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November 1, 1999

VIA HAND DELIVERY

Michael Hebert
(6EN-HX) Project Manager
Compliance Assurance and Enforcement Division
United States Environmental Protection Agency
Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

Re: Sparton Groundwater Monitoring Program Plan

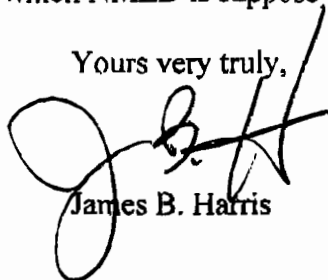
Dear Mike:

Enclosed please find three copies each of the work plan for the offsite containment system, the work plan for the assessment of aquifer restoration, and the work plan for the installation of a source containment system. Gary will be sending you, as soon as he finds out what one acronym means, by federal express what I hope is the final version of the Groundwater Monitoring Plan. Exhibit G needs to be modified. The containment well is on the wrong lot and the infiltration gallery is not correctly represented. Call Gary.

Once you receive the information from Gary, you should have all of the work plans or attachments that we were modifying.

I still need to see Attachment H, which NMED is suppose to be preparing.

Yours very truly,



James B. Harris

JBH/ts

Enclosures

40301 00001 Dallas 1067210.1



FAX TRANSMISSION SHEET

U.S. EPA, REGION 6 COMPLIANCE ASSURANCE AND ENFORCEMENT DIVISION HAZARDOUS WASTE ENFORCEMENT BRANCH TECHNICAL SECTION

TRANSMISSION DATE: November 2, 1999

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Number of Pages (including cover sheet): 2 If all pages were not received, please contact the sender.

COMMENTS:

Please see letter from Harris. The package I received only contained the three workplans prepared by Stavros. I am still hunting for the revised PIP and SVE workplans. According to a Pierce voice mail, he has dropped them in the mail to me on Friday. I hope they used a good horse.

Thanks, Hebert

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GROUNDWATER MONITORING PROGRAM PLAN

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

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Appendix A: Boring, Well, and Abandonment Records and Logs

SECTION ONE INTRODUCTION

This Groundwater 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., shall continue monitoring the existing groundwater monitoring wells in accordance with the GWMPP. This Plan supersedes all previous groundwater monitoring programs.

The purpose of the GWMPP is to provide detailed procedures, methodologies, and guidance, for the implementation of a site-specific groundwater sampling and analyses program. The GWMPP is prepared as a complete, stand-alone document for field personnel to use in the implementation of the sampling program. The GWMPP is designed to be an evolving document which incorporates modifications to the sampling program as site-specific conditions change. The objective of the GWMPP is to provide consistent, high-quality, reproducible water elevation and water quality data in support of multiple site assessment and remedial programs.

The GWMPP is separated into five sections, including this introduction. Historical groundwater monitoring programs and a brief discussion of the site geology and hydrogeology, are described in Section Two. The groundwater sampling and analysis plan and procedures for sampling the existing groundwater monitoring well network is described in Section Three. The schedule for implementation and reporting is described in Section Four. Field procedures used in the routine monitoring of groundwater are described in Section Five.

SECTION TWO HISTORICAL GROUNDWATER MONITORING

Since 1983, Sparton has conducted groundwater monitoring activities under a variety of programs. A summary of the site geology and hydrogeology and monitoring well characteristics, as well as a discussion of the groundwater monitoring to date, is presented below.

2.1 SITE GEOLOGY AND HYDROGEOLOGY

A revised RCRA Facility Investigation (RFI) Report dated May 1, 1992 presents a description of the site geology and hydrogeology that was compiled from previous investigations and the RFI investigation. A summary of the site geology and hydrogeology as presented in the RFI report is presented below.

2.1.1 Site Soils and Geologic Stratigraphy

Three convergent site surface soils of the Bluepoint Series; the Bluepoint loamy fine sand, the Bluepoint fine sand, and the Bluepoint-Kokan Association hilly, are identified on the Sparton property. The soils are defined using the Unified Soil Classification System (USCS) as a silty sand (SM) and borderline silty sand/poorly graded sand (SM/SP), respectively. The Bluepoint Series profile consists of an approximate 8-inch surficial brown loamy fine sand with an underlying pale brown to light yellowish brown loamy sand to a depth of approximately 60 inches or more. The profile is described as being slightly calcareous and mildly to moderately alkaline, with a high permeability and rapid infiltration.

The Sparton facility is located within the Albuquerque Basin, which is a fault trough (Bryan, 1938) component of the Rio Grande depression. Precambrian to Holocene Age geologic materials are present within the Albuquerque Basin, with outcrops of Precambrian, Paleozoic, and Mesozoic rock identified on the east and west basin rims. The basin fill material consists of Tertiary (Santa Fe Group) and Quaternary deposits, which have been estimated to be up to 18,000 feet in depth. The Santa Fe Group and the Quaternary deposits represent the local aquifer underlying the Sparton facility.

The Santa Fe Group was defined by Kelley (1977) as consisting of three members; the lower Zia Sandstone Member, the middle Red Member, and the uppermost Ceja Member. At the time of the RFI report, all monitoring wells installed were estimated to be installed above the top of the uppermost Ceja Member. The upper portion of the Ceja Member was characterized as “dominantly yellowish to grayish sandy pebble gravel and pebbly sand with lesser amounts of interbedded clay, mud, and sand” (Lambert, 1967, p.74).

Lambert (1967, Fig. 2) mapped cobble and pebble gravels resting on the lower part of a larger and deeper section of sands and muds identified as the Los Duranes Formation. The Los Duranes Formation is described by Lambert (1967, p. 154) as a relatively thick sequence of clay, mud, sand, and gravel deposited by the Rio Grande. Lambert estimated the formation to be approximately 300 to 400 feet in thickness and filling a broad valley cut into the Ceja Member.

Exposed sections of the Los Duranes were described by Lambert as consisting of well-stratified sequences of alternating clay and sandy mud layers of overbank origin. In addition to the mud-clay sequences, interbedded lenses of pebbly sand and sandy pebble gravel channel deposits were identified. Gravel is apparently less abundant in the formation than mud-clay or pebble sand, occurring locally within the sand beds and as separate layers up to 15 to 20 feet thick according to Lambert.

Rio Grande Floodplain Alluvium, consisting of fine to medium sand and gravels, overlies the Los Duranes Formation and is intertwined with alluvial fans and aprons of Young alluvium. The estimated thicknesses of the alluvium based upon the studies of Lambert (1967, p. 213) and Borklund and Maxwell (1961) are 120 to 130 feet and 80 to 120 feet, respectively. Young alluvium, consisting of primarily muddy fine sand with lesser amounts of sandy gravel and mud, is present as alluvial fans and aprons at the facility.

2.1.2 Site Hydrogeology

Groundwater is encountered beneath the facility at depths ranging from 65 to 75 feet. West of the facility the depth to water becomes larger; at the location of off-site containment well CW-1 (about ½ mile west of the site) the depth to water is 200 feet. Groundwater elevation at the site fluctuates approximately two to three feet in response to recharge from farm irrigation and the Corrales Main Canal. Off-site calculated hydraulic gradients vary from 1:350 to 1:780, with the gradient in a general westward direction. The gradients on-site range from 1:50 to 1:350. In general, the RFI data concluded that groundwater flows in a westerly direction.

On-site aquifer tests conducted at PW-1 indicated a transmissivity value of 12,000-18,000 gpd/ft, hydraulic conductivity of 160-240 gpd/ft², storativity of 0.002-0.003, and porosity of 0.25-0.40.

Off site tests at well CW-1 indicate a hydraulic conductivity in the same range (240 gpd/ft²) but a larger transmissivity (37,500 gpd/ft) due to the larger thickness of the tested interval. The RFI report indicated that two primary sediment types were encountered in borings advanced at the Sparton facility; clays and sandy muds interbedded with gravelly sands. Both types of sediment were identified in every boring however, gravelly sands were predominate in the upper and lower portions of the aquifer.

2.2 STATE MONITORING PROGRAM

In 1983, Sparton began groundwater 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 Groundwater 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, and chromium.

2.3 RFI MONITORING PROGRAM

In response to the USEPA Administrative Order on Consent dated October 1988, Sparton installed 40 groundwater monitoring wells (MW-26 through MW-64, and PZ-1) and implemented an on-site groundwater 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 work plan (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 (P-1, MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-8, MW-10, and MW-11), resulting in an active network of 57 groundwater 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 three wells (PZ-1, MW-50, and MW-54) 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 groundwater monitoring program in the 4th Quarter of 1991, called the Supplementary Groundwater Monitoring Program (SGMP). Originally, this program involved sampling 12 off-site wells (MW-35, MW-36, MW-37, MW-46, MW-48, MW-51, MW-53, MW-55, MW-56, MW-58, MW-60, and MW-62) and three on-site wells (MW-32, MW-42, and MW-43) on a quarterly basis for VOC analysis using EPA Method 8240. The SGMP was expanded to sample 19 off-site wells (MW-36, MW-37, MW-46, MW-48, MW-51, MW-53, MW-55, MW-56, MW-57, MW-58, MW-60, MW-61, MW-62, MW-64, MW-65, MW-66, MW-67, MW-68, and MW-69) and three on-site wells (MW-32, MW-42, and MW-43) 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 Groundwater 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 monitoring for VOC's under USEPA Method 8240 and then Method 8260B.

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), additional monitoring wells were also sampled. Monitoring wells sampled during the December 1993 sampling event include MW-13, MW-29, MW-30, MW-31, MW-34, MW-38, MW-39, MW-40, MW-41, MW-44, MW-45, MW-47, MW-49, MW-52, MW-57, MW-59, MW-63, and MW-64. Monitoring wells sampled during the January 1996 sampling event include PZ-1, MW-12, MW-13, MW-17, MW-29, MW-30, MW-31, MW-33, MW-34, MW-38, MW-39, MW-40, MW-41, MW-44, MW-45, MW-47, MW-49, MW-52, MW-59, and MW-63.

In 1996, Sparton installed five additional downgradient “sentinel” groundwater monitoring wells to confirm plume limits and rates of movement. The new wells, with subsequent sampling and analysis, were added to the SGMP well network (current total of 28 monitoring wells).

In February 1998, a deeper “sentinel” well (MW-70) was added to on-site well cluster #4 (MW-15, MW-41, and MW-32). Monitoring well MW-70 is screened approximately twenty feet below MW-32. During the summer of 1998, Sparton installed monitoring well MW-71 adjacent to existing well cluster MW-60/61 to define the plumes vertical extent. In the fall of 1998, MW-71 was retro-fitted and converted to a two-inch diameter well upon identification of potential casing leakage.

During February and March 1999, Sparton installed on site wells MW-72 and MW-73. Well MW-72 is located between MW-15 and MW-43, and is screened about 25 to 35 feet below the water table. Well MW-73 is located between MW-14 and MW-15, and is screened about 24 to 29 feet below the water table. Both wells were installed to better define the plume along the northwest property line.

2.5 EXISTING MONITORING WELL SYSTEM CHARACTERISTICS

The existing groundwater monitoring well network characteristics are presented in Table 2-1. Specifically, Table 2-1 describes the characteristics of each groundwater monitoring well in the monitoring system including location, diameter, ground and top of casing elevations, total depth, screen interval (length), and screen construction and slot size. Table 2-2 presents a summary of the status of each respective well including a description of dedicated sampling equipment, pump depth/elevation (if applicable), and well packer information (if applicable). Sparton will update and redistribute Table 2-1 to EPA and NMED each time the present groundwater monitoring system is altered. Figure 1 presents the network of monitoring wells. Appendix A is a compilation of all available well construction and boring logs.

SECTION THREE

SAMPLING AND ANALYSES PLAN FOR EXISTING WELLS

The following sections describe the procedures for the collection and analysis of groundwater samples and the measurement of water levels from the existing monitoring well network.

3.1 GROUNDWATER SAMPLING NETWORK, PARAMETERS, AND FREQUENCY

The existing groundwater monitoring network consists of all on-site and off-site monitoring wells and is summarized as Table 3-1 and identified on Figure 1. The frequency of groundwater sampling and water level measurement recording, as well as the respective analytical parameters for each well, are also summarized on Table 3-1. In general, water level measurements are to be completed from all wells on a quarterly basis, while sample collection and analysis is conducted quarterly, semi-annually, or annually.

The frequency of water level measurements and the groundwater sampling and analysis will be reviewed every five years under this plan. From this review the plan will be modified as necessary and proposed modifications to this plan will be presented to the U.S. EPA and NMED for their review and approval.

As shown in Table 3-1, eight sentinel/perimeter monitoring wells (MW-52, MW-57, MW-62, MW-65 through MW-69, and MW-71) are required to be sampled on a quarterly basis. This frequency can be modified in the future if data collected since the implementation of the off-site containment system indicates that sampling of these wells is no longer required.

Analytical parameters include volatile organic compounds (VOC's) utilizing U.S. EPA SW-846 Method 8260B and analysis of chromium (total). Chromium will be analyzed utilizing U.S. EPA SW-846 6000/7000 series. Method detection limits for all constituents must be less than or equal to maximum contaminant levels (MCL's) or the state groundwater standards, whichever is more stringent for the respective constituents. Table 3-1 and Table 3-2 provides a list of the analytical parameters and respective constituent reporting limits.

In the event that additional groundwater monitoring wells are installed, this plan will be revised by Sparton to include the respective well(s) in the sampling program. In the event that the status of a well changes (i.e., from active groundwater recovery well to inactive), this plan will be updated by Sparton to include such wells as groundwater monitoring wells as appropriate.

3.2 GROUNDWATER SAMPLING PROCEDURES

3.2.1 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. In general, decontamination will include washing all purging and sampling equipment with a non-phosphate laboratory detergent, potable water rinse, followed by a

distilled water rinse in accordance with Field Procedure P-5 presented in Section Five.

3.2.2 Water Level Measurements

During all sampling events, hydraulic performance evaluations, and in accordance with the frequency identified on Table 3-1, groundwater elevations will be determined in all available wells in accordance with Field Procedure P-4 presented in Section Five. 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 distilled water prior to each use.

3.2.3 NAPL Measurements

The presence or absence of DNAPLS will be measured once in wells MW-16, MW-18, MW-23 through 26 and MW-32 in accordance with Field Procedure P-4 presented in Section Five.

3.2.4 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-1 presented in Section Five, 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.

3.2.5 Redox-Potential and Dissolved Oxygen Measurements

Redox-potential and dissolved oxygen will be measured at each well on an annual basis in accordance with Field Procedure P-3 presented in Section Five.

3.2.6 Sample Collection

Samples will be obtained with dedicated pumps or bottom filling/discharging bailers. If a pump is used, the dedicated purge/sample pump will be adjusted to achieve a minimum smooth steady flow appropriate for sample collection, consistent with rates to be established during November 1999 sampling event, and to be reported in the first annual report. Samples will be collected by pumping directly into each of the required containers. In the event additional samples are collected and filtered for dissolved metal analysis, the sample will be placed into the required container following field filtration. 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 VOC's 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.

3.2.7 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
- Sample identification and number
- Analytical parameter(s) and method and preservatives used
- Initials of collector
- Date and time of collection

3.2.8 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 when local laboratories are not used.

Sample packaging and shipment requirements will vary depending on the expected concentration of contaminants, whether or not samples will be shipped by common carrier, 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, when necessary.

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, as necessary.

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 placed inside of the shipping container.

When samples are to be shipped by common carrier, 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. 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).

When samples are to be shipped by common carrier, 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 or refrigerator until they can be logged in by the laboratory sample custodian.

3.3 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.

3.3.1 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 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 non-dedicated 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 cooler of samples submitted for volatile organic analysis.

3.3.2 Sample Containers and Preservation Methods

Table 3-3 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.

3.4 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.

3.4.1 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.

3.4.1.1 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.

3.4.1.2 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.

3.4.1.3 Chain-of-Custody Record

The COC record as shown in Figure 2 or similar lab form 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.

3.4.1.4 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.

3.4.1.5 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.

3.4.2 Documentation

The program designed to ensure that field samples and field data are valid and useful is summarized in Table 3-4. 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 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.

3.5 CALIBRATION PROCEDURES OF ANALYTICAL INSTRUMENTS

Instruments and equipment used for the laboratory analyses are controlled by the method selected to be 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 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.

3.5.1 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)

3.5.2 Field Analyses

Prior to the use of any test equipment in the field, such as a pH probe, thermometer, conductivity meter, ORP meter, DO meter, or PID, proper calibration will be ensured. Specific calibration procedures and frequencies for various instruments are described in the Field Procedure P-3 presented in Section Five.

3.6 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.

3.6.1 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 3-5.

3.6.2 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.

3.7 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 3-6 and 3-7.

3.7.1 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 3-6 and 3-7.

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 VOC's occurs during sampling or transportation to the laboratory. When non-dedicated sampling equipment is used, equipment blanks will be collected and analyzed. One trip blank will be included in each cooler containing samples to be analyzed for VOC's. Equipment blanks will be collected at a frequency of 5% of samples collected for each matrix for non-dedicated equipment.

3.7.2 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 3.10) 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 3-6 and 3-7. 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.

3.7.3 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 collection, storage, transportation, etc.). Completeness goals are presented in Tables 3-6 and 3-7.

3.7.4 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 composite 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.

3.7.5 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.

3.7.6 Procedures for Data Assessment

The QA objectives for the laboratory analyses conducted during this program are listed in Tables 3-6 and 3-7. 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.

3.8 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.

3.8.1 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.

3.8.2 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 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).

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.

3.9 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 3-8.

3.9.1 Trip Blank

One trip blank will be submitted to the laboratory with each cooler 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.

3.9.2 Equipment Blank

For non-dedicated sampling equipment, 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 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.

3.9.3 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.

3.9.4 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.

3.10 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 3-8.

3.10.1 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 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.

3.10.2 Method Blank

One method blank will be analyzed with every batch of samples supplied from the field for VOC's and metals 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.

3.10.3 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.

3.10.4 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.

3.10.5 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 3-6, the associated samples will be treated as specified in the analytical method being followed.

3.10.6 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

3.11 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.

3.12 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.

3.12.1 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 3-6 and 3-7.

3.12.2 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.

3.12.3 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

3.12.3.1 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 deviation are calculated using:

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

and

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

where:

- \bar{m} = the average of the Relative Percent Difference determinations,
- m = the RPD of a replicate pair,
- S_m = the standard deviation of the data set of RPD determinations,
- n = the number of RPD determinations.

3.12.3.2 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:

- %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:

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

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.

3.12.4 Evaluation of Field Data

The accuracy and precision of field measurements are given in Table 3-7. 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 pH, temperature, and specific conductance will be defined as achieved when three consecutive measurements are within ± 0.1 pH units, $\pm 1^\circ\text{C}$ and $\pm 20 \mu\text{mhos}$, respectively.

3.13 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. Ordinarily, dedicated equipment will be used. 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 Manager will issue a Non-Conformance Report for all areas signaling significant and systematic deficiencies to the Project Manager. Each NCR requires that a Corrective Action Report (CAR) be completed by the project manager and project QA manager to the Sparton program QA manager. 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 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.

3.14 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.
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- U.S. Environmental Protection Agency (U.S. EPA). 1996. *Test Methods for Evaluating Solid Waste*. SW-846, Update III, 3rd Edition. December, 1996.

SECTION FOUR REPORTING AND SCHEDULING

The GWMPP will generate data to monitor changes in the plume configuration and concentrations. Specific deliverables will be submitted as described below and presented in Table 4-1.

4.1 SEMI-ANNUAL PROGRESS REPORTS

Mr. Michael Hebert of EPA Region 6 , and Mr. Dennis McQuillan, Mr. Baird Swanson, and the chief of the HRMB, of NMED, will be notified two weeks prior to each scheduled sampling event.

Sparton will provide Mr. Michael Hebert of EPA Region 6, and Mr. Dennis McQuillan, Mr. Baird Swanson, and the chief of the HRMB, of NMED, with signed semi-annual progress reports while implementing the Groundwater Monitoring Program Plan. For the purpose of this Groundwater Monitoring Program Plan, analytical reports submitted shall only include analytical data set summaries, unless the full analytical package is requested. The semi-annual progress reports will be submitted within 60 days of Sparton's receipt of all the analytical data and will include water level summaries and analytical data summaries. Sparton will provide quarterly progress reports within 60 days of Sparton's receipt of all analytical data, if requested by EPA or NMED. The quarterly progress reports will include water level summaries and analytical data summaries.

In addition to the semi-annual progress reports and possible quarterly progress reports, the Site Annual Report described in Consent Decree Attachment D will include the following elements:

- A description of significant activities (e.g. sampling events, groundwater elevations data, summary of analytical results, etc.) and work completed/work accomplishments during the reporting period;
- Potentiometric surface maps and contaminant concentration contour maps (annual basis);
- Summaries of all contacts between groundwater sampling personnel and representatives of the local community, public interest groups or State government during the reporting period associated with the implementation of this plan;
- Summaries of all problems or potential problems encountered during the reporting period;
- Actions being taken and/or planned to rectify problems; and,
- The results of any sampling test and/or other data generated during the reporting period.

4.2 ANALYTICAL DATA PACKAGES

The analytical data packages from the laboratory shall be received by Sparton's project chemist or quality assurance officer within 21 business 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;
- 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 Three.

4.3 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.

SECTION FIVE FIELD PROCEDURES

The following sections describe field procedures related to the collection and analysis of groundwater 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).

5.1 INDEX OF FIELD PROCEDURES

<u>PROCEDURE:</u>	<u>DESCRIPTION:</u>
P-1	Well Purging
P-2	Groundwater Sampling
P-3	Redox-Potential, Dissolved Oxygen, Temperature, pH, and Conductivity Measurements and Equipment Calibration
P-4	Measurement of Depth to Water, Total Depth, and Nonaqueous Phase Liquids
P-5	Decontamination of Non-Dedicated Sampling Equipment
P-6	Well Development
P-7	Calculation of Borehole and Purge Volumes
P-8	Borehole and Well Abandonment
P-9	Surveying

Procedure P-1

WELL PURGING

1.0 PURPOSE

The purpose of this procedure is to provide general information on well purging by the pumping method or bailing 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 variable volumes of water. 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 Purge pump, sample pump, or bailer
- 4.2 Compressed gas or air compressor
- 4.3 Water Level Indicator
- 4.4 Portable Tank to contain the purge water
- 4.5 Field Logbook
- 4.6 Calculator
- 4.7 Groundwater Sampling Form
- 4.8 Disposable Latex or Nitrile Gloves
- 4.9 Teflon or other appropriate purging/sampling tubing
- 4.10 pH, temperature, and conductivity meter(s)

4.11 HNu or OVA as appropriate for health and safety screening

5.0 PROCEDURE FOR WELLS WITH GOOD (HIGH) RECHARGE RATES

Good or high recharge wells are those wells which can be reasonably purged of the required three well volumes within a reasonable time frame.

The groundwater wells with good (high) recharge rates shall be purged according to the following procedure. Details regarding the groundwater sampling procedure and field data will be recorded in both a bound field log book and on the groundwater sampling form. All non-dedicated purging equipment shall be decontaminated prior to and after use per procedure P-5 or dedicated or disposable equipment shall be used.

1. The wells shall be unlocked and the caps removed. Appropriate health and safety procedures shall be followed to protect against potential exposure to organic vapors which may include screening the well with an HNu or OVA. In the event that an HNu or OVA is utilized, all readings shall be recorded in the field logbook.
2. Procedure P-4 should be followed to determine the presence of immiscible layers, when appropriate (for select on-site wells) and to determine the depth of water and total depth of the well. In the event that a dedicated pump is stationed in the well preventing total depth measurements, historical well depths from previous soundings or the well construction logs shall be used.
3. The volume of water to be purged from the well is determined using procedure P-7.
4. Once the volume of water to be removed is calculated, a dedicated pump, disposable bailer or decontaminated non-dedicated pump will be used to remove the water from the well and place it in a portable tank. If a pump is used, it shall be at an appropriate rate that prevents extremely rapid drawdown, allows for adequate recharge, and minimizes turbidity and aquifer disturbance. The portable tank shall be graduated so that the amount of water purged from the well can be measured or the pumping rate and duration shall be closely monitored to assure adequate purge volume removal.
5. To document that the wells have been adequately purged, specific conductance, temperature, and pH (See Procedure P-3) shall be measured utilizing appropriate meters. The meters shall

be properly calibrated and used in a manner consistent with the manufacturers specifications. The readings shall be collected in accordance with Procedure P-3. Once the well has been properly purged and the parameters have stabilized the water samples can be collected as described in Procedure P-2.

6.0 PROCEDURE FOR WELLS WITH POOR (LOW) RECHARGE RATES

Poor or low recharge wells are those wells which can not be reasonably purged of the required three well volumes within a reasonable time frame.

The groundwater wells with poor (low) recharge rates shall be purged according to the following procedure. Details regarding the groundwater sampling procedure and field data will be recorded in both a bound field log book and on the groundwater sampling form. All non-dedicated purging equipment shall be decontaminated prior to and after use per procedure P-5 or dedicated or disposable equipment shall be used.

1. The wells shall be unlocked and the caps removed. Appropriate health and safety procedures shall be followed to protect against potential to organic vapors which may include screening the well with an HNu or OVA. In the event that an HNu or OVA is utilized, all readings shall be recorded in the field logbook.
2. Procedure P-4 should be followed to determine the presence of immiscible layers when appropriate (for select on-site wells) 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-7.
4. The wells will be evacuated of water using a disposable bailer with care taken to minimize agitation.
5. For poor recharge wells, it will not be necessary to demonstrate that pH, conductivity, and temperature have stabilized. One measurement of pH, conductivity, and temperature will be made and recorded during the purging event.

Procedure P-2

GROUNDWATER SAMPLING

1.0 PURPOSE

The purpose of this procedure is to obtain groundwater 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 immediately following purging or within three hours of purging. However, wells with poor recharge rates should be sampled within 24 hours of purging. Poor recharge wells are those that cannot be reasonably purged of three well volumes. 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 recharged 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 non-dedicated sampling equipment must be decontaminated in accordance with the Field Procedure P-5, 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 or dedicated sample pumps or disposable bailers
- 4.3 Coolers for sample shipping and cooling
- 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 Disposable Latex or Nitrile Gloves
- 4.15 Ice
- 4.16 Teflon or appropriate sampling tubing
- 4.17 55-gallon drums
- 4.18 Field Filtration Apparatus and Filters

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 or bailers as described in Procedure P-1. Water produced during purging and well sampling shall be collected in 55-gallon containers. Details regarding the groundwater sampling procedure and field data will be recorded on the groundwater 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-1.
2. Samples shall be collected by discharging the water directly into the required containers. In the event additional samples are collected and filtered for dissolved metal analysis, the samples will be placed into the required container following field filtration. After the purge period, dedicated purge/sampling pumps will be adjusted to achieve a minimum smooth steady flow appropriate for sample collection, consistent with rates to be established during November 1999 sampling event, and to be reported in the first annual report.
3. The samples for VOC's analysis shall be collected first in 3-40 mL vials with Teflon-lined

lids. The vials shall be completely filled so that no headspace is present. Samples for metals analysis shall be collected last in a 250 ml, 500 ml or 1 L polyethylene bottle pre-preserved with nitric acid (HNO₃).

4. Prior to or subsequent to sample collection, additional well water shall be collected for the field measurement of dissolved oxygen and redox-potential consistent with the protocols of Procedure P-3, when necessary.
5. When samples to be filtered are obtained using a disposable bailer, the water will be emptied from the bailer into a new polyethylene cubitainer. The water will be drawn from the cubitainer using a Geotech Series 2 peristaltic pump, pushed through a 0.45 um disposable cartridge filter and discharged directly into the appropriate sample containers. Following sample collection, the peristaltic pump will be reversed to evacuate the filter prior to disposal. The evacuated water will be disposed with the purge water. The tubing used in the peristaltic pump will be dedicated to each well or new tubing will be used for each well.

When samples to be filtered are obtained using a bladder pump, the water will be pushed through a 0.45 um disposable cartridge filter and discharged directly into the appropriate sample containers. The filter will be drained prior to disposal.

6. The samples shall be labeled and immediately be placed in a cooler containing ice to maintain a temperature of 4 degrees Celsius. Ideally, a temperature blank should be provided by the laboratory to accompany the ice chest and is used to verify that the samples have been stored at the proper temperature during sample delivery. 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

7. The cooler shall be sealed and shipped or hand delivered to the laboratory for analysis.

Procedure P-3

REDOX-POTENTIAL, DISSOLVED OXYGEN, TEMPERATURE, pH, AND CONDUCTIVITY MEASUREMENTS AND EQUIPMENT CALIBRATION

1.0 PURPOSE

The purpose of this procedure is to provide information on how to perform the measurements of redox-potential, dissolved oxygen, turbidity, temperature, pH, and conductivity in the field. The field measurements of pH, temperature, and conductivity are to be collected during the well purging process (Procedure P-1) and the well development process (Procedure P-6) to determine when well purging and development is complete (i.e. stabilization). In addition to pH, temperature, and conductivity readings, measurement of turbidity shall be collected and stabilized during the well development process. The collection of dissolved oxygen and redox-potential measurements can be completed during the purging or well sampling process. The dissolved oxygen and redox-potential measurements are factors relating to long-term aquifer monitoring and restoration and are to be collected on an annual basis.

2.0 SCOPE

This procedure addresses the field measurement of redox-potential, dissolved oxygen, temperature, pH, and conductivity using appropriate instrumentation which may include using flow-through cells or down-hole water quality loggers, or combination or individual parameter meters.

3.0 REQUIREMENTS

For monitoring wells with good or high recharge rates, the field measurements of 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 is achieved when three consecutive readings for the parameters of temperature, pH, and conductivity are within $\pm 1^\circ$ Celsius, ± 0.1 pH units, and ± 20 μ mhos/cm, respectively. The field measurements will be made either in the well ahead of the pump intake in the case of a down-hole meter, or "in-line" prior to the purge water container in the case of a flow-through cell meter, or at the discharge of the pump tubing in the case of hand held meters. Readings collected with the pH meter, conductivity meter, and thermometer or electronic meter shall be obtained at regular intervals during the purging process and continued as necessary until stabilization has occurred.

For wells with poor or low recharge rates, it will not be necessary to demonstrate that pH, conductivity, and temperature have stabilized. One measurement of pH, conductivity, and temperature will be made and recorded during the purging event.

The collection of dissolved oxygen and redox-potential measurements can be completed during the purging or well sampling process and is a one-time reading (not consecutive readings) collected on an annual basis.

4.0 EQUIPMENT

- 4.1 Disposable Latex or Nitrile Gloves
- 4.2 Field Logbook
- 4.3 Teflon® or appropriate purging/sampling tubing
- 4.4 Drums to collect purging or excess sampling water
- 4.5 Plastic Cups
- 4.6 pH Meter/Buffer Solutions
- 4.7 Conductivity Meter/Calibration Solutions
- 4.8 Temperature Thermometer or Electronic Meter
- 4.9 Dissolved Oxygen Meter, Oxidation-Reduction Potential (ORP) Meter, and Flow-Through Cell (if necessary)

5.0 PROCEDURE

A pH meter, conductivity meter, and temperature thermometer or electronic meter, will be used to collect the measurements of pH, conductivity, and temperature during well purging or well development. A dissolved oxygen meter and a redox-potential meter will be utilized to collect dissolved oxygen and redox-potential measurements after well purging or during well sampling on an annual basis. In general, a best effort should be made to collect the measurements simultaneously and from the same representative water. The respective meters are to be calibrated in accordance with standard industry practice and in accordance with the manufactures recommended protocols. In general, the meters are calibrated and utilized for the collection of measurements by the following general procedures:

Calibration and Collection for Dissolved Oxygen

The oxygen probe should be calibrated daily. The oxygen probe will be calibrated and operated in

accordance with the manufacturer's procedures.

Calibration and Collection 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 in accordance with manufacturers specifications until 7.0 appears on the meter.
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 water. Record the reading.
10. Readings collected with the pH meter shall be obtained at regular intervals during the purging process and continued as necessary until stabilization has occurred. Stabilization is achieved when the pH parameter measurements are within ± 0.1 pH units.

Calibration and Collection 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 a value of between 500 and 1500. The meter shall be calibrated and operated in accordance with manufacturer's specifications and procedures.

Temperature Readings

Temperature readings will be taken with an alcohol-filled scientific thermometer or electronic meter. 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 or the cup on the thermometer shall be filled with water from the well. The thermometer shall be placed into the cup and a temperature recorded or a direct reading shall be collected from the electronic meter.
4. Remove the thermometer and rinse it with distilled water.
5. Readings collected with the thermometer shall be obtained at regular intervals during the purging process and continued as necessary until stabilization has occurred. Stabilization is achieved when the temperature parameter measurements are within $\pm 1^\circ$ Celsius.

Calibration and Collection for Redox Potential

The redox-potential probe should be calibrated daily. The redox-potential probe will be calibrated and operated in accordance with the manufacturer's specifications and procedures.

Procedure P-4

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, the thickness of non aqueous phase liquids (if present), and determination of well volumes. These procedures are frequently conducted in conjunction with groundwater sampling and the preparation of potentiometric surface maps. Only select monitoring wells as presented below will be gauged on a one-time basis (assuming non-detect) for the presence of non aqueous phase liquids.

3.0 REQUIREMENTS

Groundwater level measurements should precede groundwater purging or sampling and should progress from non-impacted wells to wells which are known to be impacted.

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
- 4.4 Appropriate Keys (for locked wells)
- 4.5 Field Logbook
- 4.6 Groundwater 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 by rinsing with distilled water before and after each use per Procedure P-5. In general, water level measurements should first be collected from monitoring wells that are not contaminated or have minimal contamination and proceed to wells which have elevated concentrations of contaminants.
3. All information shall be recorded in the field log book and on the groundwater sampling form (if sampling is to occur).
4. The presence of non-aqueous phase liquids (DNAPL) will be determined using an interface probe by first checking the surface of the groundwater and then slowly taking continuous readings until the bottom of the well is reached. Specifically, on-site monitoring wells MW-16, MW-18, MW-23 through MW-26, and MW-32, should be gauged once to verify the presence/absence of DNAPL. If DNAPL is detected, the respective wells should be monitored quarterly for DNAPL and thickness measurements should be recorded on sample logs. If the interface probe indicates 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. No further gauging for DNAPL will be required if it is not detected in the above on-site wells unless changes in site specific conditions merit DNAPL reevaluation.
5. Measurements should be taken from a surveyed reference mark on the top edge of the well head. 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.

Procedure P-5

DECONTAMINATION OF NON-DEDICATED SAMPLING EQUIPMENT

1.0 PURPOSE

The purpose of this section is to provide information on the proper decontamination of non-dedicated 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 Distilled Water
- 4.5 Aluminum Foil
- 4.6 Scrub Brushes
- 4.7 Four to Six 55-gallon Drums
- 4.8 Pressure Washer

5.0 PROCEDURE

5.1 Decontamination of Non-Dedicated Groundwater Sampling Equipment

Prior to and after the collection of groundwater samples, sampling equipment shall be decontaminated by the following procedure.

Water Level Meter Tape

1. Rinse several times with distilled water.

Procedure P-6

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 may include the use of, air ejector pumps, bailers, submersible pumps, and jetting tools. 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 Bailer, or Jetting Tool
- 4.2 Electric Submersible Pump or Air Ejector 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 or Appropriate Tubing
- 4.9 HNu or OVA

5.0 PROCEDURE

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

1. The wells shall be unlocked and the caps removed. Appropriate health and safety procedures shall be followed to protect against potential exposure to organic vapors which may include screening the well with an HNu or OVA. In the event that an HNu or OVA is utilized, all readings shall be recorded in the field logbook.
2. Well development shall include the removal of water added and lost to the formation during the well installation process. At a minimum, two-times the volume of water lost must first be removed.
3. At a minimum, well development shall consist of the removal of a three well volumes as calculated by Procedure P-7. The well will be pumped until the water is visibly observed to be clear.
4. Well specific devices, such as bailers, submersible pumps, and jetting tools, shall be used to develop and remove water from the well. The following procedures will apply to wells of a specific size:
 - 2-inch wells: Wells that are 2-inch in diameter shall be developed using decontaminated bailers and/or air ejector pumps.
 - 4-inch wells: Wells that are 4-inch in diameter shall be developed using a combination of jetting and pumping. A jetting tool will be placed above a four-inch electric submersible pump. The well will be jetted by closing the a valve on top of the drop pipe and working the jetting tool up and down within the screen interval. After each jetting cycle, the valve will be opened and the well will be pumped until the water is clear. Following jetting, the jetting tool will be removed and the pump will be placed back in the well and operated until three well volumes have been removed from the well, and the water being pumped is visibly observed to be clear.

Procedure P-7

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 and to determine the requisite volume of water to be removed during well purging or development for wells with good or high recharge rates.

2.0 SCOPE

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

3.0 REQUIREMENTS

Procedure P-4 (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 Groundwater Sampling Form
- 4.3 Field Logbook
- 4.4 Calculator

5.0 PROCEDURE

1. Complete the following form and attach to Groundwater Sampling Form.

CALCULATION OF WELL VOLUMES

WELL ID: _____

DATE: _____

Parameter Definitions:	Parameter:	Symbol:
Depth to water from MP*:	_____ ft.	D
Total Depth of well from MP:	_____ ft.	TD
Height of water column in well*:	_____ ft.	TD - D = h
Radius of well casing:	_____ in.	r_w

Volume per lineal foot given a diameter: _____ gal/liner ft. c

diameter:	gal./linear ft.:	diameter:	gal./linear ft.:
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 :

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

TOTAL VOLUME TO BE REMOVED:

$$v_R = 3 (v_C) \quad 3 \times \text{_____} = \text{_____} \text{ gal.}$$

Notes:

MP = Measuring Point

* = or depth to/from packer for wells so equipped.

Procedure P-8

BOREHOLE AND WELL ABANDONMENT

1.0 PURPOSE

This section describes the methods of securing a borehole or monitoring well 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 exists for a borehole or well to act as a migratory pathway for contaminants into groundwater or the unsaturated soils. Therefore, specific procedures must be established to prevent this potential occurrence. The State of New Mexico, through specific regulation at 20 NMAC 6.2 Section 4107.C, has identified specific requirements for the plugging, abandonment, or destruction of monitoring or water supply wells. These requirements shall be followed in the event that any monitoring well is proposed for abandonment.

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

5.0 PROCEDURE

Monitoring wells or borings requiring abandonment shall be abandoned in accordance with State of New Mexico regulations and guidance. In general, the procedures identified below represent standard industry practices for the abandonment of bore holes and monitoring wells.

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 well casing will be perforated in significant intervals which are either not grouted or not screened. The well will then be filled with grout using a tremie pipe. The well will then be pressure grouted to assure that the annular space in screened and perforated intervals are properly grouted.
5. The grout will consist of water mixed with 94 pounds of Portland type I cement to which five pounds of bentonite powder is added. The mixture shall weigh 13.5 to 14.0 pounds per gallon.
6. The grout shall be placed in such a fashion as to prevent voids or air pockets from forming.
7. A written abandonment report shall be sent to all authorizing agencies stating what abandonment occurred and how it was performed.
8. The Groundwater Monitoring Program Plan will be updated to reflect the abandonment of any monitoring wells.

Procedure P-9

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 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.

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 groundwater gradients. However, no more than Third Order Accuracy will 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 1.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

5.2 MONITORING AND PUMPING WELLS OR PIEZOMETERS

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 groundwater altitudes. The wellhead elevation and the well designation shall be permanently recorded directly on the protective casing.

5.6 REPORTS AND DOCUMENTATION

The Registered Surveyor shall submit a map to the Project Manager at the completion of each survey assignment. The map shall identify the elevation and grid coordinates for each monitoring well. Additional information that may be appropriate to document includes: the activity, personnel involved, survey approach used, benchmark location, construction, and elevation, and any technical evaluations that were made in the performance of the work.