5-6 and 5-7. Sampling precision will also be determined through the collection and analysis of field duplicates at a frequency of 5%. In addition, field duplicate analyses will provide an estimate of each sample medium's heterogeneity.

5.7.3 Completeness

Completeness is a measure of the amount of valid data obtained compared to the amount expected to be collected. It is usually expressed as a percentage. The objectives for the monitoring activities are to obtain samples for all analyses required in each individual area, to provide a sufficient quantity of samples for each of the required analyses, and to obtain quality control samples representative of all possible contamination sources (e.g., sample

DRAFT

collection, storage, transportation, etc.). Completeness goals are presented in Tables 5-6 and 5-7.

5.7.4 Representativeness

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a data population, process condition, a sampling point, or an environment. For this monitoring program, grab and composited samples will be taken and such samples are, by definition, representative of only the conditions at the point in time collected, within sampling and analytical error.

5.7.5 Comparability

Comparability expresses the confidence with which one data set can be compared to another. To achieve comparability in this program, the data generated will be reported using units of ug/L and mg/L. By using sampling and analysis procedures consistent with EPA protocols, all data sets will be comparable within the Sparton Technology Site and between other EPA sites to ensure that a consistent database is used from which decisions concerning remedial action are made. To ensure data comparability, NIST traceable, standard reference materials will be analyzed to establish that analytical procedures are generating valid data.

5.7.6 Procedures for Data Assessment

The QA objectives for the laboratory analyses conducted during this program are listed in Tables 5-6 and 5-7. **[These tables will be provided in the final version]** Accuracy values include components of both random error (i.e., variability due to imprecision) and systematic error (i.e., bias), thereby reflecting the total error for a given measurement, expressed as a percentage of the true value. The precision values presented therein represent variability for replicate measurements of the same analyte and are expressed in terms of the RPD for duplicate measurements of the same samples. The QA objectives for the laboratory analyses are based primarily on performance data derived from method validation studies for MS/MSD analyses, surrogate spike recoveries, and other QC samples. These are not intended to represent data validation criteria *per se*, but rather represent the performance capability of the methods.

DRAFT

5.8 INTERNAL DATA REDUCTION, VALIDATION AND REPORTING PROCEDURES

Described below are the types of procedures that will be followed by during the reduction, validation, and reporting of field and analytical data. Field and analytical data collected during this monitoring program will be used to monitor the groundwater contamination and determine the groundwater pump and treat system efficiency.

5.8.1 Data Reduction

Data reduction will consist of compiling and summarizing data collected during monitoring activities. Field and analytical data will be summarized in a tabular or other appropriate format. All information and data will be reported and verified for accuracy with the original sources of data. For analytical data, units designated by the analytical method will be reported.

Data produced for internal records and not reported as part of the analytical data will include laboratory worksheets and notebooks, sample tracking system forms, instrument logs, standards records, maintenance records, calibration records, and associated quality control. From non-laboratory sources, these data will include field logbooks, sample and QC sample tracking sheets, well development logs, instrumentation and calibration logs, and geologic logs. These data will be generated during the field activities, and where relevant, will be summarized for interpretation or use throughout the data evaluation process.

5.8.2 Data Validation

Quality control data provided by the laboratory will enable the Project QA Manager to evaluate the validity of the analytical data in terms of accuracy, precision, and environmental significance. The Project QA Manager will review the data applying the evaluation acceptance criteria specified below.

All analytical data will be evaluated in accordance with the essential applicable elements specified in the analytical method. The data evaluation will consist of a review of the

DRAFT

following items:

Data Completeness: If data packages are incomplete or illegible, the laboratory will be contacted to cure and resubmit the data package.

Holding Times: If the holding time is exceeded, all positive results will be flagged as estimated (J) and all non-detects will be flagged as estimated (UJ). If holding times are grossly exceeded, the data will be qualified as unusable or rejected (R).

Blanks: Any analyte detected in the blank and in any of its associated samples will be considered non-detected in the samples when the sample's concentration is less than five times the blank concentration (or less than ten times the blank concentration for the common laboratory contaminants methylene chloride, acetone, or 2-butanone).

Sample Duplicate: If laboratory or field duplicate analyses result in a RPD greater than QC criteria, the positive results for the analysis will be flagged as estimated (J) and all non-detects will be reported unqualified. If one value is non-detected and the other is above the detection limit, all positive results will be flagged as estimated (J) and all non-detects will be flagged as estimated (UJ).

Laboratory Control Sample (LCS): The LCS recovery control limits will be generated by the laboratory and updated on a regular basis. The laboratory will submit the most current control limits for the analyses requested in each data report. If the LCS recoveries are less than the lower limit reported by the laboratory, all associated results will be flagged as estimated (J or UJ). If the LCS recoveries are greater than the upper limit reported by the laboratory, all associated positive results will be qualified as estimated (J). If the LCS recoveries are grossly low, all associated non-detect results will be qualified as unusable (R).

Surrogate (Organics Only): If the results of the surrogate are greater than QC criteria (above the true concentration) all positive results will be flagged as estimated (J) and all non-detects will be reported unqualified. If the results of the surrogate are less than QC criteria (below the true concentration) all positive results will be flagged as estimated (J) and all non-detects will be flagged as estimated (UJ). If the results of the surrogate analyses are grossly below the true concentration, all positive results and all non-detects will be flagged as unusable or rejected (R).

DRAFT

Matrix Spike: If the spike recovery is not within the control limits, data for that sample will be qualified appropriately. If the results of the matrix spike are greater than QC criteria (above the true concentration) all positive results will be flagged as estimated (J) and all non-detects will be reported unqualified. If the results of the matrix spike are less than QC criteria (below the true concentration) all positive results will be flagged as estimated (J) and all non-detects will be flagged as estimated (UJ). If the results of the matrix spike analyses are grossly below the true concentration, all positive results and all non-detects will be flagged as unusable or rejected (R).

Field measurement data (i.e., pH, temperature) will be reviewed for completeness and accuracy only.

5.9 FIELD GENERATED QC SAMPLES

Quality control samples collected in the field and submitted to the laboratories along with the environmental samples are discussed in this section. The types of QC samples that will be collected during the monitoring program include: trip blanks, equipment blanks, and field duplicates. Field QC samples and frequency of collection are shown in Table 5-8. **[this table will be provided in the final version]**

5.9.1 Trip Blank

One trip blank will be submitted to the laboratory with each shipment of samples for volatile organic analysis. The analysis of this blank will provide a baseline measurement of any contamination that the samples may have been exposed to during transport. A trip blank will be comprised of a sample bottle filled with deionized, organic-free water, preserved, handled like a sample, and sent to the laboratory for analysis. Trip blanks will be prepared by the laboratory and will be submitted for liquid samples.

5.9.2 Equipment Blank

One equipment blank will be collected per sampling episode per sampling medium or at a frequency equal to approximately 5% of the samples collected for each media, whichever is more frequent. The analysis of these blanks will serve to verify the cleanliness of the sampling equipment. An equipment blank will be collected by rinsing decontaminated field

DRAFT

equipment with water, transferring the water to a sample bottle, and submitting the sample for analysis. Deionized, organic-free water will be used. The equipment blank will be analyzed for the same parameters as the samples associated with that equipment.

5.9.3 Field Duplicates

Approximately 5% of all the samples will be collected in duplicate and submitted for laboratory analysis. Duplicates are two samples that will be collected independently from one sampling location during a single episode of sampling. Duplicates will provide information about sample variability.

5.9.4 Documentation and Review of Quality Control Activities

Custody of field quality control samples will be documented from the time of QC sample collection throughout transfer of the sample to the laboratory. Documentation of sample collection, shipment, laboratory receipt, and laboratory custody will be maintained in order to accomplish this objective. Field quality control samples will be packed and delivered along with their corresponding environmental samples.

5.10 LABORATORY GENERATED QC SAMPLES

The laboratory will comply with the QC sample requirements for the analytical methods used during this monitoring program. The QC sample types generally required by the analytical methods are described in the following sections. The type and frequency of laboratory QC samples is shown in Table 5-8.

5.10.1 Laboratory Control Standard

One laboratory control sample (LCS) will be analyzed with each batch of aqueous volatile samples supplied from the field and with each batch of samples prepared for inorganic analysis. A LCS will be analyzed for each batch of samples tested for inorganics. The LCS will routinely be used to establish the precision and accuracy of an instrument or procedure. The analytical results of the LCS will be recorded in the instrument logbook and on the control chart; results must be within the acceptable control limits. An LCS solution will be prepared by adding known

DRAFT

quantities of an EMSL-Cincinnati Standard, a NIST Standard Reference Material, or a reference-traceable stock material to deionized water or the solvent of interest. A LCS solution will typically be carried through the entire sample preparation and analysis procedure.

5.10.2 Method Blank

One method blank will be analyzed with every batch of samples supplied from the field for VOCs, metals, and hexavalent chromium analysis. A method blank will be comprised of laboratory-pure, analyte-free water carried through the entire sample preparation and analysis procedure. Analysis of the method blank will provide a check of the background contamination due to sample preparation procedures.

5.10.3 Laboratory Replicates

Inorganic parameters will be analyzed in duplicate by the laboratory at a frequency of one per twenty samples. A replicate analysis will be produced by analyzing two aliquots of a single sample to determine analytical precision.

5.10.4 Matrix Spike/Matrix Spike Duplicates

One organic matrix spike and matrix spike duplicate pair will be analyzed for each combination of matrix and level (low or medium) at a frequency of one per twenty samples per matrix. The analyte spike will be added prior to digestion/distillation of the sample. If the spike recovery is not within the control limits specific to this project, the data for that sample will be qualified appropriately.

5.10.5 Surrogate Spikes

All collected samples requiring organic analysis by GC/MS or GC will be spiked with an appropriate set of surrogate standards prior to sample preparation. The surrogate standards will encompass the full range of types of organics to be analyzed in the sample and will also serve as checks on any matrix interference exhibited by the samples. If the percent recoveries of the surrogates are outside the acceptable method-required criteria limits given in Table 5-6, **[To be provided in the final version]** the associated samples will be treated as specified in the analytical method being followed.

5.10.6 Documentation and Review of Quality Control Activities

Laboratory quality control samples will be documented as specified by the analytical method. The QC activities pertinent to the analysis of each shipment of samples from the field will be documented in discrete sections of the analytical data report and will include:

- A case narrative describing any problems encountered with method blanks, matrix spike, and matrix spike duplicates, surrogate recoveries, initial calibration, and continuing calibration;
- Compilation of method blanks data;
- Compilation of matrix spike and matrix spike duplicates; and
- Surrogate recoveries data

5.11 PREVENTIVE MAINTENANCE

The ability to generate valid analytical data requires that all analytical instrumentation be properly and regularly maintained. The laboratories will maintain full service contracts on major instruments. These service contracts provide emergency service repair. The laboratories will keep large inventories of replacement parts for instruments and have mechanical and electrical repair capabilities in-house. Routine maintenance will be performed by laboratory personnel. Records of preventive maintenance for each instrument will be kept in a bound notebook.

Preventive maintenance of field equipment is also required in order to ensure the collection of valid field measurements. The field team leader will be responsible for maintenance on all field equipment.

5.12 DATA ASSESSMENT PROCEDURES

The following are procedures for evaluating the precision, accuracy, and completeness of analytical data generated during laboratory analysis for this monitoring program. The Project QA Manager will be responsible for overseeing data assessment and review.

5.12.1 Evaluation Of Analytical Precision and Accuracy

Precision and accuracy for all laboratory analyses will be ensured by adherence to protocols specified in the analytical methods specified in Tables 5-6 through 5-7.

5.12.2 Evaluation of Completeness

Completeness will be measured as the percentage of valid data points obtained compared to the amount expected to be collected. Factors that affect completeness by resulting in the loss of valid data can include exceedance of validation criteria or sample loss because of broken containers or other reasons.

5.12.3 Review of Data Quality

A review of data quality will be conducted on data that are not validated and following the validation of analytical data. The purpose of the review is to provide the following types of information pertinent to characterizing data quality:

Adequacy of data recording and transfer

Precision or bias of data

Adequacy of data calculation, generation, and processing

Documentation of procedures

Identification of data qualifiers to define the usability and limitations of the data

5.12.3.1 Evaluation of Analytical Precision

For replicate results D_1 and D_2 , the RPD is calculated as follows:

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

When the RPD is obtained for at least ten (10) replicate pairs, the average RPD and the standard

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deviation are calculated using:

NOTE THE FOLLOWING TWO EQUATIONS NEED TO BE CORRECTED DUE TO CONVERSION ERROR

$$\bar{m} = \frac{\sum_{i=1}^n m_i}{n}$$

and

$$S_m = \frac{\left[\sum_{i=1}^n (m_i - \bar{m})^2 \right]^{1/2}}{n - 1}$$

where:

- m = the RPD of a replicate pair,
= the average of the Relative Percent Difference determinations,
Sm = the standard deviation of the data set of RPD determinations,
n = the number of RPD determinations.

5.12.3.2 Evaluation of Analytical Accuracy

To determine the accuracy of an analytical method and/or the laboratory analyst, a periodic program of sample spiking will be conducted. The results of sample spiking will be used to calculate the quality control parameter for accuracy evaluation, the %R.

The %R will be defined as 100 times the observed concentration, minus the sample concentration, divided by the true concentration of the spike.

$$\%R = \frac{O_i - O_s}{T_i} \times 100$$

where:

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- %R = the percent recovery,
 O_i = the observed spiked sample concentration,
 O_s = the sample concentration;
 T_i = the true concentration of the spike.

The true concentration is calculated from:

$$T_i = \frac{\text{Spike Conc. [c] (mg/L) x Volume of Spike (mL)}}{\text{Volume of Sample (mL) + Volume of Spike (mL)}}$$

[NOTE THE FOLLOWING TWO EQUATIONS NEED TO BE CORRECTED DUE TO FILE CONVERSION ERROR]

When the percent recovery is obtained for at least ten spiked samples, the mean percent recovery and the standard deviation are calculated using the formulae:

$$\overline{\%R} = \frac{\sum_{I=1}^n \%R_i}{n}$$

and

$$S_r = \frac{\left[\sum_{I=1}^n (\%R_i - \overline{\%R})^2 \right]^{1/2}}{n - 1}$$

where:

- $\overline{\%R}$ = the mean percent recovery;
 $\%R_i$ = the mean percent recovery of a single spiked sample;
 n = the number of results;
 S_R = the standard deviation of the data set of percent recovery determinations.

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5.12.4 Evaluation of Field Data

The accuracy and precision of field measurements are given in Table 5-7. Even though field measurements produce definitive data, the simplicity of the measurements eliminates the need for extensive QC analyses; also, the equations used in the evaluation of accuracy and precision of laboratory data are not applicable to the field measurements to be performed. The field data are used to determine stability prior to sampling and, therefore, do not require a data quality assessment such as that performed for the laboratory data. Parameter stability for redox potential, dissolved, oxygen, turbidity, pH, temperature, and specific conductance will be defined as the achievement of measurements within 10% of the previous two measurements for each parameter.

5.13 CORRECTIVE ACTION PROCEDURE

Corrective action procedures will be initiated when a failure to properly follow project plans is recognized. Errors in following sampling protocols or improperly or inadequately decontaminating sampling equipment may make it impossible to meet the data quality objectives. Therefore, the deficiencies noted in following standard protocol will be addressed immediately upon recognition.

Corrective action procedures for this project may be the result of a field surveillance activity or an observation made by a field team member or other trained personnel. The person recognizing the failure is responsible for bringing the error to the attention of the responsible party (i.e., the person improperly following procedures), making note of the problem in the field notebook, and notify the Program QA Manager.

The Program QA Manger will issue a Non-Conformance Report for all areas signaling significant and systematic deficiencies to the Project Manager (Figure 5-3). Each NCR requires that a Corrective Action Report (CAR) be completed by the project manager and project QA manager to the M&E program QA manager (Figure 5-4). A QA file will be used to track NCRs and CARs. These reports will be addressed in the final removal action report where appropriate.

Corrective action by the laboratory will be implemented whenever out-of-control events exist. If the analyst perceives problems which may affect data quality, it is his/her responsibility to

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report the event to his/her supervisor. If the supervisor determines that the problem will affect data quality, he/she will initiate corrective action and the client should be contacted by the laboratory Quality Assurance Officer. Samples analyzed during out-of-control situations will be reanalyzed prior to reporting of results.

Corrective action procedures to be implemented by the laboratories will be addressed in the laboratory's QAPP. Quality control records addressing daily instrumental calibration, instrumental control limits, method detection limits, and analyses of quality control samples will be maintained for five years. Any problems encountered and corresponding corrective action will be documented by the laboratory.

5.14 REFERENCES

- U.S. Environmental Protection Agency (U.S. EPA). 1983. *Methods for Chemical Analysis of Water and Wastes*. EPA-600/4-79-020. March 1983.
- U.S. Environmental Protection Agency (U.S. EPA). 1986. *Test Methods for Evaluating Solid Waste*. SW-846, 3rd Edition. September, 1986.
- U.S. Environmental Protection Agency (U.S. EPA). 1992. *Test Methods for Evaluating Solid Waste*. SW-846, Updates I, 3rd Edition. June, 1992
- U.S. Environmental Protection Agency (U.S. EPA). 1994. *Test Methods for Evaluating Solid Waste*. SW-846, Update II, IIA, IIB, 3rd Edition. July, 1994.
- U.S. Environmental Protection Agency (U.S. EPA). 1996. *Test Methods for Evaluating Solid Waste*. SW-846, Update III, 3rd Edition. December, 1996.

SECTION SIX REPORTING AND SCHEDULING

The GWMPP will generate data to evaluate the performance of the groundwater extraction and treatment system to monitor changes in the plume configuration and concentrations. In accordance with the FAO, specific deliverables will be submitted as described below and presented in Table 6-1.

6.1 Monthly Progress Reports

Sparton will provide EPA with signed monthly progress reports while implementing the FAO. The monthly progress reports will include the following elements:

A description of significant activities (e.g. sampling events, ground water elevations data, analytical results, etc.) and work completed/work accomplishments (e.g. performance levels achieved, hours of treatment operation, volume of recovered ground water from each recovery well, concentration of contaminants in treated volume, efficiency of the ground water treatment system reported as percent reduction of hazardous waste constituents, etc. during the reporting period; Summary of the on-site ground water extraction and treatment system effectiveness; Potentiometric surface maps and contaminant concentration contour maps for each of the flow zones in the aquifer; Summaries of all findings; Summaries of all contacts with representative of the local community, public interest groups or State government during the reporting period; Summaries of all problems or potential problems encountered during the reporting period;

- Actions being taken and / or planned to rectify problems;
- Projected work for the next reporting period; and
- The results of any sampling test and/or other data generated during the reporting period.

6.2 Analytical Data Packages

The analytical data packages from the laboratory shall be received by the project chemist or quality assurance officer within 14 days of the collection of samples in the field. The analytical data reports shall contain a minimum of the following:

- Analytical data for each sample submitted for analysis;
- Procedure used for each requested analysis performed;
- Date of sample receipt;
- Date of sample extraction, digestion and date of analysis;
- Matrix of each sample analyzed;
- Volume or weight of sample digested and/or analyzed;
- Estimated Quantitation Limits (EQLs) for each parameter;
- Method or Preparation Blank analytical results associated with the project samples;
- Laboratory Control Sample (LCS) Recoveries;

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Project specific and/or batch Matrix spike/Matrix Spike Duplicate (MS/MSD) Recoveries and Relative Percent Differences (RPD);

Surrogate Recoveries for organic analyses;

Initial and Continuing Calibration associated with each analysis;

- Case Narrative documenting any out-of-control events during sample analysis;
- Technical problems, quantitation limit adjustments due to interferences; and
- Analysis with respect to holding time requirements.

The analytical reporting as outlined above shall allow for the data review and validation as stated in section 5.0.

6.3 CORRECTIVE ACTION REPORTS

Corrective action procedures shall be initiated when a failure to properly follow project plans is recognized. Errors in Following sampling protocols or improperly or inadequately decontaminating sampling equipment may make it impossible to meet data quality objectives. Therefore, the deficiencies noted in following standard protocol will be addressed immediately upon recognition.

Corrective action procedures for this project may be the result of a field surveillance activity, a direct result of performance, or an observation made by a field team member or other trained personnel. The person recognizing the failure is responsible for bringing the error to the attention of the responsible party (i.e. the person improperly following procedures), making note of the problem in the field notebook, and modify the program QA manager. The program QA manager shall issue a Non-Conformance Report (NCR) for all areas signaling significant and systematic deficiencies to the project manager. Each NCR required that a Corrective Action Report (CAR) be completed by the project manager to the program QA manager.

A QA file will be used to track NCRs and CARs. These reports will be addressed in the final corrective action measure report where appropriate.

Corrective action by the laboratory shall be implemented whenever out-of-control events exist. If the analyst perceives problems which may affect data quality, it is his/her responsibility to report the event to his/her supervisor. If the supervisor determines that the problem will affect data quality, he/she will initiate corrective action and the client should be contacted by the laboratory Quality Assurance Officer. Sample analyzed during out-of-control situations shall be reanalyzed prior to reporting of results.

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**TABLE 6-1
SCHEDULE OF SAMPLE DATA AND QA REPORTS**

Type of Report	Frequency	Submitted by	Submitted to
Monthly Report	Monthly	Project Coordinator	USEPA
Analytical Data Packages	14 days after sample receipt, except 7 days for monthly groundwater samples	Laboratory Project Manager	Project Chemist or Quality Assurance Officer
Corrective Action Report	As needed, per occurrence	Personnel taking corrective action	Project Manager

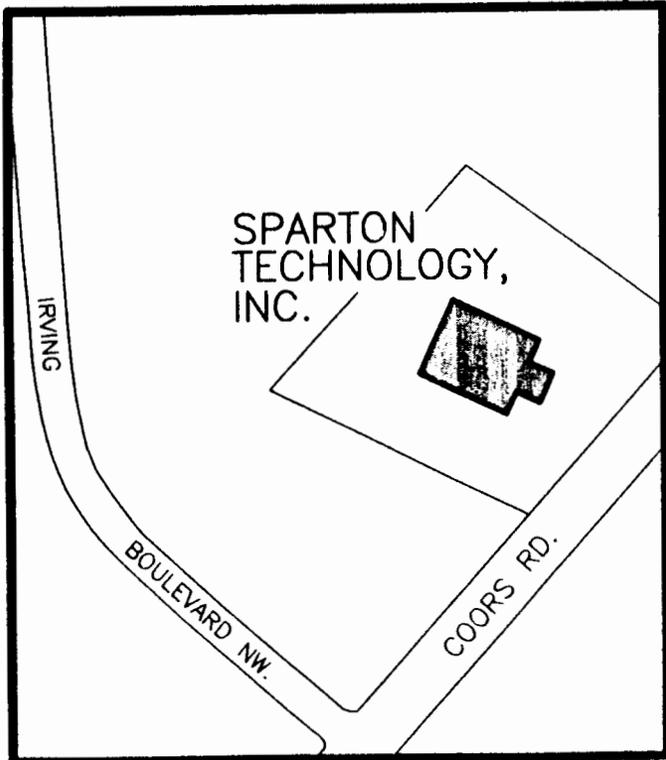
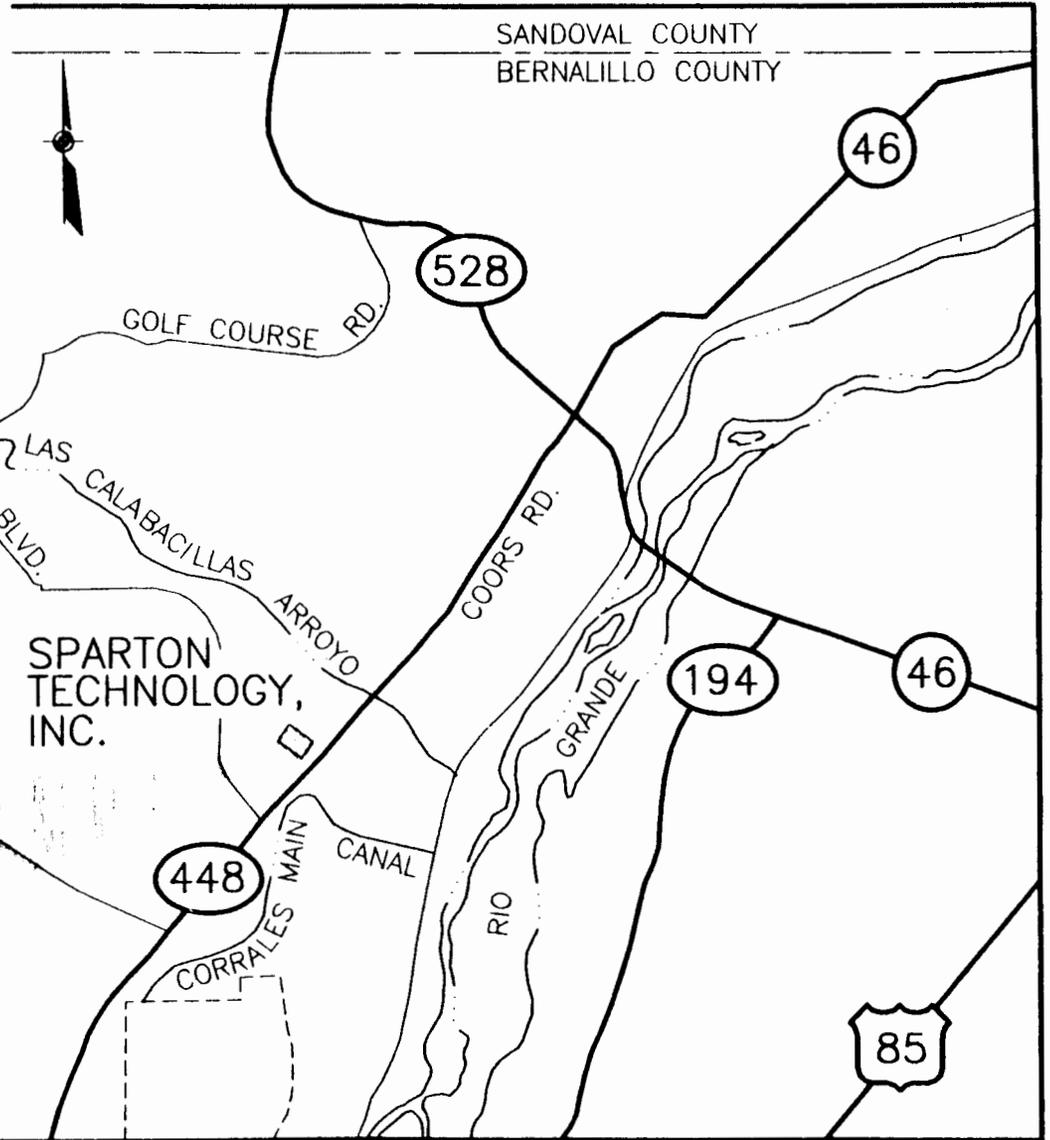
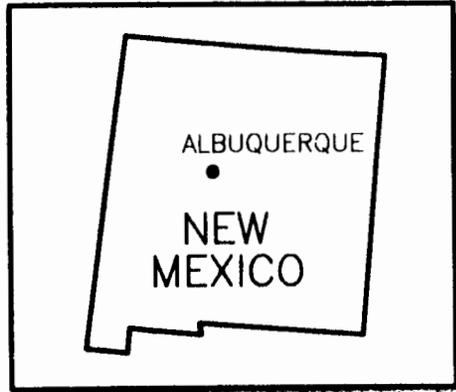


Figure 1

010505

008608

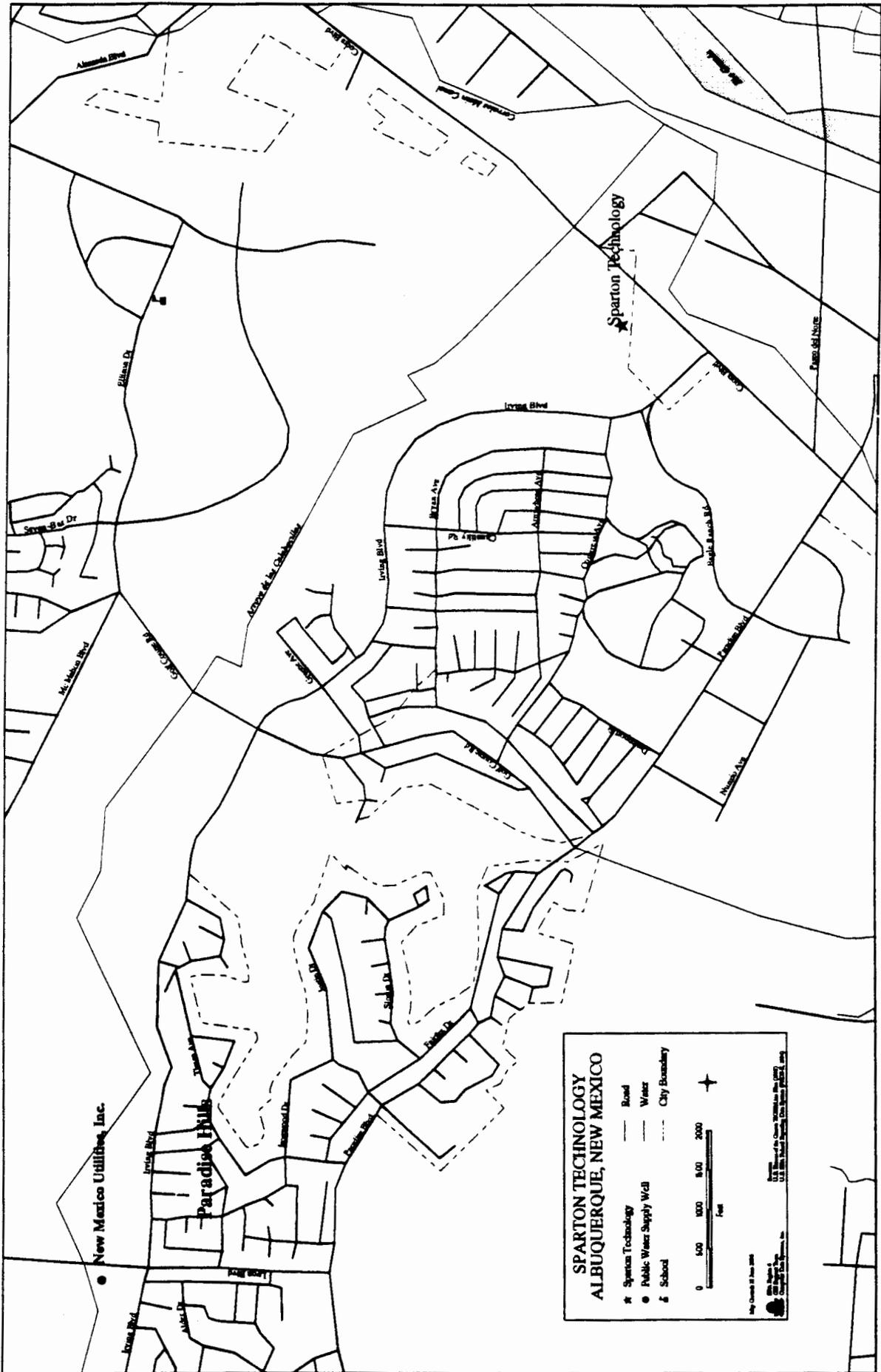
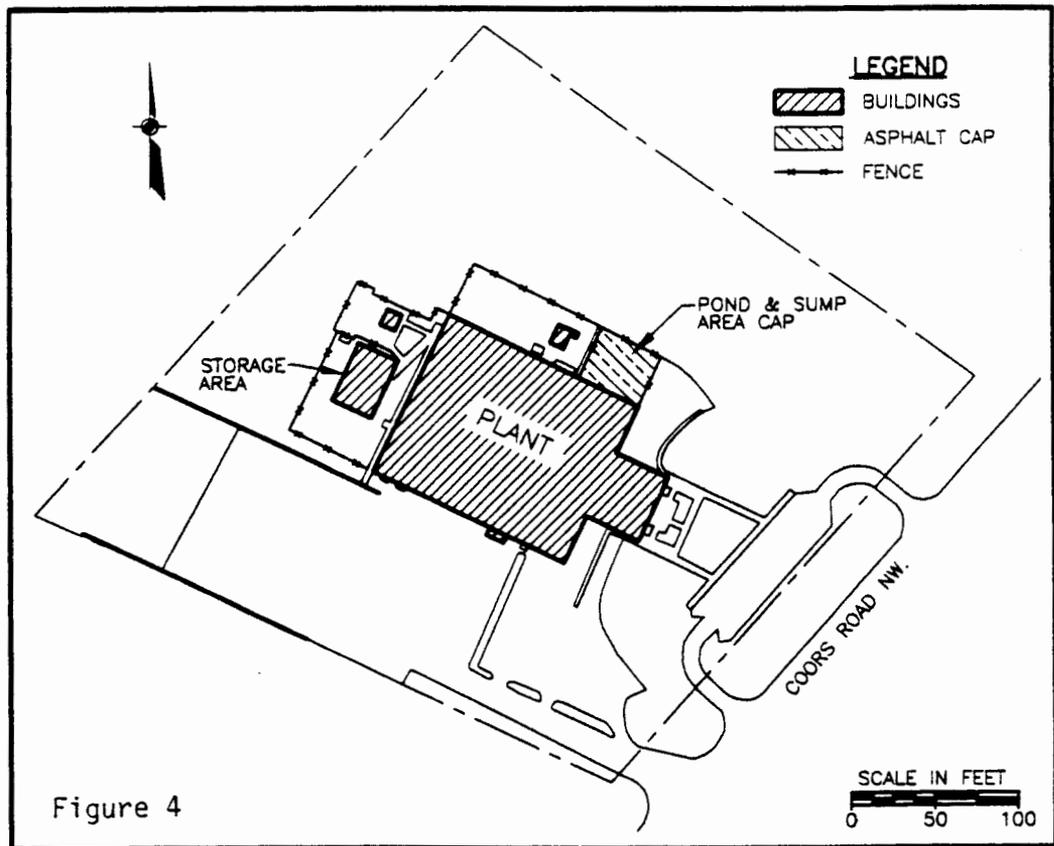
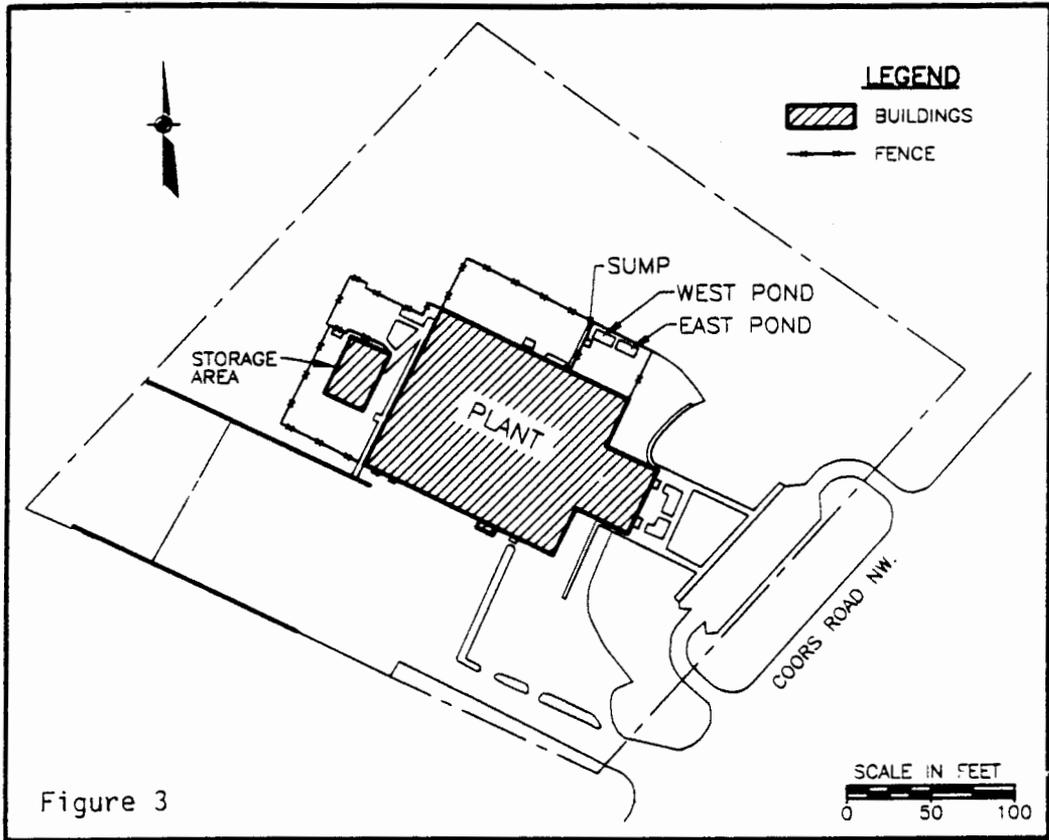


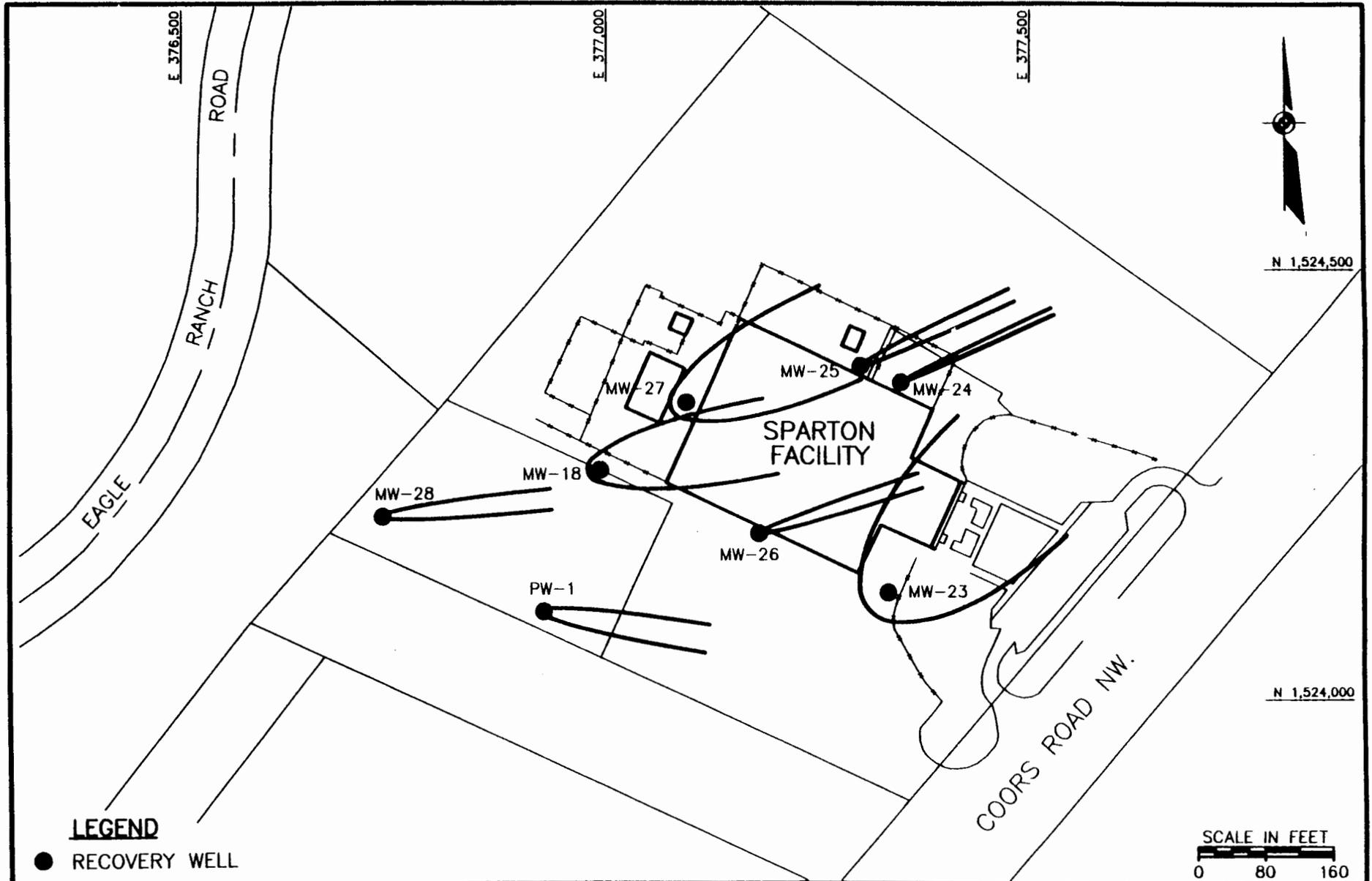
Figure 2

010506

008610



010508 008615



SPARTON TECHNOLOGY, INC.
**APPROXIMATE CAPTURE ZONES FOR THE UPPER
 FLOW ZONE RECOVERY WELLS**
 ALBUQUERQUE, NEW MEXICO

Project Number	
165022	
File Name	Figure
SPAR-CAP	5

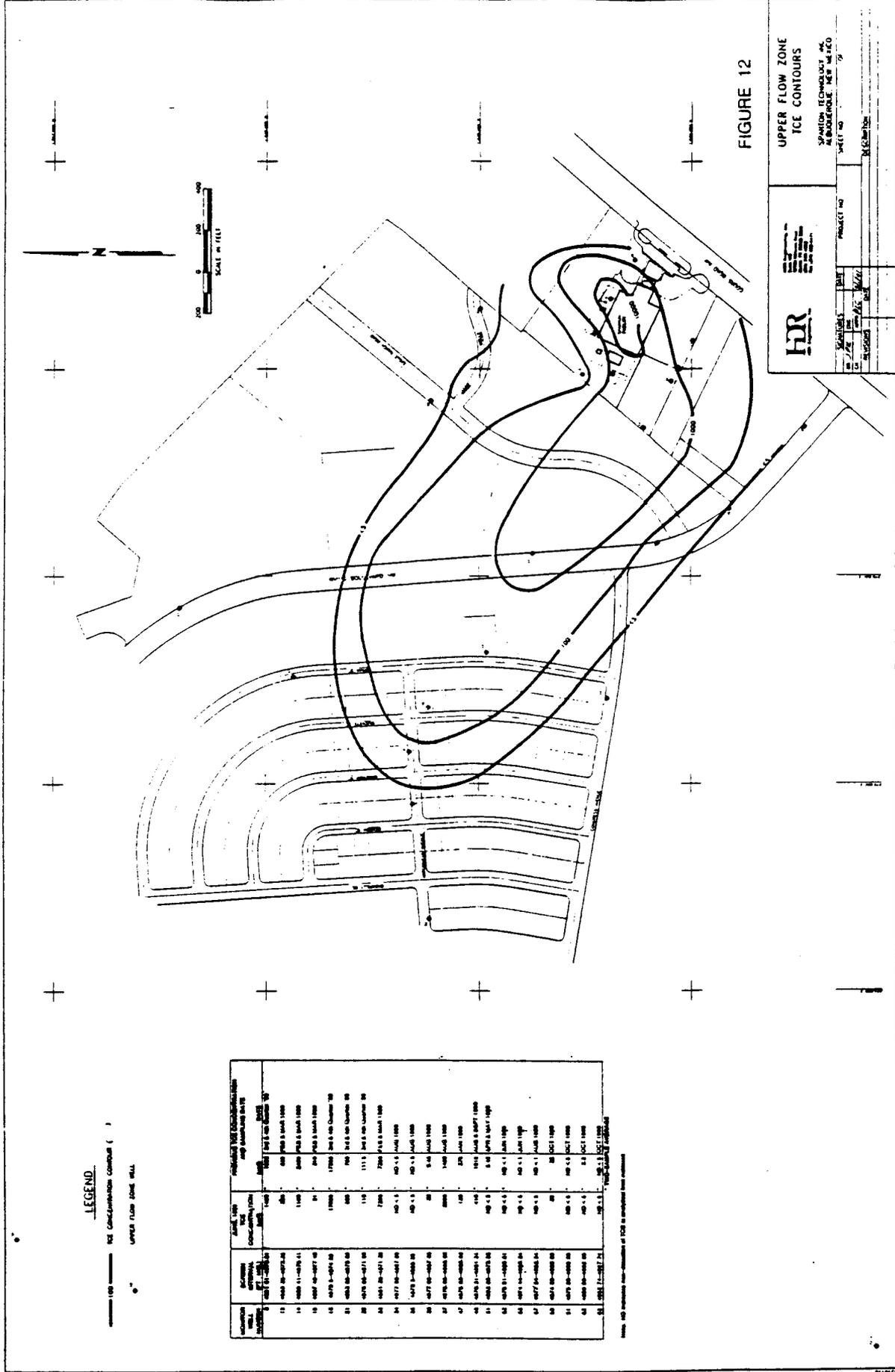


FIGURE 12

**UPPER FLOW ZONE
ICE CONTOURS**

SPARROW TECHNOLOGY INC.
ALBUQUERQUE, NEW MEXICO

PROJECT NO. _____
SHEET NO. _____

DATE: _____
BY: _____
CHECKED BY: _____

LEGEND

100' CONTOUR

UPPER FLOW ZONE WALL

NO.	DATE	DESCRIPTION	BY	CHECKED
1	10/15/03	PRELIMINARY	JL	ML
2	11/10/03	REVISED	JL	ML
3	12/15/03	REVISED	JL	ML
4	01/20/04	REVISED	JL	ML
5	02/15/04	REVISED	JL	ML
6	03/10/04	REVISED	JL	ML
7	04/05/04	REVISED	JL	ML
8	05/01/04	REVISED	JL	ML
9	06/01/04	REVISED	JL	ML
10	07/01/04	REVISED	JL	ML
11	08/01/04	REVISED	JL	ML
12	09/01/04	REVISED	JL	ML
13	10/01/04	REVISED	JL	ML
14	11/01/04	REVISED	JL	ML
15	12/01/04	REVISED	JL	ML
16	01/01/05	REVISED	JL	ML
17	02/01/05	REVISED	JL	ML
18	03/01/05	REVISED	JL	ML
19	04/01/05	REVISED	JL	ML
20	05/01/05	REVISED	JL	ML
21	06/01/05	REVISED	JL	ML
22	07/01/05	REVISED	JL	ML
23	08/01/05	REVISED	JL	ML
24	09/01/05	REVISED	JL	ML
25	10/01/05	REVISED	JL	ML
26	11/01/05	REVISED	JL	ML
27	12/01/05	REVISED	JL	ML
28	01/01/06	REVISED	JL	ML
29	02/01/06	REVISED	JL	ML
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35	08/01/06	REVISED	JL	ML
36	09/01/06	REVISED	JL	ML
37	10/01/06	REVISED	JL	ML
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39	12/01/06	REVISED	JL	ML
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45	06/01/07	REVISED	JL	ML
46	07/01/07	REVISED	JL	ML
47	08/01/07	REVISED	JL	ML
48	09/01/07	REVISED	JL	ML
49	10/01/07	REVISED	JL	ML
50	11/01/07	REVISED	JL	ML
51	12/01/07	REVISED	JL	ML
52	01/01/08	REVISED	JL	ML
53	02/01/08	REVISED	JL	ML
54	03/01/08	REVISED	JL	ML
55	04/01/08	REVISED	JL	ML
56	05/01/08	REVISED	JL	ML
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94	07/01/11	REVISED	JL	ML
95	08/01/11	REVISED	JL	ML
96	09/01/11	REVISED	JL	ML
97	10/01/11	REVISED	JL	ML
98	11/01/11	REVISED	JL	ML
99	12/01/11	REVISED	JL	ML
100	01/01/12	REVISED	JL	ML

Figure 6

010509

008617

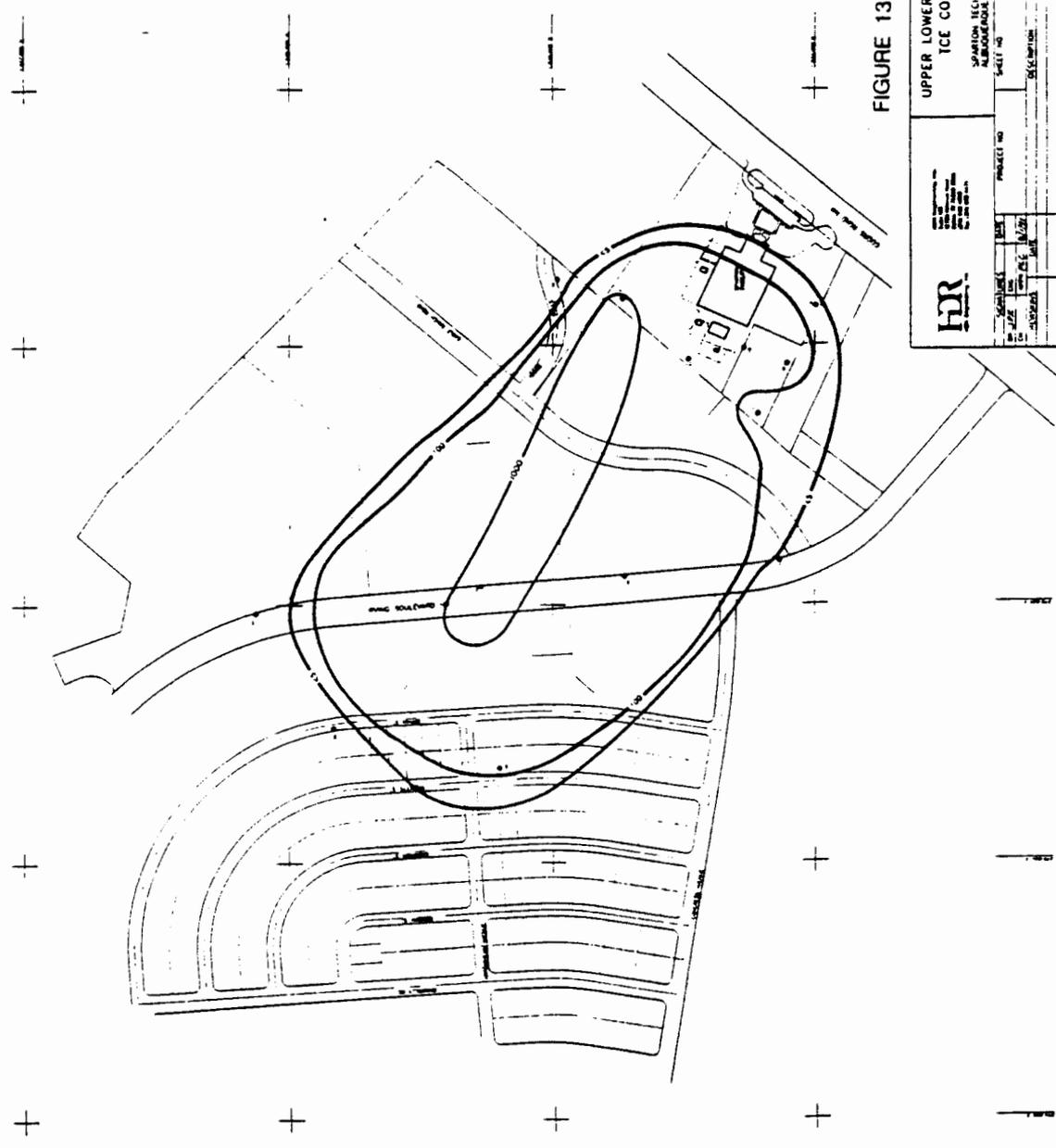


FIGURE 13

UPPER LOWER FLOW ZONE
ICE CONTOURS

		PROJECT NO.	DATE
SCALE	DATE	PROJECT NO.	DATE
SCALE	DATE	PROJECT NO.	DATE
SCALE	DATE	PROJECT NO.	DATE



LEGEND

- ICE CONCENTRATION CONTOUR (MPPI)
- UPPER LOWER FLOW ZONE BOUNDARY

STATION	DATE	ICE CONCENTRATION (MPPI)	UPPER LOWER FLOW ZONE BOUNDARY
01	01/01/01	100	
02	01/02/01	150	
03	01/03/01	200	
04	01/04/01	250	
05	01/05/01	300	
06	01/06/01	350	
07	01/07/01	400	
08	01/08/01	450	
09	01/09/01	500	
10	01/10/01	550	
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14	01/14/01	750	
15	01/15/01	800	
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18	01/18/01	950	
19	01/19/01	1000	
20	01/20/01	1050	
21	01/21/01	1100	
22	01/22/01	1150	
23	01/23/01	1200	
24	01/24/01	1250	
25	01/25/01	1300	
26	01/26/01	1350	
27	01/27/01	1400	
28	01/28/01	1450	
29	01/29/01	1500	
30	01/30/01	1550	
31	01/31/01	1600	

Figure 7

010510

008618

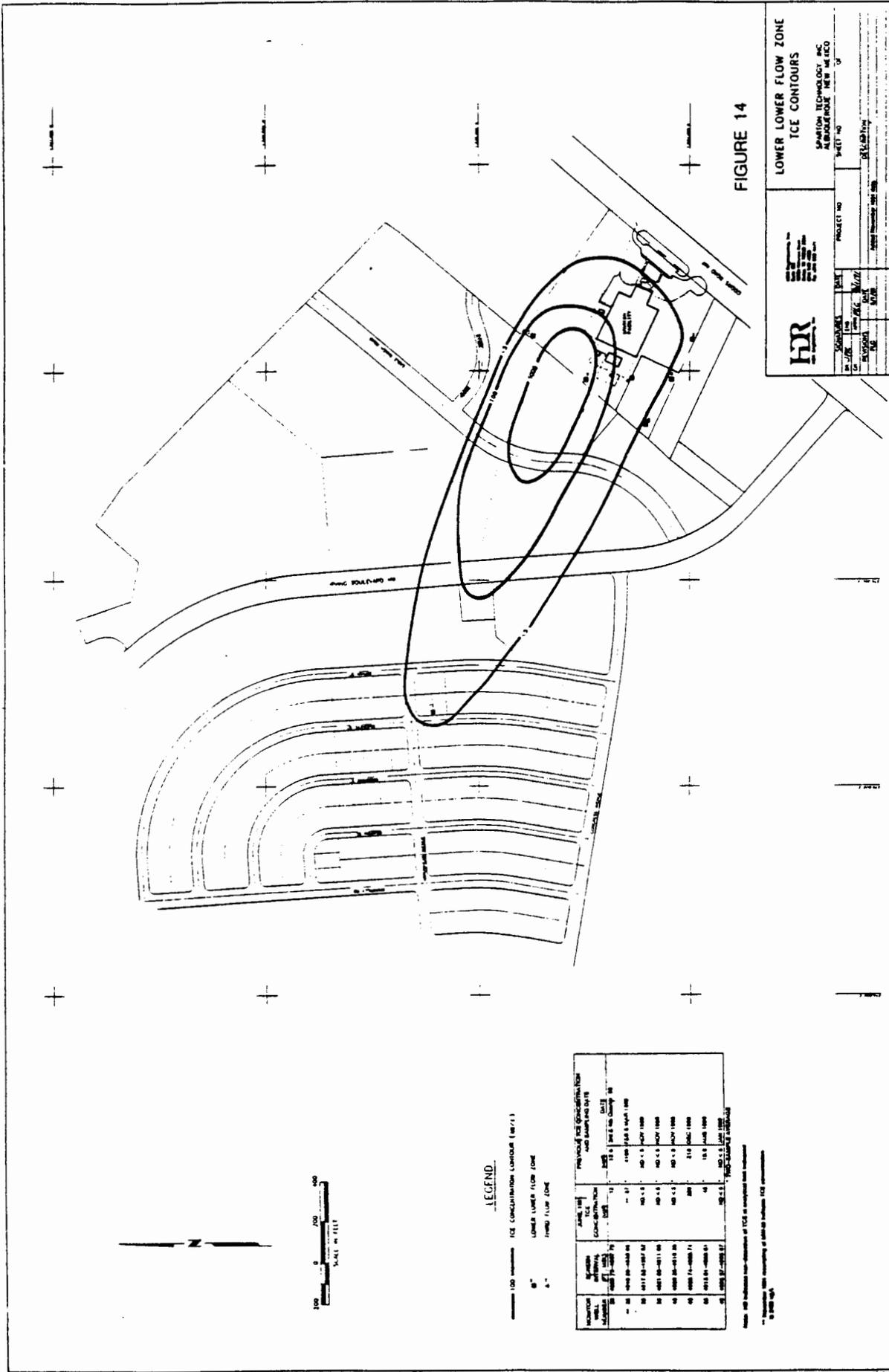


FIGURE 14

LOWER LOWER FLOW ZONE ICE CONTOURS

SPARTAN TECHNOLOGY, INC.
 ALBUQUERQUE, NEW MEXICO

PROJECT NO. _____
 SHEET NO. _____

DATE: _____
 SCALE: _____

BY: _____
 CHECKED BY: _____

Figure 8

010512

008620

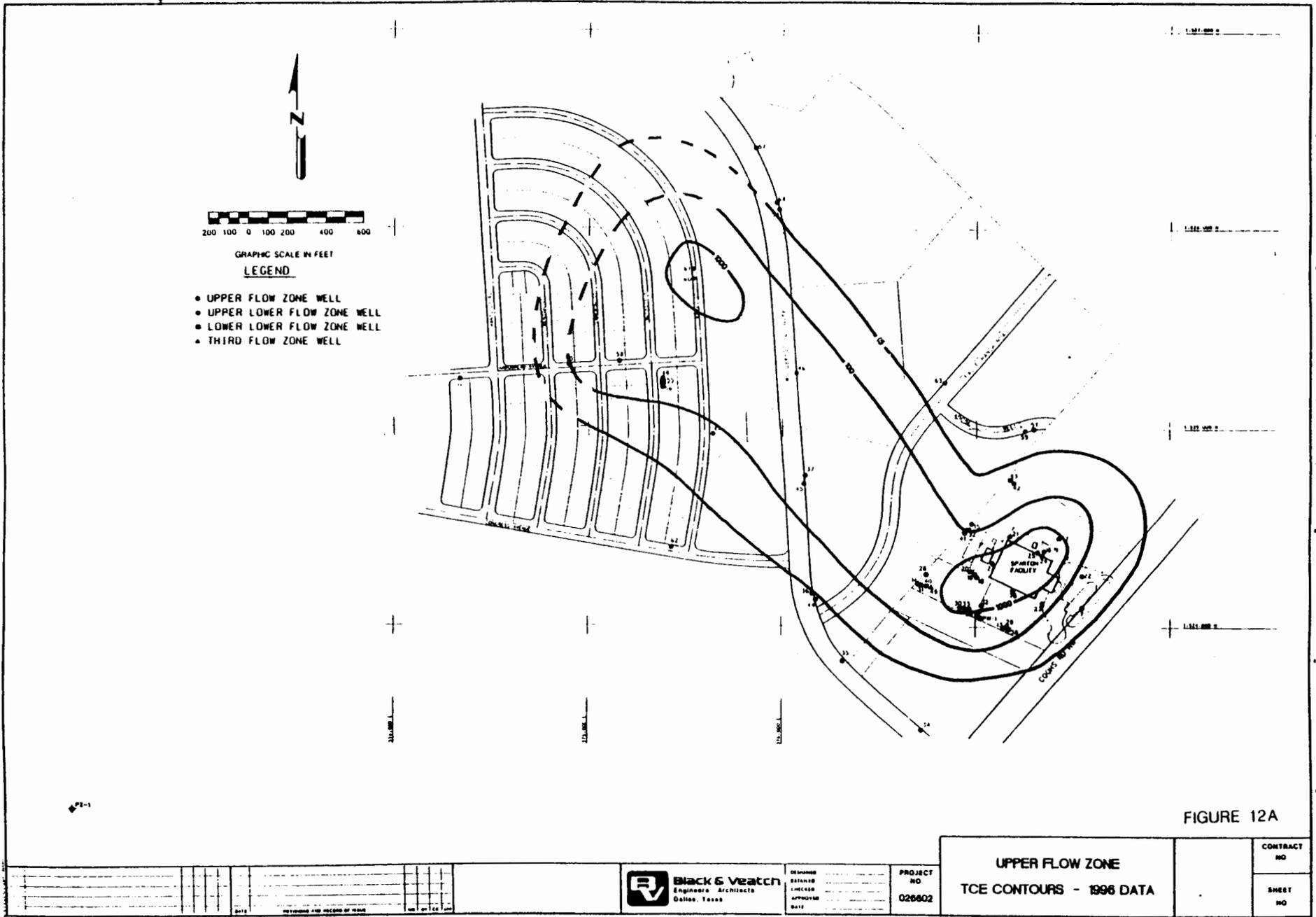


Figure 9

**TABLE 5-1
SAMPLE CONTAINERS, PRESERVATIVES AND HOLDING TIMES
FOR AQUEOUS SAMPLES**

Matrix	Analytical Parameter	Container ^(a)	Number of Containers per Sample ^(b)	Preservation	Holding Time ^(c)
Aqueous	Appendix IX Volatile Organic Compounds (VOCs)	40 mL, G vial w/Teflon-lined septa cap	3	HCl to pH < 2, Ice to 4 C ^(d)	14 days
	Hexavalent Chromium	200 mL, P	1	Ice to 4 C	24 hours until extraction, analysis within 24 hours of extraction
	Appendix IX Metals, Total	1 L, P	1	HNO ₃ to pH < 2	6 months except Mercury; Mercury - 28 days

- (a) All containers must have lids with Teflon[®] liners. G=Glass; P=High-Density Polyethylene.
- (b) The number of containers will be three times the amount noted for samples designated for MS/MSD aqueous analyses. The number of containers will be two times the amount noted for samples designated for field duplicate analyses.
- (c) When only one holding time is designated, it is the total holding time until analysis.
- (d) If due to natural carbonation in the groundwater, samples to be analyzed for VOCs shall be iced to 4 C and analyses must be performed within 7 days. No HCl is to be used for preservation if the sample effervesces due to the reaction of the acid with the carbonate in the water.

**TABLE 5-2
PROJECT-SPECIFIC MAXIMUM ALLOWABLE REPORTING LIMITS**

Parameter/Analytes	Water Reporting Limit
LABORATORY ANALYSES	
Metals	(Tg/L)
Antimony	3
Arsenic	3
Barium	5
Beryllium	2
Cadmium	1
Chromium	5
Cobalt	5
Copper	5
Lead	3
Mercury	0.2
Nickel	5
Selenium	5
Silver	5
Thallium	2
Tin	50
Vanadium	5
Zinc	5
Heavalent Chromium	50
Volatile Organics	(Tg/L)
Chloromethane	1
Bromomethane	1
Vinyl Chloride	1
Chloroethane	1
Methylene Chloride	1
Acetone	5
Carbon Disulfide	1
1,1-Dichloroethene	1
1,1-Dichloroethane	1
<i>cis</i> -1,2-Dichloroethene	1
<i>trans</i> -1,2-Dichloroethene	1
Chloroform	1
1,2-Dichloroethane	1
2-Butanone	5
1,1,1-Trichloroethane	1
Carbon Tetrachloride	1
Bromodichloromethane	1
1,2-Dichloropropane	1
<i>cis</i> -1,3-Dichloropropene	1
Trichloroethene	1
Dibromochloromethane	1
1,1,2-Trichloroethane	1
Benzene	1

010516

**TABLE 5-2
PROJECT-SPECIFIC MAXIMUM ALLOWABLE REPORTING LIMITS**

Parameter/Analytes	Water Reporting Limit
<i>trans</i> -1,3-Dichloropropene	1
Bromoform	1
Volatile Organics (con't.)	(Tg/L)
4-Methyl-2-pentanone	5
2-Hexanone	5
Tetrachloroethene	1
Toluene	1
1,1,2,2-Tetrachloroethane	1
Chlorobenzene	1
Ethyl Benzene	1
Styrene	1
Total Xylene	1
Acetonitrile	5
Acrolein	5
Acylonitrile	10
Allyl Chloride	5
2-Chloro-1,3-butadiene	5
1,2-Dichloro-3-chloropropane	5
1,2-Dibromoethane	5
Dibromomethane	1
<i>trans</i> -1,4-Dichloro-2-butene	1
Dichlorodifluoromethane	1
1,4-Dioxane	5
Ethyl methacrylate	10
Isobutanol	50
Methacrylonitrile	10
Methyl Iodide	1
Methyl methacrylate	5
Pentachloroethane	1
Propionitrile	10
1,1,1,2-Tetrachloroethane	1
Trichlorofluoromethane	1
1,2,3-Trichloropropane	1
Vinyl acetate	5

010517

**TABLE 5-3
SAMPLE CONTAINERS, PRESERVATIVES AND HOLDING TIMES
FOR AQUEOUS SAMPLES**

Matrix	Analytical Parameter	Container ^(a)	Number of Containers per Sample ^(b)	Preservation	Holding Time
Aqueous	Appendix IX Volatile Organic Compounds (VOCs)	40 mL, G vial w/Teflon-lined septa cap	3	Hcl to pH <2, Ice to 4 °C ^(c)	14 days
	Appendix IX Metals, Total	1 L, P	1	HNO3 to pH < 2	6 months except Mercury; Mercury - 28 days
	Hexavalent Chromium	1 L, P	1	Ice to 4 °C	24 hours to extraction; 24 hours to analysis from extraction

- (a) All containers must have lids with Teflon[®] liners. G=Glass; P=High-Density Polyethylene.
- (b) The number of containers will be three times the amount noted for samples designated for MS/MSD aqueous analyses. The number of containers will be two times the amount noted for samples designated for field duplicate analyses.
- (c) When only one holding time is designated, it is the total holding time until analysis.
- (d) If due to natural carbonation in the groundwater, VOC samples effervesce upon preservation, discard sample and collect non-preserved. The holding time for a non-preserved VOCs is 7 days.

010518

**TABLE 5-4.
ANALYTICAL METHODS FOR AQUEOUS SAMPLES**

Parameter	Published Method
Laboratory Analyses:	
Appendix IX Volatile Organics Compounds	SW-5030B(a)/ SW-8260B(a)
Appendix IX Metals*, except Mercury	SW-3010A(b)/ SW-6010B(a) or SW-6020(c)
Mercury	SW-7470A(c)
Hexavalent Chromium	SW-7196A(b)
Field Analyses:	
Temperature	E170.1(e)
Specific Conductivity	E120.1(e)
pH	E150.1(e)

- (a) Test Methods for Evaluating Solid Waste, SW846, Update III, 3rd ed. (U.S. EPA, 1996).
- (b) Test Methods for Evaluating Solid Waste, SW846, Update I, 3rd ed. (U.S. EPA, 1992).
- (c) Test Methods for Evaluating Solid Waste, SW846, Update IIB, 3rd ed. (U.S. EPA, 1994).
- (d) Test Methods for Evaluating Solid Waste, SW846, 3rd ed. (U.S. EPA, 1986).
- (e) Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020 (U.S. EPA, 1983).

* Trace detection levels are required for Arsenic, Lead, Selenium, and Thallium. If these cannot be attained using methods SW-6010B and/or SW-6020, the graphite furnace atomic absorption (GFAA) methods should be used. The GFAA digestion method is SW-3020A^(b) and the GFAA analytical methods are Arsenic by SW-7060A^(a), Lead by SW-7241A^(a), Selenium by SW-7740^(d) and Thallium by SW-7841^(d).

010519

**TABLE 5-5.
ANALYTICAL METHODS FOR AQUEOUS SAMPLES**

Parameter	Published Method
Laboratory Analyses:	
Volatile Organics	SW-5030B(a) SW-8260B(a)
Metals, except Mercury	SW-3010A ^(b) / SW-6010B ^(a) or SW-6020 ^(c)
Mercury	SW-7470A ^(c)
Field Analyses:	
Temperature	E170.1 ^(d)
Specific Conductivity	E120.1 ^(d)
pH	E150.1 ^(d)

- ^(a) Test Methods for Evaluating Solid Waste, SW846, Update III, 3rd ed. (U.S. EPA, 1996).
- ^(b) Test Methods for Evaluating Solid Waste, SW846, Update I, 3rd ed. (U.S. EPA, 1992).
- ^(c) Test Methods for Evaluating Solid Waste, SW846, Update II, 3rd ed. (U.S. EPA, 1994).
- ^(d) Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020 (U.S. EPA, 1983).

010520

**TABLE 5-6.
QA OBJECTIVES FOR LABORATORY MEASUREMENTS OF
AQUEOUS SAMPLES**

Parameter/Method ⁽¹⁾		Precision ⁽²⁾ (as RPD)	Accuracy ⁽³⁾ (Recovery)	Completeness
INORGANIC ANALYSES:				
Metals	SW 3010A/6010B or 6020			
Antimony		20%/30%	80-120%	90%
Arsenic		20%/30%	80-120%	90%
Barium		20%/30%	80-120%	90%
Beryllium		20%/30%	80-120%	90%
Cadmium		20%/30%	80-120%	90%
Chromium		20%/30%	80-120%	90%
Cobalt		20%/30%	80-120%	90%
Copper		20%/30%	80-120%	90%
Lead		20%/30%	80-120%	90%
Nickel		20%/30%	80-120%	90%
Potassium		20%/30%	80-120%	90%
Selenium		20%/30%	80-120%	90%
Silver		20%/30%	80-120%	90%
Thallium		20%/30%	80-120%	90%
Tin		20%/30%	80-120%	90%
Vanadium		20%/30%	80-120%	90%
Zinc		20%/30%	80-120%	90%
Mercury	SW 7470A	20%/30%	75-125%	90%
Hexavalent Chromium	SW 7196A	20%/30%	80-120%	90%
ORGANIC ANALYSES:				
Volatile Organics	SW-8260B			
Chloromethane		NPM/30%	NPM	90%
Bromomethane		NPM/30%	NPM	90%
Vinyl Chloride		NPM/30%	NPM	90%
Chloroethane		NPM/30%	NPM	90%
Methylene Chloride		NPM/30%	NPM	90%
Acetone		NPM/30%	NPM	90%
Volatile Organics (cont'd.)				
Carbon Disulfide		NPM/30%	NPM	90%
1,1-Dichloroethene		14%/30%	61-145%	90%

010521

TABLE 5-6.
QA OBJECTIVES FOR LABORATORY MEASUREMENTS OF
AQUEOUS SAMPLES

Parameter/Method ⁽¹⁾	Precision ⁽²⁾ (as RPD)	Accuracy ⁽³⁾ (Recovery)	Completeness
1,1-Dichloroethane	NPM/30%	NPM	90%
<i>cis</i> -1,2-Dichloroethene	NPM/30%	NPM	90%
Volatile Organics (cont'd.)			
<i>trans</i> -1,2-Dichloroethene	NPM/30%	NPM	90%
Chloroform	NPM/30%	NPM	90%
1,2-Dichloroethane	NPM/30%	NPM	90%
2-Butanone	NPM/30%	NPM	90%
1,1,1-Trichloroethane	NPM/30%	NPM	90%
Carbon Tetrachloride	NPM/30%	NPM	90%
Bromodichloromethane	NPM/30%	NPM	90%
1,2-Dichloropropane	NPM/30%	NPM	90%
<i>cis</i> -1,3-Dichloropropene	NPM/30%	NPM	90%
Trichloroethene	14%/30%	71-120%	90%
Dibromochloromethane	NPM/30%	NPM	90%
1,1,2-Trichloroethane	NPM/30%	NPM	90%
Benzene	11%/30%	76-127%	90%
<i>trans</i> -1,3-Dichloropropene	NPM/30%	NPM	90%
Bromoform	NPM/30%	NPM	90%
4-Methyl-2-pentanone	NPM/30%	NPM	90%
2-Hexanone	NPM/30%	NPM	90%
Tetrachloroethene	NPM/30%	NPM	90%
Toluene	NPM/30%	NPM	90%
1,1,2,2-Tetrachloroethane	NPM/30%	NPM	90%
Chlorobenzene	13%/30%	75-130%	90%
Ethyl Benzene	NPM/30%	NPM	90%
Styrene	NPM/30%	NPM	90%
Total Xylene	NPM/30%	NPM	90%
Acetonitrile	NPM/30%	NPM	90%
Acrolein	NPM/30%	NPM	90%
Acrylonitrile	NPM/30%	NPM	90%
2-Chloro-1,3-butadiene	NPM/30%	NPM	90%
1,2-Dibromo-3-chloropropane	NPM/30%	NPM	90%
1,2-Dibromoethane	NPM/30%	NPM	90%
<i>trans</i> -1,4-Dichloro-2-butene	NPM/30%	NPM	90%
Dichlorodifluoromethane	NPM/30%	NPM	90%

010522

**TABLE 5-6.
QA OBJECTIVES FOR LABORATORY MEASUREMENTS OF
AQUEOUS SAMPLES**

Parameter/Method ⁽¹⁾	Precision ⁽²⁾ (as RPD)	Accuracy ⁽³⁾ (Recovery)	Completeness
1,4 Dioxane	NPM/30%	NPM	90%
Ethyl methacrylate	NPM/30%	NPM	90%
Isobutyl alcohol	NPM/30%	NPM	90%
Methylacrylonitrile	NPM/30%	NPM	90%
Methyl Iodide	NPM/30%	NPM	90%
Methyl methacrylate	NPM/30%	NPM	90%
Pentachloroethane	NPM/30%	NPM	90%
Propionitrile	NPM/30%	NPM	90%
1,1,1,2-Tetrachloroethane	NPM/30%	NPM	90%
Trichlorofluoromethane	NPM/30%	NPM	90%
1,2,3-Trichloropropane	NPM/30%	NPM	90%
Vinyl acetate	NPM/30%	NPM	90%
	NPM/30%	NPM	90%
Surrogates:			
1,2-Dichloroethane-d ₄	NPM	76-114%	90%
Bromofluorobenzene	NPM	86-115%	90%
1,2-Dichlorobenzene-d ₄	NPM	88-110%	90%

NOTES:

1. Methods

Organics: VOCs by SW-8260B in *Test Methods for the Evaluation of Solid Waste*, SW-846, Update III, Third Edition, U.S. EPA, June 1996

Inorganics: Metals by SW-6010B or 6020/7470A1 in *Test Methods for the Evaluation of Solid Waste*, SW-846, Updates II and III, Third Edition, U.S. EPA, 1994 and 1996.

- 2. Precision -** Relative percent difference (RPD) between laboratory replicates/field replicate analyses with the exception of VOCs. Where one RPD is listed, it is the laboratory replicate acceptance criteria; where two numbers are listed, they are the laboratory replicate/field duplicate RPD acceptance criteria, respectively.

Precision for VOCs is measured on a quarterly basis as the Relative Standard Deviation (RSD) of the Laboratory Fortified Blank (LFB) replicate analyses.

- 3. Accuracy -** Acceptable matrix spike recovery range as specified by the method.

NPM Not part of method

010523

**TABLE 5.7.
QA OBJECTIVES FOR FIELD MEASUREMENTS**

Parameter	Method ⁽¹⁾ Reference	Precision ⁽²⁾	Accuracy ⁽³⁾	Completeness
WATER				
Standing Water Levels	Solinst Water Level Indicator	±0.01 ft	0.005 ft	90 %
Temperature	E170.1, Mercury Thermometer or Electronic Temperature Probe	±0.1 °C	0.05 °C	90 %
Conductivity	E120.1, Electrometric	±25 Tmho/cm ²	10 Tmho/cm ²	90 %
pH	E150.1, Electrometric	±0.1 pH units	0.05 pH units	90 %

NOTES:

1. Methods: E - *Method for Chemical Analysis for Water and Wastes* (U.S. EPA, 1983).
2. Expressed as the acceptable deviation from the scale.
3. Expected based on equipment manufacturer specifications.

010524

TABLE 5-8.
QC SAMPLE TYPES, CRITERIA, AND CORRECTIVE ACTION

Type	Purpose	Frequency	Criteria	Corrective Action
Field Generated QC Samples:				
Trip Blank	Verifies no contamination during sample transport/storage	1 per shipment of VOC samples for each matrix	No compound of interest >EQL	Qualify data or resample
Equipment Blank	Verifies effective decontamination procedures used in field	5% of samples collected per media	No compound of interest >EQL	Qualify data or resample
Field Duplicate	Measure sample variability (submit "blind" to lab)	5% of samples	$\pm 30\%$ RPD ⁽²⁾ (aqueous)	Compare to lab replicates; check systems for possible matrix interferences or improper sample collection procedure
Laboratory Generated QC Samples:				
Matrix Spikes and Duplicates (MS/MSD)	Checks recovery from real matrix	1 per 20 samples or 1 per batch as supplied from the field	Recoveries as specified in Table 5-6	Qualify data or recalibrate, reanalyze, and document corrective action
Laboratory Control Samples (for Metals)	Verifies analyst proficiency with method and instrumentation	1 per 20 samples or 1 per batch as supplied from the field	Metals - $\pm 20\%$ of true value	Check system; reanalyze all samples in batch
Continuing Calibration - Organics	Verifies calibration curve	≥ 1 per day of analysis	$\pm 25\%$ initial calibration	Recalibrate; check system

010525

TABLE 5-8.
QC SAMPLE TYPES, CRITERIA, AND CORRECTIVE ACTION

Type	Purpose	Frequency	Criteria	Corrective Action
Continuing Calibration - Inorganics	Verifies Calibration Curve	1 per batch ⁽²⁾ of ten samples	± 10% of true value	Recalibrate; check system
Method Blank	Verifies clean reagents, instrument systems, and lab environment	1 per batch ⁽²⁾ as supplied from the field. VOCs after each GC/MS tune	No compound of interest > 5 times EQL ⁽³⁾	Reanalyze; if second blank exceeds criteria, clean and recalibrate system; document corrective action
Laboratory Replicates (including matrix spike duplicates)	Checks precision of analytical method	1 per 20 samples per matrix	RPD as specified in Tables 5-6 and 5-7	Compare with field duplicates; check matrix interferences
Surrogate Standards	Measures recoveries in actual sample matrices	All GC/MS and all GC samples	Recoveries as specified in the Tables 5-6	Reanalyze samples where method requires; qualify or reject data

NOTES:

- Between duplicate measurements.
- The term "batch" refers to samples analyzed together in a specified group using the same methods, the same types and lots of reagents, and the same time frame for analysis.
- Validation criteria. Acetone, methylene chloride, and 2-butanone.

RPD - Relative Percent Difference

VOC - Volatile Organic Compounds

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Fax

To: Mr. Carl Will	From: Mr. Wallace O'Rear
Fax: 505/827-1544	Pages: 13 (including cover)
Phone: 505/827-1561	Date: 05/06/98
Re: Sparton GW Monitoring Plan	CC:
<input checked="" type="checkbox"/> Urgent <input checked="" type="checkbox"/> For Review <input type="checkbox"/> Please Comment <input type="checkbox"/> Please Reply <input type="checkbox"/> Please Recycle	

● **Comments:** Following this facsimile are tables that go with the groundwater monitoring plan you should have received this morning. Please let me know if you need any additional information.