QUALITY ASSURANCE QUALITY CONTROL PROGRAM

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Engineers and Environmental Management Consultants

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I. PURPOSE OF THE QUALITY ASSURANCE PROGRAM

The purpose of the Quality Assurance and Quality Control (QA/QC) program is to establish and maintain field and sampling practices to ensure the scientific reliability, compatibility and legal defensibility of analytical data generated in support of K. Singh & Associates' programs.

This program has been developed to provide management control to ensure that all technical analytical data generated during projects are accurate, defensible and representative of conditions encountered at the site. Adherence to the protocols specified in this manual is critical to developing required data packages for each project. Management of this program is through K. Singh & Associates, Inc.

II. INTRODUCTION

This QA/QC program outlines the purpose, policies, organization and operations established to support field activities conducted by and for K. Singh & Associates, Inc. Implementation of this program in the field and at all laboratories performing chemical analysis for K. Singh & Associates' programs will better ensure the validity of data and provide a reliable foundation on which to base decisions.

The concepts expressed in this document represent what is considered by K. Singh & Associates, Inc. to be an acceptable approach for conducting field activities. Principles and procedures are the result of general operations and trends in field activities. This QA/QC program has been designed to be theoretically sound and operationally efficient.

In implementing this QA/QC program, it is important that the reader understand the definitions used within. A Quality Assurance program is defined as a "system for verifying and maintaining a desired level of quality in a product or process." A Quality Control plan is a specific description of how the Quality Assurance program will be carried out. This Quality Assurance program will guide sampling activities and QA/QC procedures associated with laboratory analytics.

This program discusses activities associated with well construction, collection and management of various media samples, including laboratory control procedures. K. Singh & Associates, Inc. subcontracts analytical work to state permitted or USEPA certified contract laboratories (part of the contract laboratory program (CLP)).

Modifications to this QA/QC program may be made only after specific approval by the QA officer (QAO). This will allow a degree of flexibility for the program and will provide updating as more experience and knowledge become available in QA/QC of field activities.

This QA/QC program includes changes as of June 15, 1992.

III. QA/QC OBJECTIVES

QA/QC is an integral part of all sampling programs. The main objectives of the QA/QC program is to establish procedures for conducting the site sampling effort. Data generated from the field samples are required to be meaningful, representative, complete, precise, accurate, scientifically reliable and legally defensible.

Specific QA/QC objectives include:

> Ensuring that all samples are collected according to acceptable and recognized procedures;

> Assisting in the early recognition of deficiencies which might affect the quality of data;

> Ensuring the proper handling and management of samples during and after collection;

> Ensuring that all samples are sufficiently documented to maintain indisputable tracking of each sample, and;

> Ensuring that QA/QC procedures are followed during the monitoring of groundwater, air, and leachate.

IV. ORGANIZATION OF PROGRAM

A. INTRODUCTION

It is K. Singh & Associates' policy to provide each client with professional consulting, general support and analytics. The president of K. Singh & Associates, Inc. is ultimately responsible for the quality of the data generated by K. Singh & Associates, Inc. The president, through the project manager, directs the QA/QC program to document the control of data adequately. Figure 1 illustrates the project organization and delegation of responsibilities. Primary project responsibility resides with the project manager. The Quality Assurance Officer (QAO) has the overall responsibility for project quality assurance. Should the QAO identify assurance problems, the project manager, assistant project manager, or On-Site Coordinator (OSC) and QAO jointly will determine the appropriate corrective action. Such action then will be taken by the OSC at the direction of the project manager.

B. PROJECT MANAGER RESPONSIBILITIES

Daniel J. Mueller, project manager, has the responsibility to ensure that site activities run smoothly and that the QA/QC procedures described herein are followed by all field personnel. In particular, the project manager will monitor daily the quality assurance activities of the field team, ensure conformance with authorized policies and sound practices, and recommend improvements as necessary.

The project manager, through the OSC, has overall responsibility for collecting, logging, packing and shipping samples, including the introduction of control samples into the sample train. The project manager will ensure that sampling is conducted in a manner consistent with the guidelines contained herein. He will also ensure that the various QA/QC procedures for each piece of equipment, including maintenance, are followed by laboratory field personnel. Once samples are analyzed, the he will ensure that resultant analytical data undergoes proper QA/QC evaluation upon receipt by the QAO.

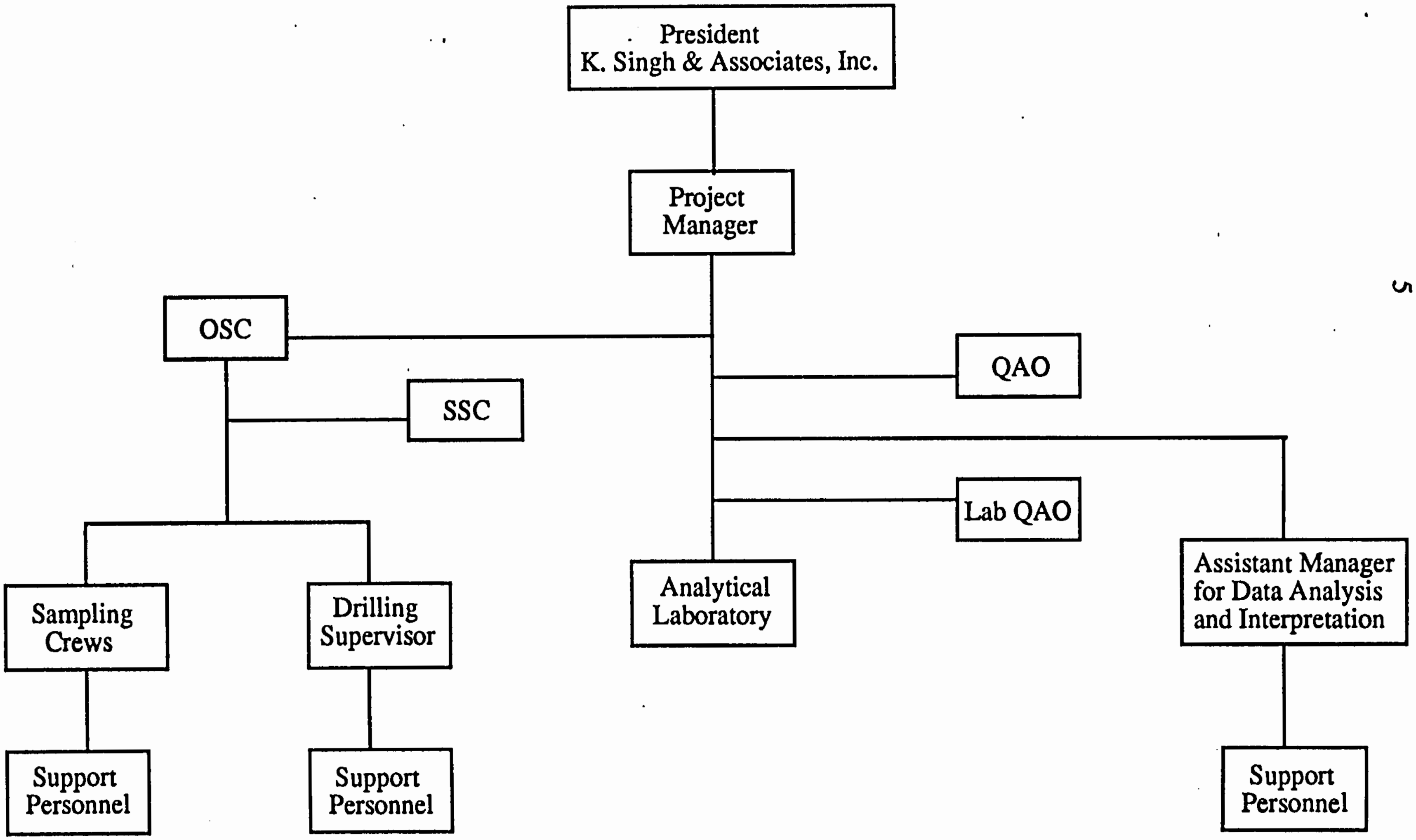
C. SITE PERSONNEL RESPONSIBILITIES

During site operation involving sampling, the following personnel will be on-site:

On-Site Coordinator (OSC): Dr. Raghu Singh

The OSC is responsible for the overall management of site operations. Responsibilities include site health and safety, emergency coordination, community relations, document coordination, sample handling and packaging and sample transportation to the contract laboratory. The OSC may designate other personnel to assist in any of the activities listed but will maintain ultimate responsibility.

Figure 1: TYPICAL PROJECT ORGANIZATION



Quality Assurance Officer (QAO): Dr. Pratap Singh

The QAO is responsible for coordinating all quality assurance activities such that complete integration of the QA/QC program is achieved. The QAO is responsible for ensuring that field sampling personnel are briefed on K. Singh & Associates QA/QC program and specific project QA/QC procedures. The QAO ensures that the K. Singh & Associates, Inc., QA/QC program objectives are met by the laboratory and reviews the laboratory's QA/QC program to verify that it meets K. Singh & Associates, Inc. QA/QC objectives. Upon receipt of analytical data from the laboratory, the QAO is tasked with completing the data validation, see Section IX, Data Validation.

Site Safety Officer (SSO)

The SSO is responsible for overseeing the implementation of the health and safety plan during site operations. This includes air monitoring, if required, personnel decontamination, supervision of treatment during emergencies and ensuring compliance of field personnel with the health and safety plan.

Sampling Crew(s)

The sampling crews are responsible for collecting data according to the requirements of the QA/QC program and the site-specific field sampling procedures manual.

V. MONITORING WELL CONSTRUCTION, INSTALLATION, AND DEVELOPMENT

A. INTRODUCTION

K. Singh & Associates, Inc. utilizes a variety of methods for well-drilling, construction, installation and development, depending on the focus or objectives of the project type. For purposes of the QA/QC program, only a discussion of hollow-stem continuous flight auger drilling will be addressed.

A distinction should be made between piezometers and monitoring wells. A piezometer well is strictly used to determine static water level and aids in establishing horizontal and vertical groundwater flow directions. A monitoring well, in addition, is constructed to provide measurement of total depth and a collection of representative groundwater samples. The drilling methods discussed herein are applicable to both piezometer and monitoring well construction.

K. Singh & Associates, Inc. subcontracts well drilling work. However, the QAO, through the project manager, is responsible to see that the QA/QC program is followed by drillers and K. Singh & Associates field crew. This includes decontamination of drilling equipment prior to and between wells to prevent cross contamination of wells where contamination has been detected or is suspected, based on previous site characterization work. Care should also be taken to see that existing contaminants are not spread throughout a borehole or on the ground surface.

B. HOLLOW-STEM CONTINUOUS-FLIGHT AUGER

Hollow-stem continuous-flight auguring is commonly used in drilling small diameter monitoring wells in moderately deep (approximately 150 feet) unconsolidated deposits. Drill rigs used for this method are commonly mobile, fast and relatively inexpensive. Replacement of hollow-stem flight augers, however, can be costly. Drilling fluids are not normally used and the aquifers penetrated are minimally impacted. Another advantage is that hollow-stem augers provide a temporary casing to prevent caving and sloughing of the borehole. Screens can be installed and filters packed without using casing or drilling fluid. Another advantage is that detailed descriptions of the lithology can be obtained through augers using split-spoon samplers.

Some problems may occur when using hollow-stem auguring in heaving sand environments. Proper drilling procedures can prevent them. For example, by filling the auger with water, a positive pressure head can be developed within the auger stem. Once the knockout plug is removed, the heaving sands are displaced.

As with all drilling procedures, care should be taken not to introduce contaminants, such as contaminated water, into the borehole. Any water that is used should be either distilled, deionized or tap water. Also, to ensure a proper well installation when driving casing, the outer diameter of the casing should be considered when calculating the sealant and filter pack volume. These calculations should be recorded in the field logbook.

C. WELL MATERIALS SELECTION

Polyvinyl Chloride (PVC):

PVC casing and screens will be used in this drilling program because of their low-cost and easy installation. PVC is inert to chemicals in most natural environments, however, PVC does deteriorate in contact with ketones, esters and leach constituents. PVC with flush-threaded joints is preferred to eliminate the possibility of introducing solvents from the joint adhesives into groundwater.

A disadvantage of using PVC is its limited strength. PVC casing and screens cannot withstand excessive stress during well construction. PVC wells are constructed within hollow-stem boreholes after the steel drive casing has been removed.

Well-Filter Pack and Grout:

The filter pack is that material which encompasses the well screen and extends up to two feet above the screen. Figure 2 indicates the filter pack. Materials used for the filter pack will be chemically inert, well-rounded, and dimensionally stable, clean quartz sand or silica. Natural gravel packs will be acceptable if drilling conditions dictate that to be the most efficient method.

Grout is important to prevent the potential for cross contamination between aquifers. The annulus between the well casing and borehole wall, above the filter pack, will be grouted with a bentonite/cement mixture. Clean water should be used when mixing grout to prevent introduction of contaminants to the well.

Cement Bentonite Mixture:

Combining cement and bentonite together enhances the structural strength or impermeability of the grout. Upon drying, the cement bentonite mixture is slightly weaker than pure cement and somewhat more permeable than bentonite. See Figure 2 for placement of this grout.

The cement bentonite slurry will be installed using the Tremie method to ensure a good seal. This mixture will be used as the annular sealant in the unsaturated zone above a bentonite seal and below the frost line. The mixture of cement to bentonite will be in the amount of two to five percent by weight of cement content to aid in reducing shrinkage and control the setting time. From below the frost line to the surface, a cement apron, at least four inches thick, will extend a minimum of three inches from the borehole.

Once the well is completed, a threaded or flanged cap or compression seal will be locked into place to prevent tampering. A vent hole will be provided to allow gases to escape.

Well Development:

To remove foreign sediment and drilling mud from inside the well and around the well screen, the well will be developed with compressed air or mechanical surging. The importance of well development is two-fold: 1) to maximize the wells' production capacity, and 2) to remove foreign particles which may contaminate water supplies. To be effective, well development must involve reversal or surges in flow to prevent bridging. Surge blocks, bailers or pumps can create these reversals.

The time required to develop a well depends upon the formation which is screened. Wells with screens set in sand or gravel may only require a few minutes to develop; whereas, wells set in silty sand may require hours or a day to develop. Wells will be developed until the water removed is free of residual silt and turbidity. Trisodium phosphate can be used to facilitate water well development, but will not be used here in order to prevent the potential for groundwater contamination. All developing equipment and construction materials will be decontaminated prior to use and between well installations.

Air Development

Air development is the most common method of well development. A large capacity air compressor pumps air into the well, forcing water out through the screen and casing. Water flowing into the well constantly replaces the water pushed out by the compressed air. A purging action is also created by the air lifting the water up the casing and allowing it to drop again.

Surging breaks fine soil particles free of coarser particles and washes them away. A filter will be installed if air developing is chosen. This filter will remove oil from the compressed air which would otherwise volatilize and spray into the compressed air or possibly contaminate the groundwater.

Mechanical Surging

Often the most efficient means of development is mechanical surging, especially for large diameter wells. A surge block is lowered to the screen interval and used to churn water in the well, removing finer particles from the formation. The silty water then is pumped or boiled from the well.

VI. SAMPLING CONTROL PROCEDURES

A. INTRODUCTION

The purpose of this section is to ensure QA/QC in sampling and analysis of leachate and groundwater by the use of control samples. To successfully comply with this QA/QC program, it is essential that controls are initiated and maintained throughout the analysis of samples.

Specifically, each testing lot must contain at least one control sample. It is imperative that the type of control sample selected - blank, duplicate, spike, etc,- provide the desired effect. Field duplicates will be taken at a frequency of one for each 10 wells sampled. Periodically, the project manager should document the control sample data as well as specific observations delineating the effectiveness of the control samples for each analytical method. These observations include a rationale for each of the following:

> Selection of the samples used for blanks, the samples used for spikes and the samples used for duplicates, etc.

> Number of field blanks, method blanks, spikes and duplicates.

> Descriptions of the method of control sample collection.

Correct usage of each type of control sample is discussed in the following paragraphs:

B. CONTROL SAMPLES

Control samples are those which are introduced into the train of actual samples as a monitor on the performance of the sampling procedures and the analytical system. A control sample may consist of a standard or natural matrix.

Types of control samples, including duplicates, field blanks, method blanks, and spikes provide a different form of quality control for the analytical system, as follows:

>> Duplicates can provide indications of the precision of the analytical system. They will not provide indications of matrix effects or accuracy.

A duplicate sample is the second sample collected at the exact same location and depth and time as the original sample. A duplicate sample serves to check accuracy and reliability of laboratory instruments, procedures and field activities.

>> Field blanks can provide an indication of positive interferences introduced in the field and in the laboratory. They will not provide information on matrix effects, accuracy, precision, or natural background. Matrices to be used for control blanks must be determined to be free of contamination prior to use. Field blanks are used to check for contaminant introduction due to either introduction between the sample and the container or a handling procedure which alters the sample analysis results. A filter blank is created by filling a designated sample container with distilled/deionized water. The field blank should be clearly labeled, so that it does not remain obscure from the other samples when being analyzed The field blank should be taken to the sampling location and returned to the laboratory in a manner identical to the handling procedures used for all the samples. These blanks should be subjected to the same analysis. A minimum of one field blank per sampling event is recommended.

>> Method blanks can provide an indication of positive interferences introduced within the laboratory. They will not provide information of matrix effects, accuracy, precision or natural background. Matrices to be used for control blanks must be determined to be free of contamination prior to use.

A method blank is collected to check the effectiveness of decontamination procedures for sampling equipment. Following a sampling event, sampling equipment will be decontaminated. Then distilled/deionized water will pass through the sampling equipment into the designated container.

As with the field blanks and duplicates, sample labeling should not indicated that it is a blank. The method blank should be transported to the laboratory and analyzed with the other samples. At a minimum, one method blank should be collected for each sampling event or for each different type of sampling equipment used.

>> Spikes in standard matrices can provide information on accuracy, but will not indicate matrix effects or natural background levels,

>> Spikes of natural samples in conjunction with analysis of unspiked natural samples can provide information on matrix effects, natural background and accuracy.

VII. SAMPLE MANAGEMENT AND COLLECTION

A. INTRODUCTION

The objectives of procedures for sampling are as follows:

- >> Samples collected must be representative of the matrix of materials from which they were taken.
- >> Samples analyzed must be the actual sample which was collected from the site, and for which data was reported.
- >> Appropriate holding times and adequate storage methods for samples must be maintained in order to minimize degradation of the sample between the time of sample collection and the time of sample analysis. Degradation occurs through chemical processes within the sample, such as bacteriological modification, or through tampering.
- >> Data reported by the laboratory must be a reasonable indication of conditions in the sample at the time of analysis and therefore, assuming the three preceding criteria are met, are representative of matrix conditions at the time of sampling.

Trace levels of contaminants from external sources must be eliminated through the use of proper sampling techniques. Sample management and stringent documentation are critical to successful quality assurance.

Sampling techniques can be found in various approved documents such as the "Handbook for Sample Preservation of Water and Wastewater", EPA-600/4-82-029, September 1982, and "Addendum to Handbook for Sampling and Sample Preservation", EPA-600/4-82-029, EPA-600/4-83-039. Sampling techniques will be chosen to obtain the best possible samples, taking into consideration such factors as site conditions, availability of equipment, cost, etc.

B. SAMPLE MANAGEMENT

The management of samples, up through the point of transferring the samples to the laboratory, will be under the supervision of the Project Manager.

- >> The Project Manager, through the On-Site Coordinator (OSC), will ensure the samples are being labeled, preserved, stored and transported according to the prescribed methods.
- >> If the Project Manager determines that significant deviations from the sampling protocol have occurred, resulting in a suspected compromise of the sample integrity, all samples are taken during that sampling run prior to correction of the procedure will be discarded and fresh samples taken.
- >> The Project Manager, through the OSC, will introduce control samples (duplicates, spikes and blanks) into the sample flow in an inconspicuous fashion. A random introduction of control samples should be accomplished during the logging-in process without leaving such clues as a sudden perturbation in the sequence of laboratory numbers or the appearance of a cleaned up extract in a group of soil samples.
- >> The Project Manager will assign internal laboratory identification numbers to all incoming samples and QA/QC samples. The identification numbers will be sequential and will be maintained in a bound logbook to associate the number with the sample.

During the assignment of the internal identification numbers, the Project Manager will establish the sample lots and sample order within each lot ensuring the QA/QC samples are included within each lot. Identification numbers within a lot will be sequential.

C. SAMPLE COLLECTION

The objective of developing sampling procedures is to assure that samples obtained during the investigation are representative of the matrix being examined. Trace levels of contaminants from external sources are controlled by proper and consistent sampling techniques. Sample management and stringent documentation are critical to successful quality assurance.

The first link in the analytical chain is the sample collection. Field sampling personnel are key in ensuring the overall quality control of the data. Field tasks for sample collections include:

> Formulation and implementation of a site-specific sampling plan, to include sampling locations, methods and sample quantities:

> Ensuring that samples are representative of the site conditions and the matrix from which the samples are collected:

> Implementation of chain-of-custody procedures:

> Properly preserving and shipping samples to ensure that they arrive at the laboratory unchanged:

> Documenting field measurements (such as pH, temperature, total dissolved solids, dissolved oxygen): and

> Collecting additional samples as required to fulfill QA/QC requirements.

Selection of an appropriate sampling method is important to ensure that samples are representative. Since water and air components tend to be homogeneously dispersed, collection of representative samples is more easily accomplished. Soil and sediment, however, are more likely to contain unevenly distributed contaminants. Therefore, good judgement and appropriate sampling techniques will be implemented when collecting soil and sediment samples.

Special consideration for sampling, groundwater, leachate, and air, soils, are presented herein, but these considerations do not detail actual sample collection techniques for each media. Further sample collection details would be presented in the site specific field sampling procedures manual. The following paragraphs delineate special sampling considerations for each sample media.

Groundwater

Groundwater sampling will be conducted on wells E-2BR, E-3R, E-3B, E-4, E-5, E-6B, E-7, E-8, E-11 E-16, LP2, and Leachate MH (located on-site), after the wells have been properly developed. In addition wells PW-4&5, PW-11, PW-13-17, PW-21, PW-54-55, PW-91-92, PW-94-97, and PW-99-106, which are located off-site, will also be sampled.

These samples will be tested for field pH, alkalinity, nitrates, chloride, manganese, iron, among other things.

Procedures for Sampling Monitoring Wells:

1) Measure the length of casing sticking up from the top of the protective casing to the top of the ground surface. Measure from the top of the well protective casing to the top of the water. Record the depth for future calculation of groundwater elevations. All measuring devices used in the well must be decontaminated prior to use.

2) Measure the depth from the top of the casing to the bottom of the casing or sediment/water interface for initial sampling of a new well.

3) Subtract the depth to the top of the water from the depth to the bottom of the casing or sediment/water interface to determine the height of standing water in the casing.

4) Before sampling, remove a minimum quantity of water from the well equal to three to five times the calculated volume of water in the well which cannot be pumped or bailed dry. The following equation is utilized to calculate three volumes of water in a two-inch well:

$$V = 0.459 [(D + S) - M]$$

Where : V = well volume (gallons)
D = well depth (feet)
M = depth of the water from the top of steel casing (feet)
S = casing stickup (feet)

A bailer which measures 1-1/4 inches by five feet holds 0.35 gallons of water. Based upon the calculated volume of water in the well and bailer used, the amount of the water to be bailed prior to sampling will be determined.

5) If the well goes dry during pumping or bailing, it is preferable to allow the well to recover and again empty the well before sampling.

6) Obtain a sample for chemical analysis immediately after pumping or bailing is complete. In case a well is pumped or bailed dry, and recovery is very slow, obtain a groundwater sample as soon as possible after the well has recovered.

7) The sampling equipment (bailer, pump, etc.) must be decontaminated after sampling to prevent cross contamination between sampling wells (Refer to VII-E for decontamination procedures). Materials incidental to sampling such as bailer ropes and tubing must also be decontaminated between sampling events. Sampling equipment must be protected from ground surface contamination by clean plastic sheeting. No sampling should be conducted when windblown particles may contaminate the sample or sampling equipment.

8) Field measurements will be taken at each of the sampling locations for pH, specific conductance and temperature and recorded in a bound field logbook. Field instrument calibration and operation will be in accordance with Section X. Pertinent observations

such as color or odor also will be noted. Field measurement equipment will be decontaminated between sampling points using distilled/deionized water.

9) Water samples will be filtered through a 0.45 micron filter to remove suspended particulate matter in accordance with the requirement. Samples for metals analyses must be filtered in the field prior to preservation. Any exceptions to this procedure must be approved by the Project Manager. The filter materials known to adversely affect the analytical procedure must not be used. Temporary sample storage bottles should be thoroughly rinsed with acid and distilled water before reuse.

10) At wells selected for quality control, samples are either taken in duplicate (to check sampling precision) or split (to check analytical precision). For wells selected (prior to the sampling trip) for duplicate samples, the normal sampling procedure is followed with the exception that two sets of sample containers are filled. This second set of containers is then treated the same as the other samples.

11) Follow sample container and preservation requirements presented in Section VII-D collection of aqueous samples.

12) Sample custody and custody procedures to be followed are described in Section VIII.

Leachate

Leachate sampling will be conducted in the leachate manhole wetwell, concurrent with groundwater monitoring well sampling. Each sample will be analyzed for fieldpH, Alkalinity, Chloride, Iron, and other compounds.

The procedure for sampling the leachate manhole is the same as the procedure followed for groundwater sampling.

Gas Monitoring

Gas monitoring will occur at sites where probes D-26--27, D-4--5, D-24--25, D-20--23, D-8--9, D-16--17, D-19, L-1--2, and the blower inlet are located. Gas monitoring will also occur in vents G-1--5, G-7--8. These probes and vents will be monitored for methane plus carbon dioxide, and or oxygen.

The procedure to be followed for gas monitoring will be as follows:

1) Identify the gas monitoring probe locations.

2) Calibrate the methane, carbon dioxide, and oxygen monitors.

3) Attach tube from monitoring probe to the methane, carbon dioxide, and oxygen monitors.

4) Take a reading from the monitors, and record in a bound field logbook.

D. SAMPLE PRESERVATION PROCEDURES

To prevent or retard the degradation/modification of chemicals in water samples during transit and storage, the sample will be containerized and preserved as outlined in Table 2 for the compound of interest.

Sample containers and necessary preservatives for both aqueous and solid samples will be provided by the laboratory conducting the analyses. All sample containers will be certified sterile prior to their use.

Efforts to preserve the integrity will be initiated at the time of sampling and will continue until analyses are performed.

E. DECONTAMINATION PROCEDURES

All equipment associated with construction and installation of wells, field measurements and sampling of all types of media will be decontaminated prior to use and following each sampling event. Care must be taken so that contamination is not introduced to a matrix and to prevent the passing of contamination from one sampling location or matrix to another.

Field measurement devices will be rinsed with distilled/deionized water between sampling locations. Sampling equipment including trowels, bucket augers, bailers, etc., will be decontaminated by the following procedures:

> Wash with mixture of non-phosphate detergent and distilled/deionized water.
> Rinse with distilled/deionized water.
> Wash with 5% Nitric acid rinse (for samples to be analyzed for metals in particular).
> Rinse with distilled/deionized water.
> Wash with Acetone (pesticide grade) or Methanol.
> Rinse with distilled/deionized water.
> Air dry, if time permits.

Decontaminated sampling equipment will be wrapped in clean plastic or placed in plastic bags, and properly identified between sampling events and at the completion of sampling. All augers will be thoroughly steam-cleaned prior to use at each boring. At the completion of well installation activities, the drill rigs, other equipment and all tools will be decontaminated between samples by rinsing with cleaned tap water, scrubbing with a brush, rinsing with Acetone (pesticide grade) or rinsing with distilled/deionized water and air drying.

TABLE 1

SAMPLE CONTAINERS AND PRESERVATIVES CONTAINERS

SAMPLE CONTAINER	CONTAINER
FOR AQUEOUS SAMPLES:	
Volatile Organics	4-40-ml glass vials; Teflon-lined septums
Base/Natural and Acid Extractables	950-ml amber glass bottle (organically rinsed) with Teflon-lined lid
PCB/Pesticides	950-ml amber glass bottle (organically rinsed) with Teflon-lined lid
Metals	1-500-ml Nalgene; field-filtered through 45 micron filter and fixed with 5-ml of 1:1 Nitric acid to pH< 2
Cyanide	1-500-ml Nalgene; fixed with 2.5-ml of 25% NaOH to a pH > 12
Inorganics	1-950-ml amber glass bottle with Teflon-lined lid, no fixative
FOR SOLID SAMPLES:	
Volatile Organics septum	2-40-ml amber glass bottles, vials with Teflon-lined
Base/Natural and Acid Extractables*	950-ml amber glass bottle with Teflon-lined lid
PCB/Pesticides*	950-ml amber glass bottle with Teflon-lined lid
Metals*	500-ml amber glass bottle with Teflon-lined lid
Cyanide*	500-ml amber glass bottle with Teflon-lined lid

NOTE: No fixatives are required by PADER for soil, sediment or solid waste samples.

* Can be combined into 1-950-ml amber glass bottle if the full analytical series is required.

VIII. SAMPLE DOCUMENT CONTROL

A. INTRODUCTION

The goal of the Document Control and Record keeping program is to assure that all documents related to measurement data will be accountable when the project is completed. This program includes a serialized document number system and a document inventory procedure, all under the supervision of the Project Manager.

Documents included in the program are:

A. Bound Field Logbooks
B. Sample Identification Documents
C. Chain-of-Custody Records
D. Analytical Data from Laboratories

Unless prohibited by weather, waterproof ink is used in recording all data on serialized accountable documents.

B. SERIALIZED DOCUMENTS

The Project Manager is responsible for assigning the necessary serialized documents to project personnel and maintaining the project file.

C. FIELD LOGBOOKS

Field logbooks will be maintained for each sampling event. All field measurements and observations and field instrument calibrations are recorded in the logbooks with all pertinent information necessary to explain and reconstruct sampling operations. All site logbooks must be bound, contain numbered pages and be waterproof. Site logbooks will contain sampling locations, station numbers, dates, times, sampler's name, designation of sample as grab or composite, notation of the type of sample (e.g. groundwater, soil boring, etc.), preservative used, on-site measurement data and other field observations. When wells are being constructed, information on the design and installation of each well will be recorded in the logbook. Such well information may include:

> Date/time of sampling,
> Well depth (0.1 or -0.1 feet),

Each page of a logbook is dated and signed by all individuals making entries on that page. The On-Site Coordinator is responsible for ensuring that logbooks are present during all monitoring activities and are stored safely to avoid possible tampering.

[redacted]

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CHAIN OF CUSTODY RECORD

Project No.	Project Name	Laboratory	Report To

Samplers

Station No.	Date	Time	COMP	GRAB	Station Location	No. of Un- pres.	No. of HCL pres.	No. of HNO-3 pres.	No. of H2SO4 pres.	Test Parameters														Sample Description

RELINQUISHED BY:	DATE/TIME	RELINQUISHED BY:	DATE/TIME	RELINQUISHED BY:	DATE/TIME
RECEIVED BY:	DATE/TIME	RECEIVED BY:	DATE/TIME	RECEIVED BY:	DATE/TIME

D. SAMPLE IDENTIFICATION DOCUMENTS

The Project Manager will obtain serialized sample tags from the QA Officer (QAO) who will assign these tags to field personnel and maintain a log of the assignments. The sample tags must contain the project identification number (S.O. number), date, time and location of the sample collection, designation of the sample as a grab or composite, notation of the media sampled and type of sample (e.g. groundwater, soil boring, etc.) identification of preservatives used, any remarks, and the signature of the sampler. Sample tags should not be placed on the bottles so as to obscure any QA/QC data on the bottles. Sample tags should be filled out using waterproof ink.

Individuals are accountable for each tag assigned to them until it has been filled out, attached to a sample and transferred to another individual with the corresponding Chain-of-Custody Record. If any of these forms are lost, voided or damaged, it should be noted in the appropriate logbook immediately upon discovery.

At the completion of field sampling, all unused sample tags are returned to the Project Manager by the individual to whom they were originally assigned. The serial numbers of the returned items will be noted in the Project Manager's log.

E. CHAIN-OF-CUSTODY RECORDS

The accountability of a sample begins when it is taken from its natural environment. Chain-of-Custody (sample handling) records must be completed at the time of sampling (see Figure 3). The following Chain-of Custody must be implemented by the On-Site Coordinator (OSC) to assure sample integrity. Entries will be made in waterproof ink during sampling.

The samples are under custody of the OSC if:

> they are in his/her possession,
> they are in view after being in possession,
> they are locked up or sealed to prevent tampering, or
> they are in a designated secure area.

The Project Manager will obtain Chain-of-Custody records from the QAO and these will be assigned and accounted for in a manner similar to that for the sample tags. A sample Chain-of-Custody record is shown in Figure 3. When samples are transferred from a field sampler to laboratory personnel via common carrier, mail, etc., the original accompanies the shipment while the copy is signed by the OSC and forwarded to the Project Manager's file. Unused forms will be returned to the QAO.

The Chain-of-Custody record will include the following information: name of the person collecting the samples; date samples were collected; number, type and volume of container used; signature of the K. Singh & Associates person relinquishing samples to a non-Singh person (such as a Federal Express Agent); and the date and time of transfer noted. Any special instruction, such as rapid turn around time in the laboratory or analytical concern, should be noted in the remarks section of the custody form.

All containers should be sealed prior to, or if not practical, at a delivery service office prior to container transfer to the laboratory. The duplicate custody record will have the signature of the relinquished field technician and a statement of intent as to where the container(s) are going, as well as the time and date. The duplicate custody record then is placed in a plastic bag, taped to the underside of the container lid and the box is then closed. Filament tape is used to secure the container closed and at least two custody seals are to be affixed to the container in such a way that the container cannot be opened without breaking the seals.

When the container(s) reach the shipping agents office, the relinquishing individual will record all specific shipping data (airway bill number, office, time and date) on the original custody record. The original record is then to be delivered to the Project Manager. A complete custody record is comprised of the original and duplicate custody records. It is the responsibility of the Project Manager to ensure that all records are consistent and are made a part of the permanent job file.

The sample custodian at the laboratory will open the container, retrieve the duplicate record, and complete the "Received by" box of the record. The custodian also will fill in the "Method of Shipment" box with the shipper's name and airway bill number, where applicable.

F. CUSTODY SEALS

Custody seals are pre-printed adhesive-backed seals with security slots designed to break if they are disturbed. Individual sample bottles are sealed over cap by the sampling technician. Sample shipping containers (coolers, cardboard boxes, etc.,) are sealed in many places to ensure security. Custody seals are signed and dated before use. Once the sample(s) are received at the laboratory, the custodian will check to see that the seals on all containers are intact. Logbook entries will be completed to document arrival status of custody seals.

G. CORRECTIONS TO DOCUMENTATION

As previously noted, unless prohibited by weather conditions, all documentation in logs, field logbooks, sample tags, custody records and other data sheets are filled out with waterproof ink. None of the accountable serialized documents listed above are to be destroyed or thrown away even of they are illegible or contain inaccuracies which require a replacement document. No pages will be removed from the logbooks for any reason. If corrections are necessary, they must be made by drawing a single line through the original entry, so that the original entry can still be read, and writing the correction along side.

If an error is discovered on a sample tag, custody record or field logbooks, when possible the person who made the error should correct it. Corrections or insertions are made by inserting the word or abbreviation for "corrected," the date, and the correcting person's initials beside the correction. The procedure applies to words or figures added to a prior recorded statement.

If a sample tag is lost in shipment or a tag was never prepared for a sample(s) or a properly tagged sample was not transferred with a formal Chain-of-Custody record, the following procedure applies: a written statement is prepared detailing how the sample was collected, air-dispatched or hand-transferred to the field laboratory. The statement should include all pertinent information, such as entries in field logbooks regarding the sample, whether the sample was in the sample collector's physical possession or in the locked compartment until hand-transferred to the laboratory. Copies of the statements are to be sent to the Project Manager.

H. CONSISTENCY OF DOCUMENTATION

Before releasing any analytical sample results, the laboratory assembles and cross-checks information on corresponding sample tags, custody records, bench cards, analysis logbooks and sample entry logbooks to ensure that data pertaining to each particular sample is consistent throughout the record. A statement that all project evidentiary data in the laboratory's possession has been accounted for accompanies the transfer of any analytical data from the laboratories.

The Project Manager conducts a cross-check of evidentiary data in his possession (field logbooks, custody records, etc.) to ensure that information recorded corresponds to information from each or the laboratories and is consistent throughout the project record.

I. DOCUMENT NUMBERING SYSTEM AND INVENTORY PROCEDURE

In order to provide document accountability to the appropriate individuals, each of the document catagories discussed above features a unique serialized number for each item within the category. Traffic reports, sample tags and custody records are numbered before assignment by K. Singh & Associates by the Project Manager. All documents not covered by the above field logbooks are uniquely and serially numbered using the project code as part of the number when appropriate.

IX. DATA VALIDATION

Data validation is the review process necessary for validating laboratory analytical data. This data review is particularly important where the question of enforcement or litigation arises. The K. Singh & Associate Project Manager is responsible for accumulating the laboratory data package and overseeing the data validation process by the Quality Assurance Officer (QAO).

Upon receipt of a data package from a laboratory, the QAO will review and validate the data according to prescribed QA protocols. The QA protocols are used to determine the quality of the laboratory. The specific criteria to be evaluated include:

> Detection Limits
> Initial Instrument Calibration
> Continuing Instrument Calibration
> Tailing Factor
> Instrument Tune and Performance
> Preparation Blanks
> Reagent Blank
> ICP Interference Check
> Screening Chromatogram
> Spike Sample Analysis
> Duplicate Sample Analysis
> Narrative

Upon completion of review of the QA protocols, the QAO judges the data to be in one of four QA catagories, ranging from acceptable to unacceptable. These four catagories are defined in Table 2.

The data package must be searched manually to review sample results for completeness and to inspect for the QA protocol criteria. The QAO must document the QA protocol results then return the data package and QA results to the Project Manager.

TABLE 2

DATA EVALUATION SCORE CATAGORIES

ACCEPTABLE:	Data is within established control limits or the data which is outside established control limits does not affect the validity of the analytical results.
ACCEPTABLE	Data is not completely within established control limits. The deficiencies are WITH EXCEPTION: identified and specific data is still valid, given certain qualifications which are listed below.
QUESTIONABLE:	Data is not within established control limits. The deficiencies bring the validity of the entry data set into question. However, the data validity is neither proved nor disproved by the available information.
UNACCEPTABLE:	Data is not within established control limits. The deficiencies imply the results are not meaningful.

X. FIELD INSTRUMENTS

A. CALIBRATION AND PREVENTIVE MAINTENANCE

Activity Before Site Visit

Field meters to be used during the sampling, specifically pH and specific conductance/thermistor meters will be checked against K. Singh & Associates, Inc., laboratory meters to ensure proper calibration and precision response. Thermometers will be checked against a precision thermometer certified by the National Bureau of Standards. These activities will be performed by K. Singh & Associates Equipment Manager. In addition, buffer solutions and standard KCI solutions to be used to field-calibrate conductivity meters will be laboratory tested to ensure accuracy. The preparation data of standard solutions will be clearly marked on each of the containers to be taken into the field.

Organic vapor analyzers (OVA) and HNU meters will be checked and maintained according to the maintenance schedule. Both instruments are under contract to be checked and overhauled once annually or whenever problems arise. Batteries of both OVA and HNU meters should be charged to full capacity prior to use. The hydrogen supply for the OVA also should be filled and calibrated with Benzene prior to use in each sampling project or as necessary. Also, the OVA should be calibrated (methane) prior to each sampling project. The combustible gas/oxygen concentration meter must be charged to full battery capacity and calibrated prior to each use.

A log will be maintained by the K. Singh & Associates Equipment Manager for each field instrument. The log will document any problems experienced with the instruments, corrective measures taken, battery replacement dates, date used and by whom. Appropriate new batteries will be purchased and kept with the meters for replacement when necessary in the field.

All equipment to be utilized during the field sampling will be examined to certify that it is in operating condition. This includes checking the manufacturer's operating manuals and instructions with each instrument to ensure that all maintenance items are being observed. Field notes from previous sampling trips shall be reviewed so that any prior equipment problem notations are not overlooked and so all necessary repairs to equipment have been carried out. A spare electrode will be sent with each pH meter that is to be used for field measurements.

Two thermometers will be sent to each field site where measurement of temperature is required, including those sites where a specific conductance/thermistor meter is required.

Activity At Site

The pH meter is to be calibrated a minimum of twice each day using at least two different pH buffer solutions expected to bracket the pH range of field samples. Rinse the probe thoroughly between buffer measurements with distilled water and again after calibration is completed. Record in the field logbook what buffer solutions were used. When the meter is moved, check the pH reading by measuring the pH value of a buffer solution closest to the expected range of the sample. If the reading deviates from the expected range by more than 0.1 standard units, recalibrate the instrument as described above. If unacceptable deviations still occur, consult the operating manual for remedial course of action.

The specific conductance/thermistor meter is less likely to exhibit random fluctuations and will only require daily checks against a known KCI solution, which should be chosen to be within the expected conductivity range. Note that specific conductance is temperature-dependent and therefore the meter reading must be adjusted to reflect the temperature of the standard solution. Thoroughly rinse the probe with distilled water after immersing in a KCI standard solution with both the conductivity probe and a mercury thermometer.

Before use, visually inspect the thermometer to assure there is no break in the mercury column. If there is a break, visually inspect the spare thermometer. If both thermometers have a break in the mercury, neither can be used until the break is corrected. This may be done by cooling the bulb until the mercury is all contained in the bulb.

Visually inspect each field instrument prior to field activities to detect any damage of operational problems. Check instrument operations against known solutions or gases prior to beginning field work. Refer to instrument manuals for trouble-shooting methods.

Instrumentation problems identified in the field should be relayed to the Project Manager who will in turn inform the Equipment Manager.

B. ANALYTICAL METHODS

All field measurements will be obtained in accordance with "Handbook for Sampling and Sample Preservation of Water and Wastewater", EPA-600/4-82-029, September 1982 or "Test Methods for Evaluating Solid Wastes", SW-846, July 1982. The quality assurance procedures for field analysis and equipment are detailed in the documents cited.

REFERENCES

1. Stein, D., (Ed.), The Random House College Dictionary, Revised Edition, p.1080, 1980.

2. Driscoll, F.G., Groundwater and Wells, Second Edition, p.268-270, 1986.

3. Perket, C.L., (Ed.), Quality Control in Remedial Site Investigation, 1986.

4. USEPA, RCRA Groundwater Monitoring Technical Enforcement Guidance Documents, September 1986.

5. USEPA, Instructional Guide for Reviewing Contractor Laboratory Generated GC/MS Data, Draft November 1982.