QUALITY ASSURANCE / QUALITY CONTROL PLAN
SANITARY TRANSFER & LANDFILL
DELAFIELD, WISCONSIN

1135 Legion Drive
Elm Grove, Wisconsin 53122

K. SINGH & ASSOCIATES
INCORPORATED

Engineers and Environmental Management Consultants

K. SINGH & ASSOCIATES, INC.

Engineers and Environmental Management Consultants

1135 Legion Drive, Elm Grove, WI 53122 (414) 821 - 1171 FAX (414) 821 - 1174

May 25, 1994

Ms. Margaret M. Graefe
Hydrogeologist, Environmental Repair Program
Wisconsin Department of Natural resources
4041 N. Richards Street
Milwaukee, WI 53212

Job # 4025

Subject : Quality Assurance / Quality Control Plan for Sanitary Transfer & Landfill Operation & Maintenance Contract, Delafield, Wisconsin

Dear Ms. Graefe :

We are pleased to respond to your letter of May 10, 1994 , regarding Quality Assurance / Quality Control Plan for the referenced project. Our plan is attached with this letter.

We appreciate your concern that you have not received our quality assurance / quality control plan. The plan was not forwarded to you earlier because the plan was already submitted to the Department for the same project in the past. Because, we have a new project manager, we should not have taken it for granted. I take full responsibility for this error on our part. Please be assured that we will take necessary precautions in the future.

The information required under Section 01400 and 01500 are included in this report. As per your discussion with Dr. Raghu Singh, we will prepare a plan for air quality sampling for your approval.

We will appreciate a prompt review of the plan. Please call us if you have any questions regarding this submittal.

Sincerely,

K. SINGH & ASSOCIATES, INC.

Pratap N. Singh

Pratap N. Singh, Ph.D., P.E.
Project Manager

cc : Marie Stewart / Program Coordinator, WDNR

Raghu B. Singh

Raghu B. Singh

Dilip K. Singh

Pratap N. Singh

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SECTION I. QUALITY ASSURANCE / QUALITY CONTROL PROGRAM

Purpose:

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.

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. Quality Control is defined as a "system for verifying and maintaining a desired level of quality in a product or process by careful planning, continued inspection, and corrective action where required" (1). 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 analysis.

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.

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, and

> Ensuring that all samples are sufficiently documented to maintain indisputable tracking of each sample.

SECTION II. ORGANIZATION OF PROGRAM

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.

Project Manager Responsibilities:

Dr. Pratap Singh, Project Manager, has responsibility over all field personnel to ensure that site activities run smoothly and that the QA/QC procedures described herein are followed. 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/she 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 project manager will ensure that resultant analytical data undergoes proper QA/QC evaluation upon receipt by the QAO.

Site Personnel Responsibilities:

Quality Assurance Officer (QAO)

Dr. Dilip Singh has been assigned as Quality Assurance Officer 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 is 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.

Hydrogeologist

Mr. Bret Swensen has been assigned as Hydrogeologist for this project. He will be responsible for the study of geology and hydrogeology of the site.

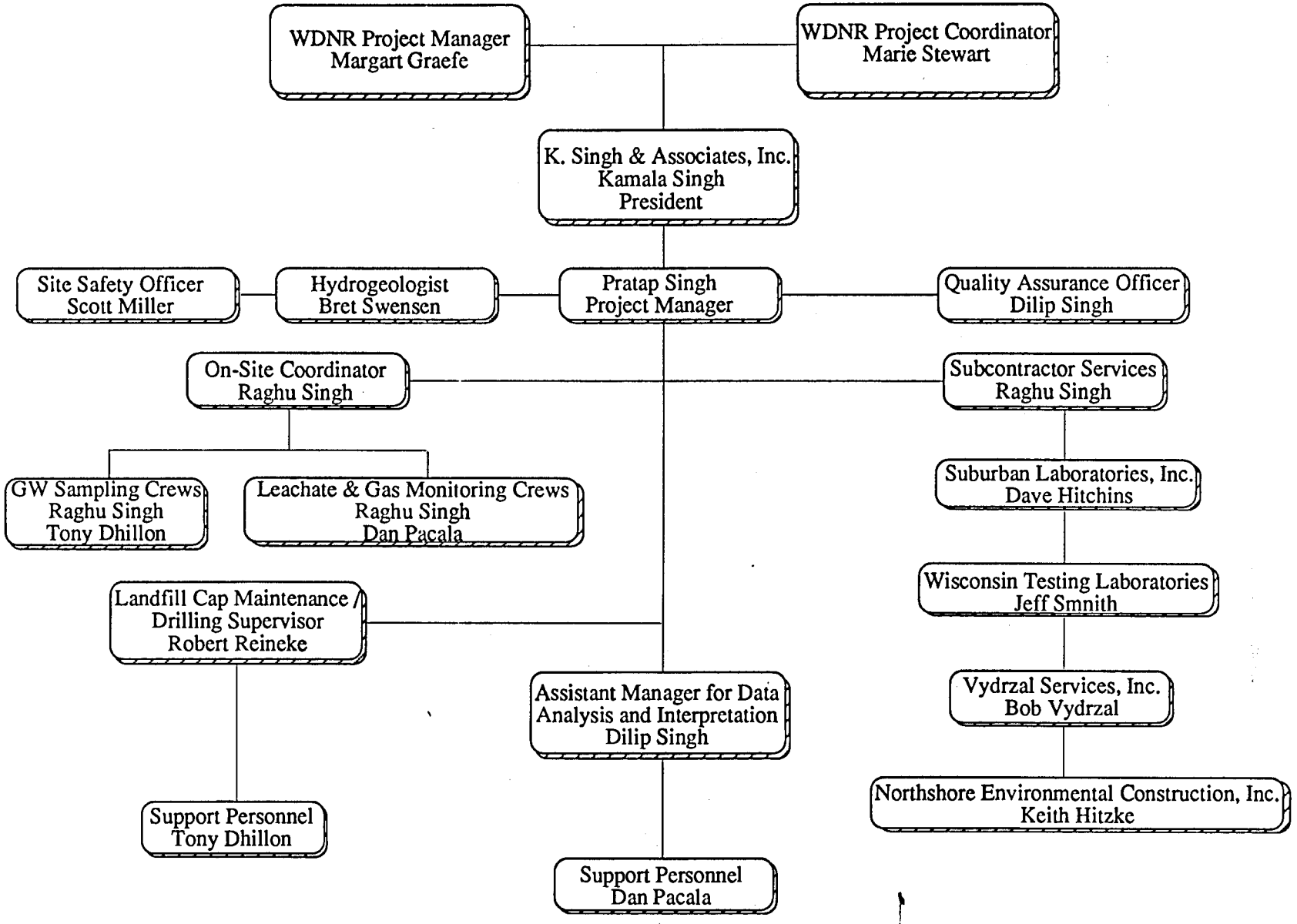

FIGURE 1. TYPICAL PROJECT ORGANIZATION

Site Safety Officer (SSO):

Mr. Scott Miller will work as Site Safety Officer 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.

On-Site Coordinator (OSC):

Dr. Raghu Singh will work as On-site Coordinator. He will be 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.

Groundwater Sampling Crews:

Groundwater sampling crews are responsible for sampling of on-site and off-site wells.

Leachate and Gas Monitoring Crews:

Leachate and gas monitoring crews are responsible for leachate and gas monitoring on the site.

Landfill Cap Maintenance / Drilling Supervisor:

Mr. Robert Reinke will work as landfill cap maintenance / drilling supervisor. He will be responsible for landfill cap repair any other drilling supervisory work. The supervisor is responsible for monitoring the progress of the contractor, documenting subsurface conditions encountered during cap repair, supervise compaction of the clay and placing sod, and collecting samples and ensuring that the construction and installation of site investigation monitoring wells and piezometer is in accordance with the site-specific field sampling procedures manual.

Subcontractor Services:

Dr. Raghu Singh will be responsible for subcontractor services. Four subcontractors are as follows:

Suburban Laboratories of Wisconsin, Inc. (WDNR Certification # 241178850) is responsible for groundwater analyses. Mr. Dave Hitchins is the contact person.

Wisconsin Soil Testing Laboratories of Menomonee Falls, Wisconsin, is responsible for testing of physical properties of clay to be used as top cover. Mr. Jeff Smith is the contact person.

Vydrzal Services, Inc. of Ixonia, Wisconsin, is responsible for mowing, snow plowing, and placing salt on the access road. Mr. Bob Vydrzal is the contact person.

Northshore Environmental Construction, Inc. of Germantown, Wisconsin, is responsible for placing clay cap, mulching, and seeding top of the landfill cover. Mr. Keith Hitzke is the contact person.

Data Analysis and Interpretation:

Dr. Dilip Singh is responsible for data analysis and interpretation. He will be assisted by Mr. Dan Pacala.

Qualifications of K. Singh & Associates, Inc. Staff:

Kamala Singh, Pratap Singh, Dilip Singh, Raghu Singh, Robert Reinke, Bret Swensen, Scott Miller, Tony Dhillon, and Dan Pacala are the staff members from K. Singh & Associates, Inc., who are assigned for the project. A brief description of their qualifications and experiences is included in Appendix A.

Qualifications of Suncontractors' Staff:

Wisconsin Testing Laboratories of Menomonee Falls; Northshore Environmental Contractors, Inc. of Germantown; Suburban Laboratories, Inc. of Waukesha; and Vydrzal Services of Ixonis, Wisconsin, are the subcontractors for the site. A brief description of qualifications and experiences of Wisconsin Testing Laboratories, Northshore Environmental Contractors, and Suburban Laboratories, are included in Appendix B.

Mr. Bob Vydrzal will be responsible for mowing, snow plowing, and placing salt on the ice.

SECTION III. MONITORING WELL CONSTRUCTION, INSTALLATION, AND DEVELOPMENT

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 piezometer 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.

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 record in the field log book.

Monitoring wells shall be installed in accordnace with the standard proccedures (2 & 3).

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. 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.

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 feet 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.

SECTION IV. SAMPLING CONTROL PROCEDURES

Introduction:

The purpose of this section is to ensure QA/QC in sampling and analysis 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. Periodically, the project manager shall 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:

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. Standard quality control procedures shall be used for the site (4).

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 not be labeled as such, so that it remains obscure from the other samples when being analyzed The field blank should be transported 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. At the minimum, 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.

SECTION V. SAMPLE MANAGEMENT AND COLLECTION

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.

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.

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 VOC's, groundwater, surface water, air, soils and sediments 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 Sampling:

Groundwater sampling for on-site and off-site wells will be conducted in accordance with the contract document (5). There are presently eight groundwater monitoring wells, lysimeter well (LP-2), and one leachate manhole on the site. Eight on-site wells will be sampled semi-annual.

There are twenty five off-site private wells which will be sampled quarterly, semi-annual, and annual as mentioned in the contract document (5). Groundwater monitoring shall be conducted consistent with RCRA Groundwater Monitoring Technical Enforcement Guidance and other methods (6, 7, 8, & 9).

At the end of each day of sampling, samples will be delivered, on ice, to the certified laboratory using standard chain of custody procedures. Test results shall be submitted to the Department using turn around documents which will be provided by the Department. Data not entered on the turn around documents will be submitted to the Department in an attachment.

Groundwater sampling for the existing on-site wells will be conducted as follows:

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. Samples for analysis of volatile compounds will not be filtered. 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) When sampling water for volatile organics, care must be exercised to prevent loss of voc's through evaporation. Precautionary measures to be taken include:
   - > Preclude aeration of the sample with any gas.
   - > Fill bottle to capacity with sample and eliminate air bubbles.
   - > Cool samples to +4 C in the temperature-control chest.
   - > Analyze as soon as possible after sampling.

11) 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.

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

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

Leachate Monitoring:

Leachate will be collected from the leachate manhole wetwell with groundwater sampling. Sample will be analyzed in accordance with the Department requirement. The procedure for the leachate collection is the same as the procedure followed for groundwater sampling. However, leachate wet well will not be surged and purged.

Gas Monitoring:

Gas venting wells and blowers will be monitored weekly for level of methane using MSA make Spotter Digital Methane Detector.

Air Quality Testing:

Air quality testing at the site shall be conducted in accordance with the Contract Documents (5). A work plan for air quality testing shall be submitted for WDNR approval.

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 1 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.

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.

Management of Wastewater:

Wastewater generated during groundwater sampling will be disposed of into 10,000 gallon leachate holding tank.

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	2-40-ml amber glass bottles, vials with Teflon-lined septum
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.

SECTION VI. SAMPLE DOCUMENT CONTROL

Introduction:

The goal of the Document Control and Recordkeeping 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.

Serialized Documents:

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

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 construction,
> Drilling method and drilling fluid used,
> Well location (0.1 or -0.1 feet),
> Borehole diameter and well casing diameter,
> Well depth (0.1 or -0.1 feet),
> Drilling and lithologic logs,
> Casing materials.

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.

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.

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 2). 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 2. 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.

R. SINGH & ASSOCIATES, INC.
Engineers and Environmental Management Consultants
1135 Legion Drive, Elm Grove, Wisconsin 53122, (414)-821-1171 FAX (414)-821-1174

CHAIN OF CUSTODY RECORD

Project No.	Project Name	Laboratory	Report To

Samplers										Test Parameters								Sample Description
Station No.	Date	Time	COMP	GRAB	Station Location	No. of Unpres	No. of HCL pres.	No. of HNO_3 pres.	No. of H_2SO_4 pres.									

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

VI-3

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.

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.

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.

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.

Document Numbering System and Inventory Procedure:

In order to provide document accountability to the appropriate individuals, each of the document categories 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.

SECTION VII. 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 categories, ranging from acceptable to unacceptable. These four categories 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.

The QAO will evaluate the laboratory data consistent with the QA/QC Program of the respective laboratory. A copy of the QA/QC Program for groundwater quality for Suburban Laboratories are included in Appendix C.

Table 2

DATA EVALUATION SCORE CATEGORIES

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 WITH EXCEPTION:	Data is not completely within established control limits. The deficiencies are 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.

SECTION VIII. FIELD INSTRUMENTS

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 be filled and calibrated with methane 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 portable, triple landfill gas analyser (CEA Instrument Model LFG-20) shall be used to measure the percentage of carbon dioxide, methane gas, and oxygen in the landfill gas. The gas analyser measures the concentrations of carbon dioxide and methane using non dispersive infrared absorption. The range for measurement varies from 0 % to 100 %. The oxygen concentration can be measured using this analyser between 0 and 25 %.

A digital methane detector shall also be used to measure low concentrations of methane. The meter is capable to measure 5 % methane. For greater concentrations of methane, the calibration curve becomes nonlinear and in such cases LFG-20 gas analyzer shall be used.

A pitot tube shall be used to measure air velocity. Air flow rate shall be determined after air velocity has been determined. A Dwyer Pitot Tube (Model 3T309) will be used in combination with a Dwyer Magnehelic Gauge (Model W27E) for the velocity measurement.

The pressure will be measured using Dwyer Magnehelic Gauges of varying ranges. The temperature will be measured using a Fluke type K thermocouple connected to a Fluke multimeter.

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.

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.

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.

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.

SECTION IX. SITE SAFETY CONSIDERATIONS

The employees will be trained in the proper material handling; proper methods for the use, storage and disposal of decontamination fluids; preventive maintenance of supporting equipment; requirements and use of respirators; and appropriate response to personal contamination or emergency conditions. Site safety considerations are included in the Contract Document (5).

The Site Safety Plan will be kept by the personnel on the site. First aid equipment should be always kept in the vehicle. However, some information required to meet any emergency situation are given below:

Immediate Emergencies:

Fire: 367-2600
Local Police: 367-2600
Medical Emergencies: 367-2600

Ambulance: 367-2600
State Police: 1-800-321-4400

Nearest Hospital: - Waukesha Memorial; Hospital Telephone: 544-2011

SECTION X. LEACHATE COLLECTION AND MANAGEMENT

The leachate collection system consists of the leachate collection manhole, a 6,000 gallon leachate collection tank, a 10,000 gallon leachate storage tank, and a concrete loading tank.The leachate collection system is equipped with a control system to prevent overflow of the tanks. The control system includes level control floats in the leachate collection manhole, the 6,000 gallon tank, and the 10,000 gallon tank. A schemetic diagram of the leachate collection system is shown on Figure 3. A detailed description of the leachate collection and management system is included in the Contract Documents (5).

Leachate from the tank is pumped periodically by a private hauler and is disposed of at the City of Waukesha Wastewater Treatment Plant. Leachate loading area is so designed that if a spill a spill occurs during pumping, the leachate will drain back into the 10,000 gallon tank.

A record of pumping of leachate from the tank is maintained. Also a periodic inspection shall be conducted by our staff to mitigate any concerns related with spill of leachate. The staff assigned to conduct this task has adequate health and safety training including technical knowledge to manage the leachate collection in an efficient manner.

A private hauler, Advanced Waste Services of Milwaukee, has been awarded a contract to haul leachate (wastewater) to the City of Waukesha Wastewater Treatment Plant. The hauling route for wastewater disposal shall be consistent with the requiremnts setforth by the Department in the contract for the waste hauler. A sketch of hauling route is included in Appendix D.

A permit to accept wastewater from the Delafield landfill has been in place. K. Singh & Associates, Inc. shall seek necessary permits from the City of Waukesha, as required.

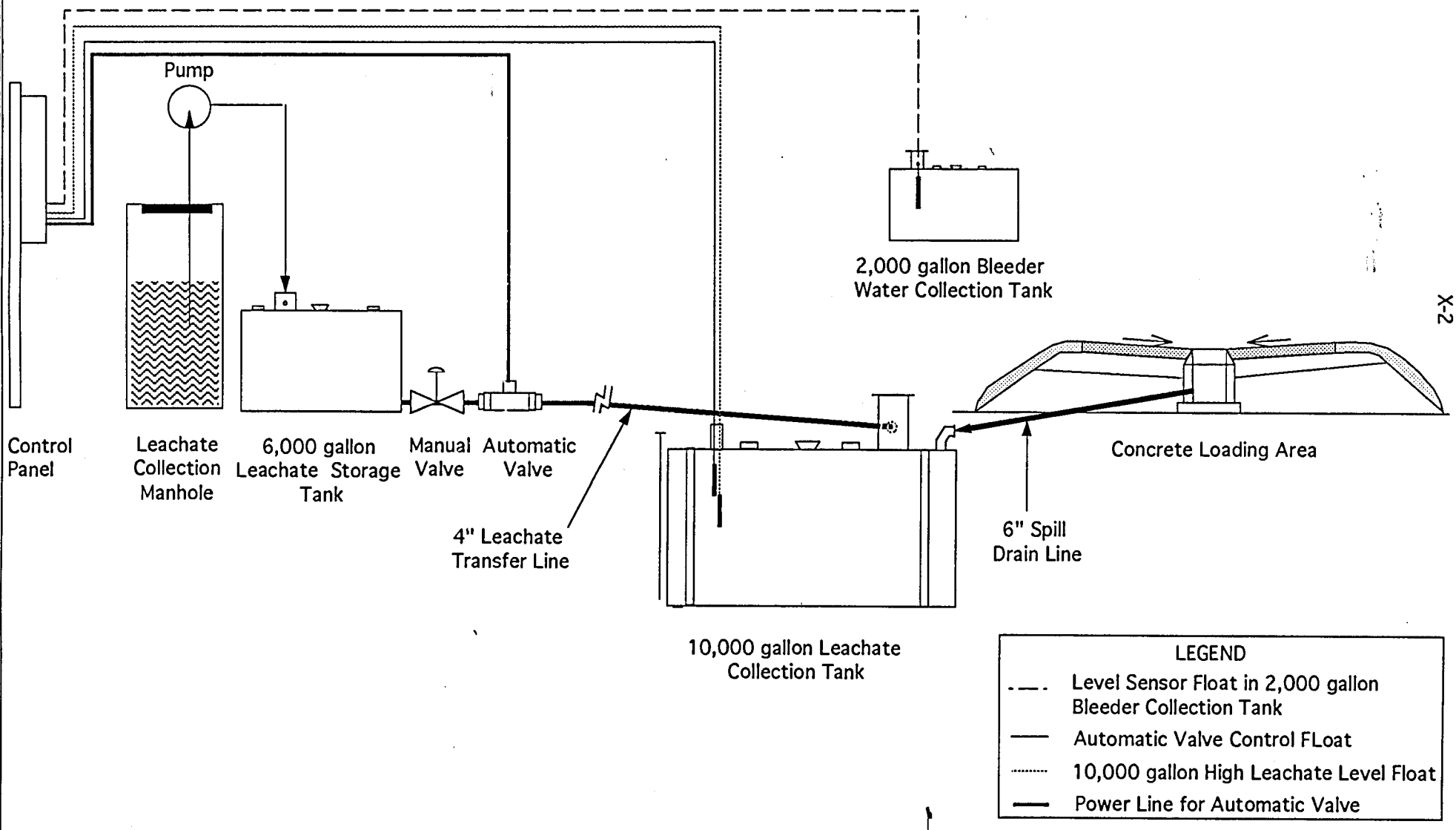

Figure 3. Schematic of Leachate Collection and Monitoring System

SECTION XI. LANDFILL CAP REPAIR & MAINTENANCE

Landfill Cap:

The surface of the landfill has experienced settlement because of the decomopsition of waste constituents in the landfill. Approximately 18 small area have experienced settlement (refer to Figure 4). Those were surveyed by Uttech Landsurveying of Beaver Dam on April 26, 1994. These areas accept surface water from the top of the landfill and eventually increase the formation of leachate.

Leachate generation may be mitigated by placement of clay to fill the low spots. Placement of clay fill will improve surface water drainage on the site and minimize the infiltration of the surface water into the landfill. Assuming that there will be no extensive repair of cap, and the low spots shall be filled with clay, volume of clay fill may be lower than 16,500 cubic yards (Refer to Table 3). Please note that Table 3 is just an estimate of volume of clay fill and is likely to change.

The specification for clay source is as follows :

1) Maximum permeability of 1X 10-7 cm / s,

2) Clay shall have fines passing sieve #200 more than 50 %,

3) Clay shall have a liquid limit of 30 or greater,

4) Clay shall have a plasticity index of 15 or greater and

5) Clay shall be compacted to no less than 85 % Standard Proctor Density.

A clay source has been identified by us. The clay has been determined to have 64 % fines. The liquid limit and Plasticity Index (PI) were determined to be 62 and 37, respectively. Testing was conducted by Wisconsin Testing Laboratories, Menomonee Falls. The test results indicate that the clay source meets the requirements specified in the Technical Specifications.

Standard Proctor Density testing indicates that the maximum density is 101.9 pounds per cubic feet and optimum moisture content is 20.1 %. A minimum 80 % Standard Proctor Density shall be 81.52 pounds per cubic feet. The coresponding moisture contents shall vary over a wide range.

Soil samples shall be collected for determining the fine content, liquid limit and plasticity index per 500 cubic yards. Soil samples shall be tested by Wisconsin Testing Laboratories, Menomonee Falls.

Soil shall be placed and compacted in eight inch lifts. Compaction and moisture contents shall be tested on site using a density meter on a 20 foot by 20 foot grid. Compaction testing shall be performed on the soils at a minimum of two tests per lift per hole. Compacted soils that do not meet the requirements shall be recompacted.

Table 3

Minimum Volume and Tonnage Required to Bring Site Up to Existing Grades

Delafield Landfill

Hole #	Approximate Area (ft^2)	Depth (ft)	Volume (ft^3)	Cubic Yds	Total Tons	Clay Tons	Topsoil Tons
1	5,460	3	16,380	607	971	809	162
2	35,100	1.5	52,650	1,950	3,120	2,080	1,040
3	8,450	2	16,900	626	1,001	751	250
4	6,240	1	6,240	231	370	185	185
5	10,400	1	10,400	385	616	308	308
6	10,010	2	20,020	741	1,186	890	297
7	4,680	1	4,680	173	277	139	139
8	17,290	2	34,580	1,281	2,049	1,537	512
9	2,765	1.5	4,148	154	246	164	82
10	26,780	4	107,120	3,967	6,348	5,554	793
11	5,850	3	17,550	650	1,040	867	173
12	7,670	1	7,670	284	455	227	227
13	5,005	1	5,005	185	297	148	148
14	6,540	1	6,540	242	388	194	194
15	6,540	1	6,540	242	388	194	194
16	4,420	1	4,420	164	262	131	131
17	3,640	1	3,640	135	216	108	108
18	3,120	1.5	4,680	173	277	185	92
Total	169,960	---	329,163	12,191	19,506	14,470	5,036

Note: According to NR 504.07 six inches of topsoil is required for final cover.

Additional topsoil may be required for areas that need reseeding.

Top Soil and Seeding:

The area that is proposed to be filled with clay shall need to be filled with six inches of top soil capable to support vegetative growth. The filled area shall be vegetated per State of Wisconsin DOT Standard Specification for Road and Bridge Construction. Accordingly seed is applied at a rate of three pounds per 1,000 square feet. Approximately one inch of mulch shall be applied uniformly immediately following seed application. The technical specifications call for 8,500 cubic yards of top soil.

A minimum of 5,000 cubic yards of top soil may be required as indicated in Table 3. In addition, other areas that show lack of vegetation shall also be vegetated as described in preceeding paragraph. In such areas, clay fill shall not be used.

Mowing, Plowing, and other Maintenance:

The landfill shall be mowed at least once per year as indicated in the Technical Specification. Additional mowing may be conducted upon approval of the WDNR project manager.

Access road shall be plowed four times a year to maintain access for pumping and hauling leachate from the leachate holding tank. Additional ploughing shall be conducted as required to maintain access.

Maintenance of blowers, structures and other components of the projects shall be performed as required by the Department.

SECTION XII. REPORTING

The reporting documents are included in Appendix E.

SECTION XIII. MODIFICATION OF PERMANENT ELECTRICAL SYSTEMS AND TELEPHONE LINES

The blower #2 has been damaged due to malfunction of motor. K. SINGH & ASSOCIATES, Inc. is planning to replace the gas extraction system at station #2 according to the plan submitted to the WDNR on May 24, 1994. No other alteration to the electrical system is planned at this time. Any needed alterations will be done at the approval of the WDNR project manager.

The telephone line is installed for the remote monitoring of the leachate collection system. There is no plan to make alterations to the existing telephone system. The remote monitoring system is programmed to take the following action when the leachate tank gets full:

(1) It dials the office of K. SINGH & ASSOCIATES, INC. with a voice message that the leachate tank is full.

(2) It dials the office of Advanced Waste Services with a voice message that the leachate tank is full.

The system can be programmed to relay messages to additional locations. Any change in program shall be done at the approval of the WDNR project manager

SECTION XIV. 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. Monitoring Well Installation Guidelines, NR 141, Wisconsin Administrative Code, 1990.

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

5. Wisconsin Department of Natural Resources, Contract Documents (Volume 2), Sanitary Transfer and Landfill, Delafield, Wisconsin, April 30, 1993.

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

7. LUST & Petroleum Analytical and Quality Assurance Guidance (PUBL-SW-130-93), WDNR, July 1993.

8. Test Methods for Evaluating Solid Waste, Physical / Chemical Methods, 3rd Edition, 1986, EPA SW846.

9. Methods for Chemical Analysis for Water and Wastes, Revised March 1983, EPA 600/4-79-020.

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

LIST OF APPENDICES

LIST OF EXHIBITS

Appendix A
Qualifications of Staff

KAMALA SINGH
President

Professional Experience: Ten years

Ms. Singh is a quality assurance and quality control manager with extensive experience in Clean Water Act, Underground Storage Tanks, environmental assessments, remedial investigation and closure and post closure monitoring projects. She has reviewed over twenty reports encompassing broad areas of solid waste and hazardous waste management. Recently, Ms. Singh has participated actively in restoration of surface impoundments used for storage of treated wastewater.

In the capacity of the President of K. Singh & Associates, Inc., Ms. Singh is responsible for day to day operations of the company, proposal preparation, client interaction and near and long-term strategic planning for the firm. In addition, she ensures that a quality control/quality assurance review is conducted for every report, consistent with the guidelines of the firm.

SELECTED TECHNICAL EXPERIENCE

Ms. Singh has performed numerous quality control/quality assurance reviews for environmental projects undertaken by K. Singh & Associates, Inc. She has reviewed hydrogeologic investigations for underground storage tanks, surface impoundments, and landfills; reviewed remedial action plans and closure plans for land disposal facilities; and coordinates actively in day to day operations and management of the environmental projects.

Ms. Singh is experienced in groundwater monitoring at land disposal facilities including underground storage tanks. She is involved in well development and well sampling projects for the firm. Ms. Singh has been instrumental in the development of the quality control/quality assurance program for the firm.

Ms. Singh's involvement in environmental projects have made her familiar with the environmental regulations both at state and federal level.

Ms. Singh has a strong background and experience in the financial management of the firm. She is responsible for the operations and management of the firm which includes short-term and long-term goal setting, strategic planning, and corporate growth. Ms. Singh has provided leadership to this firm for over six years.

Prior to starting her own business, Ms. Singh worked for DKI Group Engineers, Inc., in Chicago for three years. She was associated with the vertical and horizontal alignment of a 15 mile long and 350 feet deep conveyance and storage structure.

EDUCATION

One year Graduate Level work towards M.S. Program in Economics at Magadh University, Bihar, India

B.A. from Magadh University, Bihar, India

Course work in Computer Programming at MATC and MBTI

PROFESSIONAL BACKGROUND

K. Singh & Associates, Inc.	President
DKI Group Engineers, Inc.	Senior Engineering Technician

PRATAP N. SINGH, Ph.D., P.E. Professional Experience: 19 years
Project Manager

Dr. Singh is a senior engineer and manager with extensive experience in CERCLA, RCRA, and CWA projects. He has prepared, managed and reviewed over 500 projects relative to geologic, hydrogeologic, and geotechnical engineering investigations which encompass; siting, design, construction quality assurance documentation, and closure of solid and hazardous waste containment facilities; review of remedial design and cleanup projects both under RCRA and CERCLA; evaluation of cleanup technologies in hazardous waste management including thermal destruction, biodegradation and solidification; environmental risk assessment; expert testimony; and modeling of contaminant transport through porous of fractured media. Dr. Singh is also involved in the development of the elements of closure plans addressing the perpetual care and maintenance of low-level radioactive waste disposal facilities, radiation monitoring and public health risk assessments. Dr. Singh's recent experience is in the management of UST sites. In the last four years, he has managed over 100 UST projects in the State os Wisconsin.

Dr. Singh had performed environmental management services relative to closure of hazardous waste management facilities, RCRA Facility Assessments and Part B Permit Application review throughout the ten regions of the U.S. EPA. He has worked on over 100 projects. A significant number of these projects have been completed for Region V U.S. EPA. This involvement with the professional staff of Region V has helped in developing an understanding of the requirements and expectations of the staff.

SELECTED RECENT TECHNICAL EXPERIENCE

Dr. Singh has been actively involved in the development of a conceptual closure design methodology and perpetual care and maintenance program for the Richland facility operated by U.S. Ecology Inc., at the Hanford Reservation of the Department of Energy in the State of Washington. Dr. Singh performed an assessment of the transport of radionucleides by particulates through the process of wind erosion. This assignment included environmental radiation monitoring consisting of TLDs, soil and vegetation sampling and comparison of radiation levels with the maximum permissible dose rates established by NRC of the transport of radioactive emission in the soils.

Dr. Singh has been active in reviewing Part B Permit Applications and Closure and Post-Closure Permit Applications for completeness and technical adequacy. He has also performed Quality Control/Quality Assessments for Part B Permit Application reviews. He has performed numerous reviews of closure and post-closure plans under current EPA contract as well as for commercial clients. These projects have typically involved reviews of closure design and groundwater monitoring requirements.

He has also reviewed, managed and performed quality control reviews for numerous RCRA Facility Assessment Projects.

Dr. Singh has studied trends in the hazardous waste industry and performed detailed reviews of Superfund Innovative Technology for cleanup of hazardous wastes. These technologies included thermal destruction, biodegradation of waste by microorganisms and waste stabilization.

Dr. Singh has performed risk assessments for twelve solid and hazardous waste facilities relative to siting release pathways, design, operations, quality assurance for construction closure, health and safety, and contingency plans.

Dr. Singh performed a hydrogeologic evaluation of a Superfund site and made assessment of effectiveness of aquifer cleanup program consisting of air-stripping towers for a private client.

Dr. Singh was an Adjunct Professor at UW-Milwaukee and taught courses in Solid and Hazardous Waste Management, Groundwater Remediation and Air Quality.

Dr. Singh was the Project Manager for the State of Wisconsin's Havenwoods National Forest Hazardous Waste Site. He was responsible for the project scope development, fee negotiation with the client, design and installation of groundwater monitoring wells, landfill cover integrity evaluation and preparation of a hydrogeologic report.

Dr. Singh was the Project Manager for Schmulz Superfund Site. In the project, he was responsible for the installation of groundwater monitoring wells and the development and implementation of health and safety protocol for the project.

Dr. Singh has conducted a waste-liner compatibility study, designed leachate and gas vapor collection systems for numerous hazardous waste facilities. His design for gasoline fumes recovery has been implemented on several projects resulting in dramatic improvement in the subsurface environment.

His other assignments included a review of hydrogeologic reports, including potential migration of pollutants into groundwater, installation of monitoring wells and performing pump tests.

Dr. Singh has prepared designs and site feasibility reports for solid waste disposal facilities, performed site inspections and quality control during construction in compliance with applicable requirements. He prepared over 400 reports for bridges, silos, machine foundations, industrial buildings and solid waste facilities.

Dr. Singh was the Regional Manager and Vice President of the DKI Group Engineers in Milwaukee. In this capacity, he was involved in the development of twelve geotechnical engineering design reports for the Deep Tunnel and Shaft Projects in Milwaukee. Dr. Singh has prepared over 150 geotechnical design reports for bridges, highways, landfills, and interceptors.

Dr. Singh served as the Project Engineer under the aegis of the Program Management office for the Sewer System Evaluation Study Project. His responsibilities on the assignment included scheduling and reviewing monthly test results, writing the report for the $20 million project, and writing and reviewing technical memoranda in the area of groundwater infiltration and inflow into the sewer system.

EDUCATION

Ph. D. Soil and Water Engineering	University of Illinois
M.S. Soil and Water Engineering	University of Manitoba, Canada
B.S. Agricultural Engineering	College of Engineering, Pantnagar, India

PROFESSIONAL BACKGROUND

K. Singh & Associates, Inc.	Executive Vice President
A.T. Kearney, Inc.	Manager, Environmental Focus Group
Miller Consulting Engineers	Chief Hydrogeologist and Geotechnical Engineer
DKI Group Engineers	Regional Manager and Vice President
University of Wisconsin	Adjunct Professor; Civil Engineering Department
College of Engineering, Pantnagar	Research Engineer

PROFESSIONAL MEMBERSHIPS

Registered Professional Engineer - Wisconsin
American Society of Civil Engineers
Urban Subsurface Drainage Committee, ASCE
Environmental Concerns in Geotechnical Engineering, ASCE
International Society of Soil Mechanics and Foundation Engineering
Association of Soils and Foundation Engineering
American Well Water Association

PUBLICATIONS

Singh, P.N. and Hana, S.L.A., 1988, "Wind Erosion Control of Low-Level Radioactive Waste Sites". A paper accepted for publication in the proceedings of International Erosion Control Association's Conference in New Orleans.

Singh, P.N. et. al., 1988, "Site Closure and Perpetual Care of a Low-Level Radioactive Waste Disposal Facility in Arid Climate". A paper presented at Hazardous Waste and Hazardous Materials Conference in Las Vegas, Nevada, March 1988.

Singh, P.N., "Case Studies of Groundwater Quality in the Vicinity of Solid Waste Disposal Facilities". A paper presented at the Hazardous Tech International Conference and Exhibition, Denver, Colorado, August 1986.

Singh, P.N., "A Case Study of Groundwater Contamination in the Vicinity of a Landfill". A paper presented at the International Symposium on Management of Hazardous Chemical Waste Sites, Winston-Salem, North Carolina, October 1985.

Singh, P.N., "Response of Buried Flexible Plastic Conduits Under Loading". A paper published in the proceedings of the Intermatopma; Conference on the Advances in Underground Pipeline Engineering, Madison, Wisconsin, August 1985.

Singh, P.N., Tatioussian, S.V. and Flagg, C.G., co-authors,"Geotechnical Properties of Milwaukee Area Soils", a special publication of ASCE, Geotechnical Engineering Division, Geologic Environmental and Material Properties, Houston, Texas, October 17, 1983, pp 269-307.

DILIP K. SINGH, Ph.D., P.E. Professional Experience: 15 years
Senior Project Engineer

Dr. Singh is a senior project engineer with extensive experience in Air Pollution Control and Pollution Prevention. His key responsibility is in air management. As a project leader, he is responsible for monitoring soil remediation operations and interpretation of test results for those projects. He is responsible for quality control and quality assurance for the test results related to air monitoring. In addition to overseeing the soil remediation operations at LUST sites, Dr. Singh is also involved in Industrial Air Pollution Control.

Prior to joining K. Singh & Associates, Inc., Dr. Singh taught Chemical Engineering at Youngstown State University. He developed and taught courses on Industrial Pollution Control, Accident and Emergency Management, and Waste Water Treatment. He has co-authored workbooks on Accident and Emergency Management and Pollution Prevention. He has several publications in the areas of process modeling and process control.

SELECTED RECENT TECHNICAL EXPERIENCE

Dr. Singh is project leader for soil remediation operations for several LUST sites. He is involved in monitoring and interpretating test results from vapor extraction systems. He is responsible for monitoring air emissions, keeping the emission quality within regulatory requirements, and preparing status reports for regulatory agencies for soil remediation operations. He has prepared air permit applications and emission inventory reports for these operations.

Dr. Singh has prepared a regulatory compliance report for Ozaukee County Highway Department for its asphalt mix plant. He is project engineer for remediation operation for petroleum contaminated soil in the plant. He has also prepared emission inventory reports for the asphalt mix plant.

Dr. Singh is involved in the operation and maintenance of automatic and remote control systems for groundwater and soil remediation systems. He has supervised the installation and operation of an automated groundwater treatment system at an LUST site. His involvement includes groundwater sampling, measuring groundwater levels in monitoring wells, and preparing a status report for the groundwater monitoring system.

Dr. Singh is responsible for evaluating secondary phase vapor recovery systems for gasoline service stations. He is also involved in the evaluation of statistical inventory reconciliation systems to meet the requirements for leak detection for USTs and tank tightness testing.

EDUCATION

Ph.D.	Chemical Engineering	University of Rochester, Rochester, New York
B Tech.	Chemical Engineering	Indian Institute of Technology, Kanpur, India

PROFESSIONAL BACKGROUND/TEACHING EXPERIENCE

K. Singh & Associates, Inc.	Senior Project Engineer
Youngstown State University	Professor, Chairman, Chemical Engineering

University of Rochester — Teaching Assistant

Indian Institute of Technology — Research Assistant

PROFESSIONAL MEMBERSHIPS

American Institute of Chemical Engineers
American Chemical Society
American Society for Engineering Education
Professional Engineer

PUBLICATIONS AND BOOKS

Singh, D.K., Contributing Author, "Pollution Prevention", Dupont, R., Theodore, L., and Reynolds, J., under preparation.

Singh, D.K. and Ferron, J.R., "Diffusion of Solid Particles in Rotary Kilns", Powder Technology, tentatively accepted for publication, revision to be submitted.

Singh, D.K. and Ferron, J.R., "Continuous Particulate Mixtures in Rotary Kiln Reactors", National ALChE Meeting, Miami, FL, November, 1992.

Singh, D.K., Kudav, G.V., and Maxwell, T.T., "Neural Network Modeling of the Flow Field Around 2-D and 3-D Automotive Shapes", Proceedings National ASME Meeting, Annaheim, CA, November 1992.

Singh, D.K., "TUTSIM and its Implementation in Process Dynamics and Control", Computers in Education Journal, November 1992.

Singh, D.K., Raib, E.R., and Challa, S.V., "Personal Computer Based Data Acquisition and Control of a Stirred Tank Heater", ASEE North Central Section Meeting, Dayton, OH, April, 1992.

Singh, D.K., "Process Design Calculations Using PC Based Numerical Analysis Software in Teaching Unit Operations", ASEE North Central Section Meeting, Dayton, OH, April, 1992.

Singh, D.K. and Druker, R.W., "Using Spreadsheets to Solve Material and Energy Balance", ASEE North Central Section Meeting, Dayton, OH, April, 1992.

Singh, D.K., Contributing Author, "Accident and Emergency Management", Dupont, R., Theodore, L., and Reynolds, J., VCH Publisher, 1991.

Singh, D.K., Kudav, G.V., and Abdallah, S.A., "Modeling of Mechanical System Responses by Artificial Neural Networks", pp. 179-184, Contributing Authors, in Intelligent Engineering Systems Through Artificial Neural Networks, Dagli, C.H., Kumara, S.R.T., and Shin, Y.C. (eds.), ASME Press, 1991.

Kudav, G.V., Singh, D.K. and Abdallah, S.A., "Modeling of Linear and Non-linear Thermal System Responses by Artificial Neural Networks", pp. 601-606, Contributing Authors, In Intelligent Engineering Systems Through Artificial Neural Networks, Dagli, C.H., Kumara, S.R.T., and Shin, Y.C. (eds.), ASME Press, 1991.
Ferron, J.R. and Singh, D.K., "Rotary Kiln Transport Processes", AIChE Journal, 37(5), 747-758, 1991.

Singh, D.K., Alvi, T.A., and Pansino, S.R., "Parallel Processing Applications in Process Control", Proceedings of 22nd Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, PA, 1991.

Ferron, J.R., and Singh, D.K., "Rotary Kiln Transport Processes", National AIChE Meeting, Chigaco, IL, November, 1990.

Singh, D.K., "Transputer Based Real-time Process Control", Proceedings of National AIChE Meeting, Chicago, IL, November, 1990.

Singh, D.K., "Neural Network Model Based Control of Chemical Processes", ISA International Conference, New Orleans, LA, October, 1990.

Ferron, J.R. and Singh, D.K., "Mechanics of Particle Dispersion in Partially Filled Cylinders Rotation on their Major Axes", 21st Annual Meeting of the Fine Particle Society, San Diego, CA, August, 1990.

Singh, D.K., "Neural Network Models for Modeling and Control of Particulate Processes", 21st Annual Meeting of the Fine Particle Society, San Diego, CA, August, 1990.

Singh, D.K. and Ferron, J.R., "Simulation of Particulate Processing in Cylindrical Vessels", 21st Annual Meeting of the Fine Particle Society, San Diego, CA, August, 1990.

Singh, D.K., "Neural Network Models for the Dynamics and Control of Chemical Processes", Proceedings of 7th International Conference on System Engineering, Las Vegas, Nevada, July, 1990.

Singh, D.K., "Neural Netowrk Model Based Control of Chemical Processes", Advances in Instrumentation and Control, 45(4), 955-968, 1990, Instrument Society of America.

Singh, D.K., and Ferron, J.R., "Diffusional Mixing in Rotary Kilns", International Conference on Separation Science and Technology, Hamilton, Canada, October, 1989.

Singh, D.K. and Ferron, J.R., "Diffusional Processes in Rotary Kilns", International Conference on Control of Particulate Process Operation, Matinkyla, Finland, August, 1989.

Singh, D.K., "Flow and Mixing Characteristics of Granular Media in a Drum Mixer", pp.367-380, Contributing Author, in Particulate and Multiphase Processes, Volume I, General Particulate Phenomena, Ariman, T. and Veziroglu, T.N. (eds.), Hemisphere Publishing Corporation, 1987.

Singh, D.K., "Solid Mixing", Fine Particle Society Meeting, Miami Beach, FL, 1985.

Singh, D.K., "Transverse Mixing of Solid Particles in a Rotating Drum", Proceedings of National AIChE Meeting, Houston, TX, March, 1983.

Singh, D.K., "Fundamental Study of Mixing of Solid Particles", AIChE/ACS Symposium, Akron, Ohio, 1979.

RAGHU B. SINGH, Ph.D. Professional Experience: Nine years
Project Scientist

Dr. Singh is an Environmental Microbiologist with backgrounds in biochemistry and chemistry. He is responsible for the bio-remediation projects of the firm. He is working on the remediation of high strength sludge generated from a poultry processing plant. His work is based on the reduction of nutrient loads in the sludge, soil and groundwater, by growing and monitoring emergent aquatic macrophytes.

Dr. Singh is experienced in the preparation of Site Assessment Plans, Hydrogeological Studies, Remedial Alternatives Evaluation of petroleum contamination sites, pump tests, tank closure, and monitoring of the progress of remediation. He performs construction observation services relative to soil borings and monitoring well installations. He prepares boring logs including field screening of soil samples using the HNU Meter for analytical testing. He is the project leader responsible for groundwater monitoring and interpretation of test results for a dozen projects.

SELECTED RECENT TECHNICAL EXPERIENCE

Dr. Singh is the project leader for the bio-remediation of a 15 acre surface impoundment. The impoundment was used for storage of treated wastewater and sludge. The sludge was rich in nitrogen and phosphorus and was subjected to a hydrostatic head of over ten feet of water. This resulted in contamination of near-surface groundwater. The WDNR required closure of the landfill in an environmentally acceptable manner. Several remedial action alternatives were evaluated. In-situ detoxification of waste constituents using emergent macrophytes was selected to be the corrective action technology.

Dr. Singh has monitored the progress of remediation which involved pumping of surface water from the impoundment, planting macrophytes in exposed sludge, monitoring the growth of cattails, monitoring groundwater, evaluating the nutrient reduction in sludge, soil and the assimilation of nutrients by the macrophytes, and writing reports. The bio-remediation approach, in conjunction with selective sludge removal, has produced remarkable results.

Singh is also working on the groundwater monitoring program for Pat's Sanitary Service (lagoon) located at Burlington, Wisconsin.

Dr. Singh worked on a project concerning bioremediation of diesel contaminated soils at Weidemeyer Service Center, Kewaskum, Wisconsin. Approximately 200 cubic yards of diesel contaminated soils were excavated and bioremediated. A ten-fold increase in microbial count resulted in the degradation of DRO from 1300 to 22 ppm in 24 days. DRO concentration was found to be 11ppm after 36 days. The bioremediation technology proved to be most cost-effective. Further soil biopile will be treated in the summer months. In addition, Dr. Singh is also working on in-situ bioremediation of petroleum contaminated soils at Madison, Wisconsin.

Dr. Sigh also worked on the groundwater quality assessment for the Town of Sheboygan Landfill, in Sheboygan, Wisconsin. Currently, he is working on the groundwater quality assessment for Otto Jacobs Landfills, Lake Geneva, Wisconsin. Dr. Singh's most recent work in landfills is continued for Sanitary Transfer and Landfill, Delafield, Wisconsin. The work involves groundwater, leachate, and methane gas monitoring programs. A 10,000 gallon leachate collection tank equipped with automatic controls was installed in December of 1992.

Dr. Singh has supervised soil borings and monitoring well installation for a UST project in Lansing, Michigan. He screened soil samples using an HNU Meter and selected samples for analytical testing. He was also responsible for recovery well installation and development. He was part of a team responsible for pumping and treating contaminated water using a GAC unit. Dr. Singh also conducted pump tests to determine the cone of depression.

Dr. Singh was a key person in responding to an emergency situation in which approximately 8,000 gallons of gasoline were released in the subsurface environment. This release resulted in explosive levels of gasoline vapors at a YMCA, a restaurant and a private residence. He participated in the emergency response action consisting of excavation of a trench, installation of product and vapor recovery systems, monitoring the levels of gasoline fumes using explosiometer and the operation of vapor and product recovery systems.

Dr. Singh has successfully completed forty hours of the OSHA Hazardous Waste Site Worker training.

Dr. Singh is involved in a UST remediation project in North Riverside, Illinois. He recommended bio-remediation as a remedial corrective action approach for this project. Other activities associated with this project include permitting and seeking regulatory approval for disposal of contaminated soil to a landfill.

Dr. Singh performed on-site observation services for a MSI, Inc., underground storage tank project in Grand Rapids, Michigan. As part of the field activities, he supervised the vertical profiling of a test boring to evaluate the vertical extent of contamination of soil and groundwater using a portable Gas Chromatograph. The result of the vertical profile was acceptable to the Michigan DNR.

EDUCATION

Ph.D.	Microbiology/Biochemistry	Pant Agril/University, India
M.S.	Microbiology/Biochemistry	Pant Agril/University, India
M.S.	Organic Chemistry	Gorakhpur University, India
B.S.	Biology/Chemistry	Gorakhpur University, India

PROFESSIONAL BACKGROUND

K. Singh & Associates, Inc.	Project Scientist
University of Wisconsin-Milwaukee	Senior Visiting Scientist
N.D. Agril/University, India	Assistant Professor
Pant Agril/University, India	Teaching Assistant/Research Associate

PROFESSIONAL MEMBERSHIPS

American Society for Microbiology

PUBLICATIONS

Darmwal, N.S., Singh, R.N., and Rai, R., "Isolation of Phosphate Solubilizers from Different Sources," Current Science, Vol. 58, p. 570, 1989.

Singh, R.B. and Rana, R.S., "Effect of Benzene Hexachloride on Nitrification Activity in Soil Under Flooded Conditions," Pesticides, Vol. 22, p. 13, 1988.

Singh, R.B. and Rana, R.S., "Effect of Insecticides on Nitrifying Bacteria under Water-logged Conditions," Annuals of Agricultural Research, Vol. 8, p. 261, 1987.

Singh, R.B., Rana, R.S., and Garg, G.K., "Effect of Sevidol on Nitrification under Submerged Conditions," Pesticides, Vol. 20, p. 52, 1986.

ROBERT T. REINEKE Professional Experience: 2 Years
Staff Engineer

Mr. Reineke is an environmental engineer whose prime responsibility is in remediation of underground storage tanks and groundwater monitoring of surface impoundments and landfills. He has experience in soil and water sampling, installation of monitoring wells, performing soil borings, report writing, and operations of granular activated carbon units.

SELECTED RECENT TECHNICAL EXPERIENCE

Mr. Reineke is responsible for developing a remedial action plan for Kaul Oil Company in Milwaukee, Wisconsin.

Mr. Reineke has been involved in preparing and conducting groundwater monitoring activities for a surface impoundment in Saukville, Wisconsin.

Mr. Reineke has been involved in preparing a remedial investigation and interim remedial action plan for Heuler Tile Company in Wauwatosa, Wisconsin. He has supervised the drilling of test borings and installation of monitoring wells. He has gathered soil samples for analytical testing.

Mr. Reineke has developed a Spill Prevention Control and Countermeasure plan for Kaul Oil Company in Milwaukee, Wisconsin. He evaluated present conditions and future modifications in developing the plan.

Mr. Reineke was involved with an assessment of operations at the Verona Wastewater Treatment Facility while a graduate student at the University of Wisconsin-Madison. He was responsible for evaluating past operations and was involved in making recommendations for future renovations.

Mr. Reineke developed a study of energy consumption in landfill operations while a graduate student at the University of Wisconsin-Madison. The study is now under consideration for publication.

Mr. Reineke passed the Engineer In Training (E.I.T.) examination in May 1990.

Mr. Reineke passed the Professional Engineer (P.E.) examination in May 1992.

EDUCATION

M.S.	Environmental Engineering	University of Wisconsin-Madison
B.S.	Civil and Environmental Engineering	University of Wisconsin-Madison

PROFESSIONAL BACKGROUND

K. Singh & Associates, Inc.	Staff Engineer

BRET M. SWENSON Professional Experience: 1 year
Staff Hydrogeologist

Mr. Swenson is a hydrogeologist whose prime responsibility is in site investigations and remediation of underground storage tank sites. He has supervised the drilling of test borings, installation of groundwater monitoring and recovery wells, and remedial excavations; completed field screening of soil samples; prepared boring logs; conducted groundwater sampling and monitoring; and initiated correspondence for regulatory coordination with both state and local governments.

SELECTED RECENT TECHNICAL EXPERIENCE

Mr. Swenson is responsible for conducting a site investigation, and submitting a Remedial Investigation and Interim Remedial Action Plan for Danco Shop & Run, Town of Norway, Wisconsin to the WDNR. Upon WDNR review, Mr. Swenson supervised the remedial excavation which included removal and replacement of forty-five of sanitary sewer.

Mr. Swenson is responsible for developing Remedial Investigation and Interim Remedial Action Plans for Pugh Oil Company sites in Mt. Pleasant and Kenosha, Wisconsin. He has supervised the performance of test borings and installation of monitoring wells on and off site. He has also collected soil and groundwater samples for analytical analysis.

He has been involved in conducting additional site investigation activities for Silver Lake Service Station, Oconomowoc, Wisconsin and submitting correspondence for WDNR review. He has supervised the performance of test borings, installation of monitoring and recovery wells, and collected soil samples for analytical testing.

Mr. Swenson is responsible for conducting on site investigation, and preparing a Remedial Investigation and Interim Remedial Action Plan for Red Eagle Gas Station, Watertown, Wisconsin.

He has witnessed underground storage tank closure, performed related site assessment activities, collected soil samples for analytical analysis, and submitted Tank Closure Reports for WDNR review.

Mr. Swenson has been involved in monitoring the remediation of groundwater using air strippers, liquid and vapor phase granular activated carbon units including water sampling. He has experience in groundwater and soil sampling, and is involved in groundwater sampling for many on-going projects.

Mr. Swenson has completed 40 hours of OSHA Hazardous Waste Site Worker training, and is a state certified Site Assessor.

EDUCATION

B.S. Geosciences — University of Wisconsin - Milwaukee

PROFESSIONAL BACKGROUND

K. Singh & Associates, Inc. — Staff Hydrogeologist

SCOTT D. MILLER Professional Experience: 12 years
Environmental Scientist

Mr. Miller is an Environmental Scientist responsible for underground storage tank projects located in Michigan. He has experience with remediation of USTs, consisting of installation of air strippers, granular activated carbon units, treatment of contaminated water, groundwater and air sampling, project management, air stripping operation and remedial action, soil borings and monitoring well installation.

SELECTED RECENT TECHNICAL EXPERIENCE

Mr. Miller has been involved with the coordination, installation and operation of air stripper remediation at several UST sites in Wisconsin.

As the team leader for UST projects associated with our Michigan office, Mr. Miller has supervised monitoring well installations and completed groundwater and soil sampling investigations.

Mr. Miller has experience in groundwater and air sampling at projects located in Cross Plains and Williams Bay. He has experience in remedial efforts involving air stripper operations, treatment of contaminated groundwater and GAC unit installation.

Mr. Miller has project management experience pertaining to underground storage tank removal, groundwater, air and soil sampling, monitoring well installation and remedial investigations.

Mr. Miller has successfully completed forty hours of the OSHA training for Hazardous Waste Site Worker.

EDUCATION

Paralegal Certification		Philadelphia Institute for Paralegal Training
B.S.	Natural Resources	Colorado State University

PROFESSIONAL BACKGROUND

K. Singh & Associates, Inc.	Environmental Scientist
Maryland Casualty Company	Claim Representative
Gibbs, Roper, Loots & Williams, S.C.	Legal Assistant
Fremont State Recreation Area	Assistant Park Superintendent

TARNAM S. DHILLON
Environmental Technician

Professional Experience: 2 years

Mr. Tony Dhillon is an environmental technician whose prime responsibility is in groundwater monitoring of leaking underground storage tank sites, surface impoundments, and landfills.

SELECTED RECENT TECHNICAL EXPERIENCE

Mr. Dhillon is responsible for groundwater and leachate system sampling, gas control system monitoring, and maintenance.

EDUCATION

Graduate	G.N. Dev University, India

PROFESSIONAL BACKGROUND

K. Singh & Associates, Inc.	Environmental Technician

DANIEL D. PACALA Professional Experience: 10 years
Field Technician

Mr. Dan Pacala is a field technician whose prime responsibility is in groundwater, leachate, and gas monitoring programs.

SELECTED RECENT TECHNICAL EXPERIENCE

Mr. Pacala is responsible for groundwater and leachate system sampling, groundwater program management, gas control system monitoring, and maintenance.

EDUCATION

Associate Degree	Applied Science	Milwaukee Area Technical College

PROFESSIONAL BACKGROUND

K. Singh & Associates, Inc.	Field Technician
Waste Management	Environmental Technician
Chem-Bio Corporation	Laboratory Technician
Moldrite Products	Molding Personnel Supervisor

Appendix B
Qualifications of Subcontractors' Staff

N59 W14176 Kaul Avenue
Menomonee Falls, Wisconsin 53051

(414) 252-3300
Fax 252-5373

To: K. Singh & Associates, Inc. Date: 5-23-94

From: Wisconsin Testing Laboratories Page 1 of 4

To: Raghu Singh

From: Allan Huseth

ALLAN F. HUSETH

Summary:

From 1973 to present, Principal in Alron Engineering & Testing Corporation, d/b/a Wisconsin Testing Laboratories.

Two years employed by Wisconsin Soil Testing, Inc. 1971 to 1973.

Three years - Soils Engineer while employed by American Testing and Engineering Corporation in Indianapolis, Indiana, 1968 to 1971.

Employed nearly seven years by the North Dakota State Highway Department including four years experience in construction and materials engineering, materials testing and research, and finally three years in the position of Assistant Testing Engineer.

Experience:

Alron Engineering & Testing Corporation
General Manager and Chief Engineer

Wisconsin Soil Testing, Inc.
Chief Soils Engineer

American Testing and Engineering Corporation
Soils Engineer

The above positions, in addition to supervising duties, required the following engineering work:
Performed engineering analyses and prepared reports of soil and foundation investigations. A typical report required a descripti of the field investigation and soil conditions encountered, desig recommendations including allowable bearing pressures and settle- ment predications, and construction recommendations and procedure to guide the preparation of specifications, and inspection detail

University of North Dakota
Grand Forks, North Dakota

Sept., 1966 to August, 1968

Graduate Student and Graduate Teaching and Research Assistant each year during the regular two semester college term. Complete graduate work toward Master of Science degree in soil mechanics and highway engineering.

Minnkota Power Cooperative, Inc.
Grand Forks, North Dakota

June, 1967 to Sept. 1967

Soils Engineer

Position as a Soils Engineer on site during construction of Nelso Lake Dam near Center, North Dakota. Worked under the Resident Engineer of International Engineering Corp., of San Francisco, California. My duties included the supervision of two men on compaction control, performance of soil tests, completion of reports, and the direction of subsurface investigation concerning seepage problems which arose during construction.

North Dakota State Highway Department
Bismarck, North Dakota

Dec., 1963 to Sept., 1966 — Assistant Testing Engineer

Worked under the Testing Engineer in the Department's Central Testing Laboratory, Bismarck. Assumed responsibility for the Laboratory's operation in the absence of the Testing Engineer.

As Assistant Testing Engineer, I supervised approximately twelve men in the sections of gravel, soil, and asphalt testing. Duties included application of North Dakota Standard Specifications while reviewing and reporting test results. Directed research in several areas of highway materials.

August, 1960 to Dec., 1963 — Engineering Assistant and Laboratory Engineer

Troubleshooting of materials problems on construction, developmen of asphalt mix design procedures using Marshall Method, and laboratory research on upgrading expansive clays and soft aggrega

June, 1959 to March, 1960 — Project Engineer

Seven months during the construction season were spent at Grand Forks and Langdon supervising construction of Portland Cement Concrete Pavements, by both conventional and slip-form paving methods. Crews of up to ten men.

Three winter months were spent in Bismarck Central Design Section checking plans and assisting with necessary revisions.

Education:

M.S. - University of North Dakota, 1968

B.S.C.E. - University of North Dakota, 1959

Associate of Arts - Long Beach City College, 1956

Radioisotope Techniques - Oak Ridge Institute of Nuclear Studies
4 week course, March, 1961

Professional Organizations: Registered Professional Engineer in North Dakota, Indiana, and Wisconsin. ASTM and ACI membership.

Military Service: Enlisted into Army Reserves, January, 1960
Activated in March, 1960
Discharged, January 1968, upon completion of 8 year obligation

Personal: Married and three children

JEFFREY G. SMITH

EDUCATION:

B.S., May 1975, St. Norbert College, De Pere, Wisconsin. Natural Science major.
B.S.C.E., December 1977, Marquette University, Milwaukee, Wisconsin.
Emphasis in Structural Engineering.
M.S. December 1979, Marquette University. Emphasis in Geotechnical Engineering.

GEOTECHNICAL COURSES:

Soils Engineering
Foundation Engineering
Earth Dams and Embankments
Lateral Earth Pressures and Retaining Structures
Advanced Soil Mechanics

HONORS:

Dean's List, St. Norbert College
Chi Epsilon Fraternity (Chapter President, Fall 1977)

PROFESSIONAL EXPERIENCE:

Wisconsin Testing Laboratories (1980 to Present)
Menomonee Falls, Wisconsin

Geotechnical Engineer, advancing from Project Engineer initially, which involved field inspection and laboratory testing, and reporting. Since professional registration, engineering analysis, consultation and report preparation.

SUMMER AND PART-TIME EMPLOYMENT:

Summer, 1979:	Wisconsin Testing Laboratories, Engineering Inspector
Summer 1972-1975:	Reinders Brothers, Elm Grove, Wisconsin Underground sprinkler system installation.
Co-op 1976-1977:	City of West Allis, Wisconsin Survey Crew, Draftsman.
Academic years 1978-1979:	Marquette University Teaching Assistant.

PROFESSIONAL STATUS:

Registered Professional Engineer, Wisconsin, 1983

MARITAL STATUS:

Married and one child.

N59 W14176 Kaul Avenue
Menomonee Falls, Wisconsin 53051

(414) 252-3300
Fax 252-5373

To: K. Singh & Associates, Inc. Date: 5-20-94

From: Wisconsin Testing Laboratories Page 1 of 3

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o: Raghu Singh

From: Jeff Smith

Wisconsin TESTING LABORATORIES

Scope and Purpose

Our experience of exploration and testing in the State of Wisconsin is quite broad, since our firm is a Wisconsin based company doing the vast majority of our work in Wisconsin. However, our technical people are available for consultation and on-site services anywhere in the United States. Reference to the sheet containing the partial list of clients will present a cross-section of clients that require our services.

Our scope of services to major clients includes soil test borings, rock boring and coring, complete laboratory testing programs, construction inspection, and engineering analyses and reports. Exploration services include installation of observation wells and piezometers, as well as test borings and sampling. Laboratory tests range from simple moisture tests to conventional consolidation tests. The engineering analyses of subsurface conditions have been applied to industrial structures, office complexes, and high-rise buildings, as well as highways, drainage projects, landfills, sewer construction, and other special projects. The latter have included investigations carried out at hazardous waste sites, and also preliminary investigations for commercial production of sand and gravel.

It is our purpose to provide sound engineering services along with strong supportive services in the areas of exploration and testing. Rates for our services will always be competitive. We believe that a high quality of service, and consistency, however, generally outweigh cost considerations.

We prefer not to be placed in a position of bidding. We would much rather submit our rates on an individual project basis. An estimate of total costs can be provided. However, final costs are often subject to conditions encountered or, during construction, are subject to the contractors' progress.

Capabilities and Major Activities - Qualifications of Personnel

Wisconsin Testing Laboratories is a geotechnical engineering and materials testing firm established in 1958. This firm is owned and operated by registered professional engineers working full time in the firm. Services are provided to owners, architects, engineers, utilities, governmental agencies, developers, and others in need of geotechnical exploration, soil and materials testing, and engineering.

The exploration test drilling department accounts for a major portion of services provided. Three (3) drill rigs are operational for test borings and related investigative work in soil. Two (2) of the drill rigs (truck mounted) are also basically equipped for conventional rock coring. One (1) of the drills is mounted on a Bombardier Muskeg Carrier (track vehicle) for mobilization into wet, soft, and swamp areas. A fourth truck mounted drill rig is specifically utilized for drilling relatively shallow pier holes, and for sign post and fence post installations.

Secondly, there is the testing and inspection department. The testing services include basic field and laboratory concrete tests, soil tests in the laboratory pertaining to classification of soils and aggregates, engineering evaluations of soil and foundation problems, and soil and materials testing and inspection on construction projects. The latter includes caisson inspection and pile installation inspection. Also, a complete asphalt pavement testing service (both mix design and field testing) is provided, and "special investigations" are handled under engineering direction as the need arises.

The laboratory is equipped with necessary basic soil, asphalt, and concrete testing units, including a 400,000 lb. capacity Tinius Olsen compression machine. The concrete area includes a moist curing room with temperature and moisture controls.

Field inspection units for soil compaction control include nuclear density probes as well as other conventional equipment for field density testing. Necessary basic field concrete testing equipment is available, and special testing equipment for other construction materials. A 24 ft. Mobile Laboratory would be availabie for location on very large projects.

Our professional staff includes people in geotechnical and soils engineering and geology. Engineers with advanced degrees in soil mechanics and highway engineering, including registered professional engineers, are the foundation of the engineering staff. Wisconsin professional registration, and registration in nearby states are included. Professional society memberships include ACI, ASCE, ASTM, NSPE and WSPE.

Our staff of inspectors and technicians includes people with college background. In most cases their testing experience has been gained while employed by Wisconsin Testing Laboratories. College students are utilized full time during the summer months and part time during school months in order to fill out the staff in a supporting role, and at the same time to provide experience opportunities to prospective engineers and geologists.

Construction inspection services have, in the past, been treated as secondary to geotechnical engineering services and design services that precede construction. We believe this is wrong. In fact, inspection personnel are often required to make on-the-job decisions that outweigh many decisions required in preliminary phases of the project. It is our intention to channel higher skilled people into the inspection area to correct this oversight.

NORTH SHORE

FACSIMILE TRANSMITTAL

DATE: 5/21

NO. OF PAGES (to follow): 1

TO: Raghu

COMPANY: K Engg

FAX NO: 821-1174

FROM: D. Hu

PHONE NO: #255-4468

MESSAGE:

N117 W18493 FULTON DRIVE · GERMANTOWN, WI 53022 · 414-255-4468 FAX 414-255-6993

NORTH SHORE
ENVIRONMENTAL CONSTRUCTION INC.

May 24, 1994

K. Singh & Associates, Inc.
Attn: Raghu Singh
1135 Legion Dr.
Elm Grove, WI 53122

Dear Mr. Singh:

As you requested, I am providing information regarding Paul Deibel and myself to you.

I am the President of North Shore Environmental Construction, Inc.. I have retained that position since 1989. I have 20 years of experience in construction and general contracting.

Paul Deibel is the Construction Manager of North Shore Environmental Construction, Inc. Paul has 5 years experience in the environmental field, and 15 years experience in construction.

Paul will be in charge of project management for this project and my involvement will strictly be financial oversight of the project.

If you have any further questions, please don't hesitate to call.

Sincerely,

Keith Hitzke
President

N117 W18493 FULTON DRIVE • GERMANTOWN, WI 53022 • 414-255-4468 • FAX 414-255-6993

NORTH SHORE

FACSIMILE TRANSMITTAL

DATE: 5/20/94

NO. OF PAGES (to follow): 2

TO: Ragu Singh

COMPANY: R. Singh

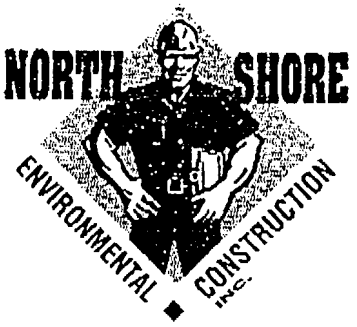
FAX NO: 821-1174

FROM: T. Fish

PHONE NO: #255-4468

MESSAGE:

N117 W18493 FULTON DRIVE · GERMANTOWN, WI 53022 · 414-255-4468 · FAX 414-255-6993



INTRODUCTION

North Shore Environmental Construction, Inc., is a full service Environmental Contractor specializing in Soil and Groundwater Remediation, and Underground Storage Tank removal, with over twelve years experience in the excavating business. We have responded to the rapidly changing laws and regulations requiring environmental clean-up by expanding our services to offer complete waste removal and clean-up. North Shore installs and maintains all types of soil and groundwater remediation systems, from soil vapor extraction to groundwater pump and teat systems. We work closely with other specialists in the field (Hydrogeologist, Environmental Engineers, Banks, Law Firms, etc.). All site personnel have completed the Hazardous Waste Worker training in conjunction with OSHA requirements.

North Shore has a specific SITE SAFETY PLAN designed for safe results in a working environment with underground storage tanks. All necessary equipment, protective clothing, respirators, explosion proof tools and monitoring equipment are used to insure site safety. We are uniquely structured to complete your project from start to finish.

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NORTH SHORE
ENVIRONMENTAL CONSTRUCTION INC.

HEALTH AND SAFETY

In order to comply with Federal and Safety requirements for the management control of hazardous materials, North Shore maintains a health and safety training program for employees engaged in site activities that may expose them to potentially hazardous substances. This program consists of the following:

Field personnel attend a 40 hour Hazardous Waste Site Training Course;
Field personnel receive 7 days of supervised field training;
Supervisors attend an 8 hour RCRA management workshop;
All technical staff attend an annual 8 hour RCRA refresher workshop;
All staff maintain IHLR10 certification requirements;
Site specific Health and Safety Plan provided for each project;
Daily safety meetings are mandatory.

All health and safety training meets the requirements of OSHA 29 CFR Part 1910, which mandates that all employees receive training before they are permitted to engage in hazardous waste operations. This training provides North Shore's employees with the skill and knowledge to perform hazardous waste operations with minimal risk to their health and safety.

N117 W18493 FULTON DRIVE • GERMANTOWN, WI 53022 • 414-255-4468 • FAX 414-255-6993

Telephone: (414) 521-24
FAX: (414) 521-06

SUBURBAN LABORATORIES of WISCONSIN, Inc.

"Analytical Testing"
N8 W22520-B Johnson Drive Waukesha, WI 53186

RESUMES OF KEY PERSONNEL

JARRETT R. THOMAS

EDUCATION:

B.S. Business/Chemistry - Elmhurst College

WORK EXPERIENCE: (1984-Present - Suburban Laboratories, Inc.)

1991-Present Vice President and Laboratory Manager
Suburban Laboratories, Inc. - Hillside, Illinois and Waukesha, Wisconsin
Responsible for development and supervision of various aspects of laboratory including customer service, Data reporting, and QA/QC.

1988-1990 Metals Technician and QA/QC Officer
Analysis of metals by ICP and furnace AA and developed Inorganic QA/QC program.

1986-1988 Wet Chemistry Technician
Analysis of BOD, COD, solids, oil & grease, and other wet chemistry parameters.

1984-1986 Sample Custodian
Responsible for receiving, logging, preservation, and security of samples.

DAVID J. HITCHINS

EDUCATION:

B.S. Chemistry - University of Illinois

WORK EXPERIENCE:

1992-Present Laboratory Director
Suburban Laboratories of Wisconsin, Inc.
Responsible for maintaining and expanding WDNR certification and directing daily laboratory operations.

1991-1992 Laboratory Manager
Giles Engineering
Started up new laboratory and obtained WDNR certification.

1989-1991 QA/QC Director
National Environmental Testing (NET) - Watertown, Wisconsin
Implemented and modified QA/QC programs to meet WDNR and USEPA requirements.

1985-1989 Laboratory Director
Wisconsin Analytical Laboratories - Watertown, Wisconsin
Responsible for obtaining and maintaining WDNR certification and directed daily laboratory operations.

1975-1985 Chemical Researcher
National Institute of Health - Madison, Wisconsin
Development of new chemical test methods.

Appendix C
QA / QC Program of Suburban Laboratories

QA/QC MANUAL

REVISION 2

08/16/93

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Please Note: Attachments are provided, as needed, per client or agency request.

APPROVAL SHEET

This manual has been reviewed and approved by the following Suburban Laboratories of Wisconsin, Inc. personnel.

H.R. Thomas JR., President

Jarrett Thomas, Vice President/Laboratory Manager/QA/QC Director

David Hitchens, Laboratory Director

1.0 REFERENCES

The following is a list of primary sources used for the generation of quality control procedures used in the laboratory:

Analytical Test Methods and Procedures - Chapter 219, Wisconsin Department of Natural Resources, Register, April, 1988 and Revision.

Handbook for Analytical Quality Control in Water and Wastewater Laboratories (EPA-600/4-79-019), Environmental Monitoring and Support Laboratory, United States Environmental Protection Agency Office of Research and Development, March 1979.

Laboratory Certification - Chapter 149, Wisconsin Department of Natural Resources, Register, November, 1992.

Manual for the Certification of Laboratories Analyzing Drinking Water (EPA-814B-92-002), United States Environmental Protection Agency Office of Ground Water and Drinking Water Technical Support Division, Cincinnati, Ohio September 1992. Supersedes EPA/570/9-82/002, October 1982.

Standard Methods for the Examination of Water and Wastewater - 17th Edition, American Public Health Association., 1989.

Taylor, John Keenan., *Quality Assurance of Chemical Measurements*, Lewis Publishers, Michigan, 1987.

Test Methods for Evaluating Solid Waste (SW-846), United States Environmental Protection Agency Department of Solid Waste, September 1986 and Final Update 1, November 1990.

2.0 PROGRAM DESCRIPTION

The purpose of a quality control program is to ensure adequate control of the variables which may affect analytical results. The importance of quality control cannot be over emphasized. All data produced by the laboratory is assumed to have far-reaching financial, regulatory or health implications. Knowledge of the data's importance, professional competence, and a strict adherence to a quality control program all contribute to the production of reliable and accurate data.

This document describes the quality assurance program to be implemented by Suburban Laboratories of Wisconsin, Inc., hereby referred to as SLI/WI. The program is designed to routinely evaluate the quality of analytical data obtained from laboratory analysis.

Revisions to this manual will be given careful attention prior to final incorporation. Changes in personnel, procedures, certifications, and instrumentation will be included in later editions of this manual.

3.0 PROGRAM ORGANIZATION AND RESPONSIBILITIES

While each employee of SLI/WI is responsible for maintaining a high level of quality, the following individuals are directly responsible for the quality control and quality assurance aspects of the laboratory.

H.R. Thomas Jr.:	President and Chief Executive Officer
Jarrett Thomas:	Vice President, Laboratory Manager, and QA/QC Director
David Hitchens:	Laboratory Director
Jeff Stoltz:	Technical Services Manager
Pat McGraw:	Field Services Manager

A copy of the laboratories organizational chart and resumes of key personnel are available as Attachments H and I.

4.0 QUALITY ASSURANCE OBJECTIVES

The ultimate objective of the QA/QC Manual is to ensure that data produced by SLI/WI is technically sound and legally defensible. This objective is evaluated in terms of precision, accuracy, completeness, representativeness, and comparability.

4.1 Precision

Precision is defined as "the agreement among a set of replicate measurements without the assumption of knowledge of the true value. Precision is estimated by means of duplicate and replicate analyses" [EPA, 1990].

There are two commonly used estimates of precision. They are (1) the relative standard deviation (RSD) or the coefficient of variation (CV),

$$RSD = CV = 100\ s/\bar{x}$$

$\bar{x}$ = the arithmetic mean of the xi measurements
s = the standard deviation

and (2) the Relative percent difference (RPD) when only two samples are available.

$$RPD = 100\ [(x_1 - x_2)/\{(x_1 + x_2)/2\}]$$

Duplicate analysis are performed at a minimum of 10% of the total sample volume. Since duplicate samples should contain concentrations of analyte above the method detection limit (MDL), the use of matrix spike duplicates (MSD) are used whenever necessary (see section 10.1.3).

4.2 Accuracy

Accuracy is defined as "the closeness of agreement between an observed value and an accepted reference value" [EPA, 1990]. Accepted reference standards are supplied by the Wisconsin Department of Natural Resources (WDNR), the United States Environmental Protection Agency (USEPA), or reputable commercial vendors.

There are two ways in which accuracy is measured in the laboratory:

4.2.1 Standard analysis

Standard analysis involves determination of analyte concentration in a clean water matrix. While this type of analysis does not provide a representative indication of the accuracy as applied to many environmental matrices, it does provide that the analytical method is properly measuring analyte concentration without the effect of matrix interference. These standards are also known as laboratory control samples and are prepared by spiking a known amount of target reference material into a known matrix - usually water. The standard is then passed through all the customary sample preparation/digestion and analysis steps.

The control standard accuracy is expressed in terms of percent recovery as determined by the following equation:

$$\% R = \frac{\text{Observed Concentration}}{\text{Actual Concentration}} \times 100$$

Control standards are performed at a minimum of 20% of the total sample volume and at the beginning of every analytical batch, immediately following the method blank.

4.2.2 Matrix spike analysis

Matrix spike analysis occurs when an aliquot of sample is spiked with a known concentration of target analyte(s). The spiking occurs prior to sample preparation and analysis [EPA, 1990]. The function of the matrix spike is to determine bias caused by the method, analyst, equipment or other interferences in a given sample matrix.

Matrix spike accuracy is also expressed in terms of accuracy through use of percent recovery.

$$\% R = \frac{\text{Observed Conc. - Background Conc.}}{\text{Spike Concentration}} \times 100$$

Matrix spike samples are run at a frequency of at least 20% of sample volume for all matrices except drinking water. Drinking water spikes are analyzed at 10% of sample volume.

The accuracy values include both random error (due to imprecision) and systematic error (due to bias). Thus, the percent recovery values represent total error in accuracy, and are the sum of the two components.

4.3 Completeness

Completeness is a measure of the amount of data obtained from the measurement process compared to the amount that was expected to be obtained under the conditions of measurement [Taylor 1987]. Completeness can be explained statistically by the following:

$$\% \text{ Completeness} = \frac{\text{Valid Data Obtained}}{\text{Total Data Expected}} \times 100$$

4.3 Completeness (Cont'd)

Completeness of a set of samples can be documented by inclusion in the final report of pertinent data such as chromatograms, quality assurance reports, and result summaries.

Other information such as logbooks, laboratory notebooks, work sheets, raw data printouts, calibration curves, and other daily quality control information are kept on file in the laboratory for future reference.

4.4 Representativeness

Representativeness is defined as the degree to which the data accurately and precisely represent a characteristic of a population parameter, variation of a property, a process characteristic, or an operational condition [Taylor, 1987].

One of the most important aspects of quality assurance is ensuring that samples provided to the laboratory are representative of the matrix being sampled. One excellent way of increasing representativeness is to submit composite and/or duplicate samples for analysis.

Once the samples arrive in the laboratory, all the necessary steps are taken to ensure that aliquots of samples needed for analysis are representative of the sample provided.

4.5 Comparability

Comparability measures the confidence at which one set of data points can be compared to another [Taylor, 1987]. One way this can be accomplished is by the use of established analytical methodologies. All methods used by the laboratory are validated, WDNR and/or USEPA approved. Certification by governmental and independent regulatory agencies and participation in the USEPA's and WDNR's round robin and performance evaluation programs, also insure comparability.

The laboratory also participates in an internal performance evaluation program where check samples performed at SLI/WI are compared with results from Suburban Laboratories, Inc.

The best way to ensure comparability is to have established quality assurance/quality control procedures These procedures are explained in greater detail in the following sections.

5.0 SAMPLING PROCEDURES

The main objective of sampling is to obtain a representative portion of the total environment under investigation. The majority of samples analyzed by SLI/WI are collected by the client. SLI/WI does not provide soil, solid waste or hazardous waste sampling. The laboratory is limited to grab or composite sampling of waters and waste waters using procedures specified by WDNR and USEPA. SLI/WI can provide clients with proper sample containers, labels, chain-of-custody forms, and seals.

5.1 Sample Collection

As a guideline, SLI/WI suggests that the following rules be followed in order to preserve sample integrity:

a. Involve a minimum number of trained persons in sample collection and handling.

b. Established written guidelines for particular procedures should be used for each type of sample collection, preservation, and handling.

c. Handle samples as little as possible.

d. Attach a sample tag or label to the sample container at the time of collection. The tag should contain the sample identification, client name, sampling date/time, location, preservation, and name of sample collector. Tags should be completed legibly in waterproof ink.

e. Use bound field books to record ALL pertinent field and sampling information. It is the responsibility of the sampling team to prepare and retain these records.

5.1 Sample Collection (Cont'd)

f. The sample collector is responsible for the care and custody of the samples until they are dispatched to the laboratory. The sample collector should make sure that each container is in his physical possession or in his view at all times or in a locked storage container where no one can tamper with it.

g. To avoid breakage, samples must be carefully packed in shipment containers such as ice chests. The shipping containers should be labeled with a security seal.

h. Chain-of-custody forms MUST accompany the samples at all times.

i. It is the responsibility of the sampling team to ensure that samples provided to the laboratory are representative of the environment under investigation.

5.1.1 Special Handling For Samples Requiring Trace Organic Analysis

In addition to the requirements in section 5.1, the following sampling procedures should be followed for samples requiring trace organics analysis.

a. Specially cleaned, organic free containers should be used when sampling for organics.

b. Bottles should be sealed with a Teflon lined cap.

c. Sampling for purgeable organics should be contained in four 40ml vials and sealed with a Teflon lined cap.

5.1.1 Special Handling For Samples Requiring Trace Organic Analysis (Cont'd)

d. The water sample vials for volatiles should be filled to overflowing from a bubble-free source so that a convex meniscus is formed at the top, and then sealed with a Teflon lined cap.

f. Bottles used for samples requiring solvent extraction should not be overfilled or prerinsed with sample.

g. Special care should be taken to reduce breakage when packing samples for shipment. The samples should be placed in a cooler and kept at $4^{o}C$ with ice.

h. Samples should arrive at the laboratory as soon as possible after collection.

5.1.2 Sampling devices

As mentioned in section 5.0, the laboratory only provides wastewater sampling consisting of grabs, time composites, and flow-proportional composites. SLI/WI utilizes sampling devices applicable to USEPA sampling requirements. The sampling devices are maintained on a regular basis and standard operating procedures have been developed regarding sampling and sampler maintenance.

5.2 Labeling

SLI/WI recommends that the following information be supplied along with each sample:

* Client Name
* Sample Description
* Sampling Date and Time
* Preservation
* Tests Required

Sample ID Number
Sampling Location
Sampling Method
Project Name/Number
Samplers Initials
Safety and Disposal Information

* As a minimum, this information should be included along with samples.

5.3 Containers

The following sample containers are available from the laboratory.

Clear Glass:
- Precleaned 40 ml Vials
- 2 oz
- 4 oz
- 9 oz
- Quart Wide Mouth
- Quart Narrow Mouth
- Gallon

Amber Glass:
- 4 oz
- 8 oz
- Quart Wide Mouth
- Quart Narrow Mouth
- Gallon

5.3 Containers (Cont'd)

Plastic:
- 4 oz
- 4 oz High Density
- Quart Narrow Mouth

Note: Teflon lined caps are provided where appropriate.

Sample containers are quality control checked for contamination annually or when a new vendor is used.

5.4 Sample Holding Times

The laboratory makes every effort to analyze samples within the required holding times. If a situation arises where a sample has been received in exceedence of holding time or the holding time is violated while in the laboratory, the client will be notified at once. If resampling is not possible the exceedence will be noted on the final report in the form of a qualifying statement.

The holding times for analyses are listed in the following sections.

5.5 Sample Container, Preservation, Volume And Holding Times

5.5.1 Inorganic Guide for Metals and Wet Chemistry *

PARAMETER	CONTAINER	PRESERVATION	MINIMUM VOLUME(ml)	HOLDING TIME
Acidity	P,G	4° C	100	14 Days
Alkalinity	P,G	4° C	100	14 Days
BOD	P,G	4° C	500	48 Hours
COD	P,G	4° C,+ Acid 1	250	28 Days
Coliform, Total	HDP	4° C	100	6 Hours
Coliform, Fecal	HDP	4° C	100	6 Hours
Total Plate Count	HDP	4° C	100	48 Hours
Chloride	P,G	None	100	28 Days
Chlorine, Resid.	P,G	None	500	Immediately
Color	P,G	4° C	250	48 Hours
Cyanide, Total	P,G	4° C,+ Base 1	500	14 Days**
Fluoride	P	None	100	28 Days
FOG (O&G)	G	4° C,+ Acid 1	1500	28 Days
Hardness, Total	P,G	Acid 1	250	6 Months
MBAS	P,G	4° C	250	48 Hours
N, Total (TKN)	P,G	4° C,+ Acid 1	1000	28 Days
N, Ammonia	P,G	4° C,+ Acid 1	500	28 Days
N, Nitrate	P,G	4° C	100	48 Hours
N, Nitrite	P,G	4° C	100	48 Hours
N, NO3 + NO2	P,G	4° C,+ Acid 1	100	28 Days
Oxygen, Diss.	G	None	500	Immediately
pH	P,G	None	100	Immediately
Phenol	G	4° C,+ Acid 1	1000	28 Days
Ortho-Phosphate	P,G	4° C, Filter	100	48 Hours
Phosphorus, Total	P,G	4° C,+ Acid 1	100	28 Days
Solids, Total	P,G	4° C	100	7 Days
Solids, Tot. Diss.	G	4° C	100	7 Days
Solids, Tot. Susp.	P,G	4° C	100	7 Days
Solids, Tot. Vol.	P,G	4° C	100	7 Days
Solids, Settleable	P,G	4° C	100	48 Hours
Conductance	P,G	4° C	250	28 Days
Sulfate	P,G	4° C	100	28 Days
Sulfite	P,G	None	500	Immediately
Sulfide, Total	P,G	4° C,+ Base 2	500	7 Days

5.5 Sample Container, Preservation, Volume And Holding Times

5.5.1 Inorganic Guide for Instrumentation and Wet Chemistry (Cont'd) *

PARAMETER	CONTAINER	PRESERVATION	MINIMUM VOLUME(ml)	HOLDING TIME
TOC.	P,G	4° C,+ Acid 1	100	28 Days
Turbidity	P,G	4° C	100	48 Hours
TOX/EOX	GA	4° C	500	14 Days
Chromium-Hex.	P,G	4° C	100	24 Hours
ALL METALS (Water Matrix)	P,G	4° C,+ Acid 2	100	6 Months***
ALL METALS (Solid Matrix)	P,G	4° C	100 g	6 Months***

* Sample Container, Minimum Volume, and Holding Time are for water samples. Solid matrix sampling recommendations may be different. Consult laboratory for correct sample handling.
Sample volumes are listed as guidelines and clients should submit enough sample to allow for laboratory quality control (duplicates/spikes/reruns etc...).

** Maximum holding time is 24 hours when sulfide is present.

*** Hg holding time is 28 days

Sample Container and Preservatives:
P Plastic, polyethylene bottle with polypropylene cap.
G Glass
HDP High Density Plastic (sterile)
GA Glass, amber bottle with a Teflon lined cap.

Acid 1 Sulfuric Acid to a pH of <2.0
Acid 2 Nitric Acid to a pH of <2.0
Base 1 Sodium Hydroxide to a pH of >12.0
Base 2 Sodium Hydroxide to a pH of >9.0

5.5 Sample Container, Preservation, Volume And Holding Times

5.5.2 Organic Guide (Water Matrix)

PARAMETER	METHOD	CONTAINER	PRESERVATION	MINIMUM VOLUME	HOLDING TIME
Purgeable Halocarbons	601	VOA	4° C,	40 X 4	14 Days
Purgeable Aromatics	602	VOA	4° C,+Pres 1	40 X 4	14 Days
Acrolein	603	VOA	4° C,+Pres 2	40 X 4	14 Days
Acrylonitrile	603	VOA	4° C,+Pres 2	40 X 4	14 Days
Phenols	604	GA	4° C	1000	7/40
Benzidines	605	GA	4° C	1000	7/40
Phthalate Esters	606	GA	4° C	1000	7/40
Nitrosamines	607	GA	4° C	1000	7/40
Organochlorine Pest.	608	GA	4° C	1000	7/40
PCBs	608	GA	4° C	1000	7/40
Nitroaromatics	609	GA	4° C	1000	7/40
Isophorone	609	GA	4° C	1000	7/40
P.A.H (PNA)	610	GA	4° C	1000	7/40
Haloethers	611	GA	4° C	1000	7/40
Chlorinated Hydrocar.	612	GA	4° C	1000	7/40
Organophosphate Pest.	614	GA	4° C	1000	7/40
Chlorinated Herb.	615	GA	4° C	1000	7/40
Purgeables	624	VOA	4° C,+Pres 1	40 X 4	14 Days
Base/Neutrals Ext..	625	GA	4° C	1000	7/40
Acid Extractables	625	GA	4° C	1000	7/40
Pesticides	625	GA	4° C	1000	7/40

Sample Preservation:
Pres 1: HCl to pH <2.0 Pres 2: Adjust pH to 4-5

Sample Containers and Minimum Volumes:
GA Glass amber bottle with teflon lined cap.
VOA Volatile Organic Analyte; 40 ml glass vial with teflon septum.

EPA Holding Time:
7/40 Days 7 days for extraction and 40 days for analysis.

5.5 Sample Container, Preservation, Volume And Holding Times (Cont'd)

5.5.3 Organic Guide (Solid and Waste Matrix)

PARAMETER	METHOD	CONTAINER	PRESERVATION	MINIMUM VOLUME	HOLDING TIME
Halogenated Volatile	8010	G	4° C	*	14 Days
Non-Halogenated Vol.	8015	G	4° C	*	14 Days
Aromatic Volatile	8020	G	4° C	*	14 Days
Acrolein	8030	G	4° C	*	14 Days
Acrylonitrile	8030	G	4° C	*	14 Days
Acetonitrile	8030	G	4° C	*	14 Days
Phenols	8040	G	4° C	*	14, 7/40
Phthalate Esters	8060	G	4° C	*	14, 7/40
Organochlorine Pest.	8080	G	4° C	*	14, 7/40
PCBs	8080	G	4° C	*	14, 7/40
Nitroaromatics	8090	G	4° C	*	14, 7/40
Cyclic Ketones	8090	G	4° C	*	14, 7/40
P.A.H (PNA)	8100	G	4° C	*	14, 7/40
Chlorinated Hydrocar.	8120	G	4° C	*	14, 7/40
Organophosphorus Pest.	8140	G	4° C	*	14, 7/40
Chloronated Herb.	8150	G	4° C	*	14, 7/40
Volatile Organics	8240	G	4° C	*	14 Days
Semi-Volatiles	8250	G	4° C	*	14, 7/40
Volatile Organics	8260	G	4° C	*	14 Days
Semi-Volatiles	8270	G	4° C	*	14, 7/40
PNAs	8310	G	4° C	*	14, 7/40

* Check with laboratory regarding appropriate sample volumes.

Sample Containers and Minimum Volumes:
G = Glass sample container. Check with laboratory regarding appropriate container size.

EPA Holding Time:
7/40 Days 7 days for extraction and 40 days for analysis.
14 or 7/40 Days Depends upon sample matrix.

5.5 Sample Container, Preservation, Volume And Holding Times (Cont'd)

5.5.4 Inorganic Guide (Drinking Water)

PARAMETER	CONTAINER	PRESERVATION	MINIMUM VOLUME	SAMPLE HOLD TIME	EXTRACT HOLD TIME
Metals (except Hg)	P,G	Acid 2	1 L	6 Months	---
Mercury	P,G	Acid 2	100 ml	28 Days	---
Alkalinity	P,G	4°C	100 ml	14 Days	---
Chloride	P,G	none	50 ml	28 Days	---
Color	P,G	4°C	50 ml	48 Hours	---
Conductance	P,G	4°C	100 ml	28 Days	---
Cyanide	P,G	4°C+Base 1	1 L	14 Days	---
Fluoride	P,G	none	300 ml	28 Days	---
MBAS	P,G	4°C	100 ml	48 Hours	---
Nitrate-*1	P,G	4°C	100 ml	28 Days	---
Nitrate-*2	P,G	4°C+Acid 1	100 ml	14 Days	---
Nitrite	P,G	4°C	50 ml	48 Hours	---
Odor	G	4°C	200 ml	24 Hours	---
pH	P,G	none	25 ml	Immediately	---
o-Phosphate	P,G	4°C	50 ml	48 Hours	---
Silica	P	4°C	50 ml	28 Days	---
TDS	P,G	4°C	100 ml	7 Days	---
Sulfate	P,G	4°C	50 ml	28 Days	---
Temperature	P,G	none	1 L	Immediately	---
Turbidity	P,G	4°C	100 ml	48 Hours	---
Coliform	HDP	4°C + Sodium Thiosulfate	100 ml	48 Hours	---

Sample Container and Preservatives:
P Plastc, polyethylene bottle with polypropylene cap.
G Glass
HDP High Density Plastic (sterile)

Acid 1 Sulfuric Acid to a pH of <2.0
Acid 2 Nitric Acid to a pH of <2.0
Base 1 Sodium Hydroxide to a pH of >12.0

*1 = Chlorinated
*2 = Non-chlorinated

5.5. Sample Container, Preservation, Volume And Holding Times (Cont'd)

5.5.5 Organic Guide (Drinking Water)

METHOD	CONTAINER	PRESERVATION	MINIMUM VOLUME	SAMPLE HOLD TIME	EXTRACT HOLD TIME
501.1, 501.2	GV	4°C+Pres 1	4x40ml	14 Days	---
502.1, 502.3	GV	4°C+Pres 1&2	4x40ml	14 Days	---
503.1	GV	4°C+Pres 1&2	4x40ml	14 Days	---
504	GV	4°C+Pres 1&2	4x40ml	28 Days	---
505	GA	4°C+Pres 1	4x40ml	14 Days	---
506	GA	4°C+Pres 1	1L	14 Days	14 Days
507	GA	4°C+Pres 1	1L	14 Days	14 Days
508	GA	4°C+Pres 1	1L	7 Days	14 Days
508A	GA	4°C	1L	14 Days	30 Days
515.1	GA	4°C+Pres 1	1L	14 Days	28 Days
524.1, 524.2	GV	4°C+Pres 2	4x40ml	14 Days	---
525.1	GA	4°C+Pres 2&3	1L	7 Days	30 Days
531.1	GV	4°C+Pres 1&4	1L	28 Days	---
547	GV	4°C+Pres 1	4x40ml	14 Days	24 Hours
548	GV	4°C	4x40ml	7 Days	24 Hours
549	GA	4°C+Pres 1&5	1L	7 Days	21 Days
550, 550.1	GA	4°C+Pres 1	1L	7 Days	40 Days

Sample Container and Preservatives:
GV 40 ml Glass Vial
GA Glass Amber Liter or Gallon

Pres. 1: Sodium Thiosulfate
Pres. 2: Hydrochloric Acid to pH<2
Pres. 3: Sodium Sulfite
Pres. 4: Monochloroacetic Acid to pH<3
Pres. 5: Sulfuric Acid to pH 2

6.0 SAMPLE HANDLING, CUSTODY, AND SECURITY

Since it is often necessary to have a written record of the chain of possession of samples from collection through final disposition, SLI/WI uses the following sample handling and chain-of-custody procedures.

6.1 Definition

A sample is in someone's "custody" if:

(1) It is in one's actual physical possession, or

(2) It is in one's view after being in one's physical possession, or

(3) It is kept in a secured area restricted to authorized personnel only.

6.2 Field Custody Procedures

a. All field operations should be well documented by the person doing the sampling.

b. A minimum number of people should be involved in the sample collection and guidelines established in section 5.0 should be followed.

6.2 Field Custody Procedures (Cont'd)

c. Chain-of-custody forms (Attachment A) should also be filled out at the site of sampling and accompany the samples at all times. The chain-of-custody, as a minimum, must contain the sample identification, type of sample, total number of containers, the signature of the sampler and/or carrier, and the date and time of sampling. When turning over possession of samples, the transferor and transferee sign, date, and time, the form.

d. All records and labels should be filled out legibly and in waterproof ink.

6.3 Laboratory Custody Procedures

The following custody procedures are followed upon receipt of samples:

a. When accepting possession of a sample, the transferee must sign and record the date and time on the chain-of-custody forms. If the person receiving the sample is not the Laboratory Custodian, the sample is kept in the persons possession and signed over to the Laboratory Custodian as soon as possible.

b. The samples are then logged into a laboratory information management system (LIMS) which automatically assigns unique lab numbers and prints out paperwork, including a intra-laboratory chain-of-custody form (Attachments B and C).

c. Depending on preservation, the samples are then stored in a secure dry room or sample refrigerator, both of which are off limits to unauthorized personnel.

6.3 Laboratory Custody Procedures (Cont'd)

d. Laboratory personnel must submit a written request for samples which require analyses. The samples are signed in and out to the chemist by the Laboratory Custodian or his designate.

e. Laboratory personnel are responsible for the care and custody of a sample once it is in their possession. The analyst is required to keep the sample in their possession, view, or secured in the laboratory at all times.

f. The entire laboratory is maintained as a secure area and is restricted to authorized personnel only.

g. Once the sample analyses are completed, the unused portion of the sample is returned to the secure area. The sample is then retained in the secured area until permission to destroy or return the sample to client is received by the custodian.

h. Final disposition of the sample is recorded and all paperwork is kept for a period of at least three years.

6.4 Sample Handling via LIMS

Upon receipt, samples are logged into a laboratory information management system (LIMS). The LIMS assigns sample numbers, prints out department data sheets and intralaboratory chain of custody records. The LIMS specifies the due date for samples based on holding times of the individual parameters. The LIMS also keeps track of all samples and several status reports are printed daily in order to monitor holding times and turnaround times.

6.4.1 Sample receiving

Samples are received by authorized personnel only. Once received, chain-of-custody information is checked against the, sample container label or any prior knowledge of sample information such as quotations or client notes. Any discrepancies are noted using a sample discrepancy form (Attachment G) and the client is notified.

6.4.2 Sample login

The following information is logged into the LIMS.

Client Name, address, phone number
Clients "report to" name
Project name
Who collected sample
How the sample was transported to the lab
Purchase order number
Date received
Date due
Sample matrix
Sample ID
Date/time collected
Sample container type
Tests required
Any and all comments

A copy of the sample login report is included as Attachment C.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

All laboratory equipment will be calibrated, daily, in accordance with the methods specified in this document. This will involve an initial calibration and preparation of calibration curves.

7.1 Calibration Curves

Calibration curves are prepared with a minimum of one blank and at least three standards. Standards are chosen to cover the entire range of the analysis with at least one standard near the analyte's detection limit. After a curve is established, it is reconfirmed by analysis of a blank and a high range standard. The standard values must be within 10% of the original value. If the value is outside the control limit, corrective action is taken. All calibration data including curves are kept in bound laboratory notebooks.

7.2 Method Calibration

Some methods do not require daily calibration. In these cases a calibration curve is prepared once, and reconfirmed each day the test is performed using a blank and a high concentration standard. If the standard is not within 10% the original value, corrective action is performed.

7.3 Calibration Frequency

SLI/WI maintains all instruments on specified calibration schedules depending upon the method performed, the analytical results obtained, and the number of samples analyzed. Generally, if more than twenty samples are analyzed in a day, instrument calibration with a known standard is performed after every twentieth sample.

Oven, refrigerator, and incubator temperatures are checked each day of operation and recorded. If inaccuracy trends are found which cannot be corrected by laboratory personnel, professional service is obtained.

Analytical balances are checked with class S weights once every month. Balances are recalibrated, serviced and certified annually by an outside agency.

8.0 ANALYTICAL METHODS

All analytical methods used by SLI/WI are USEPA or WDNR validated and approved. Any variance from the approved method will be thoroughly validated by SLI/WI and documented.

8.1 Method Performance

An initial demonstration of method performance is performed for each method, before samples are run, or whenever a new instrument is installed. The results are compared to the suggested accuracy, precision, and detection limits within the method. The results of the initial demonstration are entered onto a form and into a computer for statistical analysis. A copy of the form is provided as Attachment M. SLI/WI makes every attempt to meet method specific performance criteria, however, because of difficult sample matrices, analyte contaminant level, instrument differences, and other variables, method specific performance criteria, in some cases, may be unattainable.

8.2 Methodology

The following is a list of approved methods used or accepted by SLI/WI.

8.1 Method References For Metals

PARAMETER	EPA(a)	SM(b)	EPA(c)	EPA(d)	TECHNIQUE
ALL METALS (except Mercury)	200.7	3120B	6010	200.7	ICP EMISSION
Aluminum	202.1	3111D	7020	202.1	AA FLAME
	202.2	3113B		202.2	AA FURNACE
Antimony	204.1	3111B	7040		AA FLAME
	204.2	3113B	7041	204.2	AA FURNACE
Arsenic	206.2	3113-4D	7060	206.2	AA FURNACE
	206.3	3114	7061	206.3	AA HYDRIDE
Barium	208.1	3111D	7080	208.1	AA FLAME
	208.2	3113B		208.2	AA FURNACE
Beryllium	210.1	3111D	7090		AA FLAME
	210.2	3113D	7091	210.2	AA FURNACE
Boron	212.3	4500B			Colorimetric
Cadmium	213.1	3111B	7130		AA FLAME
	213.2	3113B	7131	213.2	AA FURNACE
Calcium	215.1	3111B	7140	215.1	AA FLAME
Chromium-Total	218.1	3111B	7190		AA FLAME
	218.2	3113B	7191	218.2	AA FURNACE
Chromium-Hex.	218.5		7195		AA FURNACE
		3500CRD	7196		Colorimetric
Cobalt	219.1	3111B	7200		AA FLAME
	219.2	3113B	7201		AA FURNACE
Copper	220.1	3111B	7210	220.1	AA FLAME
	220.2	3113B		220.2	AA FURNACE
Gold	231.1	3111B			AA FLAME
	231.2	3113B			AA FURNACE
Iron	236.1	3111B	7380	236.1	AA FLAME
	236.2	3113B		236.2	AA FURNACE
Lead	239.1	3111B	7420		AA FLAME
	239.2	3113B	7421	239.2	AA FURNACE
Lithium	242.1				AA FLAME
Magnesium	243.1	3111B	7450		AA FLAME
Manganese	243.1	3111B	7460	243.1	AA FLAME
	243.2	3113B		243.2	AA FURNACE
Mercury	245.1	3112B	7470	245.1	Cold Vapor
	245.4		7471		Cold Vapor
Molybdenum	246.1	3111D	7480		AA FLAME
	246.2	3113B	7481		AA FURNACE
Nickel	249.1	3111B	7520	249.1	AA FLAME
	249.2	3113B		249.2	AA FURNACE

8.1 Method References For Metals (Cont'd)

PARAMETER	EPA(a)	SM(b)	EPA(c)	EPA(d)	TECHNIQUE
Potassium	258.1	3111B	7610		AA FLAME
Selenium	270.2	3113B	7740	270.2	AA FURNACE
	270.3	3114B	7741	270.3	AA HYDRIDE
Silver	272.1	3111B	7760	272.1	AA FLAME
	272.2	3113B		272.2	AA FURNACE
Sodium	273.1	3111B	7770	273.1	AA FLAME
Thallium	279.1	3111B	7840		AA FLAME
	279.2	3113B	7841	279.2	AA FURNACE
Tin	282.1	3111B	7870		AA FLAME
	282.2	3113B	7191		AA FURNACE
Titanium	283.1	3111D			AA FLAME
	283.2	3113B			AA FURNACE
Vanadium	286.1	3111D	7910		AA FLAME
	286.2	3113B	7911		AA FURNACE
Zinc	289.1	3111B	7950	289.1	AA FLAME
	289.2	3113B			AA FURNACE
Total Metals Preparations:					
Dissloved	200.7	3030B	3005	200.7	
Recoverable	200.7	3030Fb	3005	200.7	
Total Metals	200.7	3030Fa	3010	200.7	
Furnace			3020, 3050		

TECHNIQUE:
ICP - Inductively Coupled Plasma Emission Spectrometer.
AA - Atomic Absorption Spectrometers.

METHOD REFERENCES:
EPA(a) *Water & Wastewater*: "Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991.

SM(b): "Standard Methods for the Examination of Water and Wastewater", APHA, 17th Edition, 1989.

EPA(c) *Soild Waste*: "Test Methods for Evaluating Solid Waste, Physical/ Chemical Methods", USEPA, SW-846, 3rd Edition/Revision 1, 1986-1991.

EPA(d) *Drinking Water*: "Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991.

8.2 Method References For Wet Chemistry

PARAMETER	EPA(a)	SM(b)	EPA(c)	EPA(d)	TECHNIQUE
Acidity	305.1	2310B			Titrimetric
Alkalinity	310.1	2320B		310.1	Titrimetric
BOD	405.1	5210			Electrode
Bromide	320.1				Colorimetric
	300.0				Ion-Chrom.
Chloride	325.3	4500-CL	9252		Titrimetric
	300.0			300.0	Ion-Chrom.
COD	410.1-2	5220B			Titrimetric
Color	110.2	2120B		110.2	Colorimetric
Cyanide, Amen.	335.1	4500-CN	9010		Colorimetric
Cyanide, Reac.			7.3.3.2		Colorimetric
Cyanide, Total	335.2	4500-CN	9010	335.2	Colorimetric
Flash Point			1010		Pensky-Marten
Flouride	340.2	4500-F		340.2	Electrode
	300.0				Ion-Chrom.
Hardness	130.2	2340C			Titrimetric
N-Ammonia	350.2	4500-NH3			Distillation Titrimetric
	350.2	4500-NH3			Colorimetric
N-Total (TKN)	351.2				Colorimetric
	351.3	4500-NH3			Digestion
		4500-NH3			Titrimetric
N-Nitrate	353.1	4500-NO3	9200	353.1	Colorimetric
	300.0			300.0	Ion-Chrom.
N-Nitrite	354.1	4400-NO2		354.1	Colorimetric
	300.0			300.0	Ion-Chrom.
Odor				140.1	
Oil & Grease	413.1	5520B	9070		Gravimetric
	413.2				IR Spec
Paint Filter			9095		Filter
pH	150.1	4500-H		150.1	Electrode
Phenols	420.1				Colorimetric
o-Phosphate	365.2	4500-P		365.2	Colorimetric
	300.0			300.0	Ion-Chrom.
Phoshorous	365.2	4500-P			Colorimetric
Solids (TDS)	160.1	2540C		160.1	Gravimetric
Solids (TSS)	160.2	2540D			Gravimetric
Solids (SS)	160.5	2540F			Volumetric
Solids, Total	160.3	2540B			Gravimetric

8.3 Method References For Organics

(Water and Wastewater Analysis)

PARAMETER	EPA METHOD	TECHNIQUE	SAMPLE PREPARATION
Purgeable Halocarbons	601	GC-HALL	P&T
Purgeable Aromatics	602	GC-PID	P&T
Acrolein and Acrylonitrile	603	GC-FID	P&T
Phenols	604	GC-FID	Extraction
Benzidines	605	HPLC	Extraction
Phthalate Esters	606	GC-ECD	Extraction
Nitrosamines	607	GC-NPD	Extraction
Organochlorine Pesticides	608	GC-ECD	Extraction
PCBs	608	GC-ECD	Extraction
Nitroaromatics and Isophorone	609	GC-FID + ECD	Extraction
P.A.H. (PNA)	610	HPLC	Extraction
Haloethers	611	GC-HALL	Extraction
Chlorinated Hydrocarbons	612	GC-ECD	Extraction
Organophosphate Pesticides	614	GC-FPD	Extraction
Chlorinated Herbicides	615	GC-ECD, HALL	Extraction
Purgeables Organics	624	GC/MS	P&T
Base/Neutral Extractables	625	GC/MS	Extraction
Acids Extractables	625	GC/MS	Extraction
Pesticides	625	GC/MS	Extraction

Reference: "Test Procedures for Analysis of Organic Pollutants in Water and Wastewater" USEPA, 40 CFR Part 136, 1991

8.2 Method References For Wet Chemistry (Cont'd)

PARAMETER	EPA(a)	SM(b)	EPA(c)	EPA(d)	TECHNIQUE
Solids (VTS)	160.4	2540E			Gravimetric
Conductance	120.1	2510B	9050	120.1	Electrometric
Sulfate	375.4	4500-SO4	9038	375.4	Turbidimetric
	300.0				Ion-Chrom.
Sulfide	376.2	4500-S			Colorimetric
	376.1	4500-S	9030		Titrimetric
Sulfide, Reac.			7.3.4.2		Titrimetric
Sulfite	377.1	4500-SO2			Titrimetric
MBAS	425.1	5540C		425.1	Colorimetric
T.O.C.	415.2	5310B	9060		UV, Persulfate
TOX/EOX	450.2	5310	9020		Microcoulometric
TRPH	418.1		9073		IR, Spec
Turbidity	180.1	2130B		180.1	Nephelometric

METHOD REFERENCES:

EPA(a) *Water & Wastewater*: "Methods for Chemical Analysis of Water and Wastes", EPA 600/4-79-020, March 1984.

SM(b): "Standard Methods for the Examination of Water and Wastewater", APHA, 17th Edition, 1989.

EPA(c) *Soild Waste*: "Test Methods for Evaluating Solid Waste, Physical/ Chemical Methods", USEPA, SW-846, 3rd Edition/Revision 1, 1986-1991.

EPA(d) *Drinking Water*: "Methods for Chemical Analysis of Water and Wastes", EPA 600/4-79-020, March 1984.

8.3 Method References For Organics (Cont'd)

(Soil, Liquid and Solid Waste Analysis)

PARAMETER	EPA METHOD	TECHNIQUE	SAMPLE PREPARATION
Halogenated Volatiles	8010	GC-HALL	5030
Non-Halogenated Volatiles	8015	GC-FID	5030
Aromatic Volatile Organics	8020	GC-PID	5030
Acrolein, Acrylonitrile	8030	GC-FID	5030
Acetonitrile	8030	GC-FID	5030
Phenols	8040	GC-FID	3550
Phthalate Esters	8060	GC-ECD	3550
Organochlorine Pesticides,	8080	GC-ECD	3550
PCBs	8080	GC-ECD	3550
Nitroaromatics/Cyclic Ketones	8090	GC-FID, ECD	3550
P.A.H. (PNA)	8100	GC-FID	3550
Chlorinated Hydrocarbons	8120	GC-ECD	3550
Organophosphorus Pesticides	8140	GC-FPD	3550
Chloronated Herbicides	8150	GC-ECD, HALL	3550
Volatile Organics	8240	GC/MS	5030
Semi-Volatile Organics	8250	GC/MS	3550
Volatiles (Capillary)	8260	GC/MS	5030
Semi-Volatiles (Capillary)	8270	GC/MS	3550
PNAs	8310	HPLC	3550

Reference: "Test Methods for Evaluating Solid Waste, Physical/ Chemical Methods", USEPA, SW-846, 3rd Edition/Revision 1, 1986-1991.

8.3 Method References For Organics (Cont'd)

(Drinking Water Analysis)

PARAMETER	EPA METHOD	TECHNIQUE	SAMPLE PREPARATION
Halogenated Volatiles	502.1	GC-HALL	P&T
Volatiles Organics	502.2	GC-PID+HALL	P&T
Aromatic Volatile Organics	503.1	GC-PID	P&T
EDB & DBCP	504	GC-ECD	Extraction
Pesticides & PCBs	505	GC-ECD	Extraction
Phthalates	506	GC-PID	Extraction
Nitrosamines	507	GC-NPD	Extraction
Chlorinated Pesticides	508	GC-ECD	Extraction
PCBs	508A	GC-ECD	Extraction
Chlorinated Herbicides	515.1	GC-ECD	Extraction
Purgeables Organics	524.1	GC/MS	Extraction
Purgeables Organics	524.2	GC/MS	Extraction
Semi-Volatile Organics	525	GC/MS	Extraction
Carbamates	531.1	HPLC	Filtration
Glyphosphate	547	HPLC	Filtration
Endothall	548	GC-ECD	LSE
Diquat & Paraquat	549	HPLC-UV	Extraction
Polycyclic Aromatics	550	HPLC-UV	Extraction
Polycyclic Aromatics	550.1	HPLC-UV	LSE.
Chlorinated Byproducts	551	GC-ECD	Extraction
Haloacetic Acids	552	GC-ECD	Extraction

Reference: "Methods for the Determination of Organic Compounds in Drinking Water" EPA/600/4-88/039, December 1988, Revision July 1991 and supplements.

Glossary:

Instruments:

GC	Gas Chromatograph
GC/MS	Gas Chromatograph/Mass Spectrometer
HPLC	High Performance Liquid Chromatograph

Sample Preparation Methods Used:

EXT	Extraction Methods that could be used include 3510, 3520, 3540, and 3550.
P&T	Purge and Trap
LSE	Liquid/Solid Extraction

Detectors:

ECD	Electron Capture
Fluor	Fluorescence
FID	Flame Ionization
FPD	Flame Photometric
HALL	Electrolyic Conductivity
PID	Photoionization
UV	Ultraviolet
NPD	Nitrogen/Phosphor.

9.0 DATA HANDLING, REDUCTION, REPORTING, AND VALIDATION

To obtain meaningful data, the sample collector must obtain a representative sample and then deliver it to the laboratory unchanged for analysis. The analyst must perform the analysis according to the approved method, complete calculations, and convert results to final form for permanent recording of the analytical data in meaningful, exact terms.

9.1 Data Handling

The following sections discuss processing of actual values, recording and reporting of data.

9.1.1 Significant figures

The term significant figure is used to describe a judgement of the reportable digits in a result. Proper use of significant figures gives an indication of the reliability of the analytical method used.

a. A value is made up of significant figures when it contains all digits known to be true and one last digit in doubt.

b. Final zeros after a decimal point are meant to be significant figures.

c. Zeros before a decimal point with nonzero digits preceding them are significant. With no preceding nonzero digit, a zero before the decimal point is not significant.

9.1.1 Significant figures (Cont'd)

d. If there are no nonzero digits preceding a decimal point, the zeros after the decimal point but preceding the nonzero digits are not significant. These zeros only indicate the position of the decimal point.

e. Most of the analysis utilize three significant figures. The following chart outlines how significant figures are determined:

XXX000
XXX00
XXX0
XXX
XX.X
X.XX
0.XXX

9.1.2 Rounding off numbers

Rounding off numbers is a necessary operation in all analytical areas. It is automatically applied by the limits of measurement of every instrument and all glassware. The following rules are applied when rounding:

a. If the figure following those to be retained is less than 5, the figure is dropped, and the retained figures are unchanged.

b. If the figure following those to be retained is greater than 5, the figure is dropped, and the retained figures raised by 1.

c. If the figure following those to be retained is 5, and there are no figures other than zeros beyond the five, the figure 5 is dropped, and the last-place figure retained is increased by one if it is an odd number or it is kept unchanged if an even number.

9.1.2 Rounding off numbers (Cont'd)

d. When a series of numbers is added or subtracted, the sum or difference is rounded off to the same number of decimal places as the added with the smallest number of places.

e. When multiplying or dividing numbers, all digits are used in the calculation.

f. When adding, subtracting, multiplying or dividing, the rounding off always takes place after the operation.

9.2 Data Reduction

The procedure employed to reduce raw data to final form would depend upon the type of analysis and the analytical method used.

9.2.1 Manual data generation

Manual data entry is performed by the individual analyst responsible for each section of the analysis. Raw data, as well as other information, are entered directly into a hard bound, parameter specific notebooks, while the analytical work is being run. All data pertaining to the run are entered in this book, and any problems or discrepancies are noted. Final results are then added to the sample data sheet and submitted to the Department Supervisor for review.

9.2.2 Automated data generation

When data are produced by means of automation, the raw data are outputted by an instrument which may or may not produce a result that is usable in final form. In either case these data are then transferred by the analyst to a hard bound, parameter specific, notebook, and calculations based on sample size or other factors are made, if necessary. Final results are then added to the sample data sheet and submitted to the Department Supervisor for review.

9.2.3 Quality assurance data reduction

After completion of analytical runs, quality assurance data are entered on QC work sheets, as well as in the parameter specific notebooks, The data are then taken from the work sheets, compared with established control limits and entered on control charts. If the data are not acceptable, corrective action is taken. Quality assurance data are then reviewed by the Quality Assurance Department.

9.2.4 Data reporting

Once all parameters have been completed, the sample data sheets containing final results are turned into the office for computer data entry and final report generation. The computer data are checked by the QA/QC Department and the final report is reviewed by the Laboratory Director, or his designate and any corrections or comments regarding the validity of the data are noted at this time, in the form of a qualifying statement. Once the report is in the correct, final form, it is signed by the Laboratory Director or his designate. A copy of the final report is placed in the client file. All sample data sheets, chain-of-custodies, and other pertinent items are also placed in the client file where they are maintained for at least three years.

9.3 Data Validation

Most data are validated by quality assurance and calibration data. All data must satisfy the following validation criteria before they can be reported out.

9.3.1 Validation Criteria

a. Calibration of all instrumentation is done, prior to analysis with at least three standards. A correlation coefficient of at least 0.995 (or other specific method requirement) is required for data to be acceptable.

b. Blanks are run at a frequency of 20% of the total sample volume or once per analytical batch. If a blank value is generated at or above the minimum detection limit, the analysis will be halted and corrective action taken.

c. Mid-range check standards are run at a frequency of 20% of the total sample volume. If the standard recovery is not within 10% of the original value, the analysis will be halted and corrective action taken.

d. For matrix spike and duplicate analysis, the data must be within established control limits to be considered valid. Any corrections or comments regarding the validity of the data will be noted in the form of a qualifying statement on the final report.

e. All samples are analyzed within the approved holding times. If, for some reason, holding times are violated, the deviation will be noted on the final report in the form of a qualifying statement.

9.3.2 Methods to identify and treat outliers

The quality of analytical data is assessed through the quality control work sheet. A separate sheet is maintained for each parameter measured. The sheets are kept for duplicate, spike recovery, and standard recovery data. Statistics used to determine control limits include the following:

Accuracy is measured using the following tools:

a. Percent Recovery-spike, (p)

b. Percent Recovery-standard (p)

c. Mean Recovery, (p)

d. Standard Deviation, (s)

e. Upper Control Limits, (p + 3s)

f. Lower Control Limits, (p - 3s)

g. Upper Warning Limits, (p + 2s)

h. Lower Warning Limits, (p + 2s)

9.3.2 Methods to identify and treat outliers (Cont'd)

Precision is measured using the following tools:

a. Difference or Range (R)

b. Mean Difference or Range, ($\bar{R}$)
To be statistically significant, n must be at least 20

c. Control Limit, ($3.27\bar{R}$)

d. Warning Limit, ($2.51\bar{R}$)

e. Relative Percent Difference, (RPD)
Statistically significant if n = 2

Outliers are evaluated through the limits shown above and corrective action is taken when necessary.

10.0 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

The QA/QC program at SLI/WI involves consideration and control of many variables.

10.1 Internal Control Check Samples

To maintain the reliability of reported data, quality control samples are analyzed on a regular basis per WDNR and USEPA requirements.

All quality assurance data generated in the laboratory are reviewed by the analyst at the time of generation and must fall within parameter specific quality control limits. If data are not within these limits, corrective action is taken.

Quality assurance data are reviewed by the Department Supervisor, as well as, the Laboratory Director.

10.1.1 Laboratory control samples (QC spikes)

a. QC spikes are performed by spiking a known matrix with compound(s) representative of the target analytes.

b. QC spikes are analyzed after each instrument or method calibration to verify that instrument or method performance is within acceptable limits.

c. The QC spike data are reviewed by the analyst at the time of generation. If the percent recovery does not fall within laboratory control limits, corrective action is taken.

d. Certain data which does not fall within laboratory control limits may be qualified by the Department Supervisor or Laboratory Director.

10.1.1 Laboratory control samples (QC spikes) (Cont'd)

e. QC spike data are entered onto control sheets and then entered into a computer and statistically treated. The data are then plotted out on graphs and used to examine trends and outliers.

10.1.2 Matrix spikes

a. Matrix spikes are performed by taking an aliquot of sample spiked with a known concentration of target analyte(s). The spiking occurs prior to sample preparation and analysis.

b. The matrix spike is used to document the bias of a method in a given sample matrix.

c. A matrix spike is analyzed for every 20 samples of a given matrix for a particular parameter.

d. The matrix spike data are reviewed by the analyst at the time of generation. If the percent recovery does not fall within laboratory control limits, corrective action is taken.

e. Certain data which does not fall within laboratory control limits may be qualified by the Department Supervisor or Laboratory Director.

f. Matrix spike data are entered onto control sheets and then entered onto computer. The data are then plotted out on graphs and used to examine trends and outliers.

10.1.3 Matrix spike duplicates (MSD)

a. Matrix spike duplicate (MSD) analysis is performed for many analysis. The MSD is analyzed because the result is sure to yield a "readable" value or a value which is above the method detection limit.

b. MSD data are reviewed by the analyst at the time of generation. If the relative percent difference does not fall within laboratory control limits, corrective action is taken.

c. Certain data which does not fall within laboratory control limits may be qualified by the Department Supervisor or Laboratory Director.

d. MSD data are entered onto control sheets and then entered onto computer. The data are then plotted out on graphs and used to examine trends and outliers.

10.1.4 Sample duplicates/replicates

a. Replicate analysis is performed by conducting multiple runs of a given sample through the analyzing instrument. This function is performed as needed and is helpful in determining instrument performance and precision.

b. Duplicate analysis is performed by subjecting a second test portion of a given material through all of the protocols required of the analytical procedure.

c. A duplicate sample will be analyzed for every 10 samples analyzed for a particular parameter.

10.1.4 Sample duplicates/replicates (Cont'd)

d. Duplicate sample data are reviewed by the analyst at the time of generation. If the concentration difference or relative percent difference do not fall within laboratory control limits, corrective action is taken.

e. Certain data which does not fall within laboratory control limits may be qualified by the Department Supervisor or Laboratory Director.

f. Sample duplicate data are entered onto control sheets and then entered onto computer. The data are then plotted out on graphs and used to examine trends and outliers.

10.1.5 Surrogate and internal standards

a. Surrogate and internal standards are compounds which are similar to the target analyte(s) in chemical composition and behavior in the analytical process, but which are not normally found in environmental samples.

b. Surrogate standards are used for organic analysis and are performed on each volatile, base neutral and acid extractable sample.

c. The recoveries of the surrogate compounds are used to isolate problems that could occur throughout the analytical process.

d. Surrogate standard data are reviewed by the Organics Laboratory Supervisor and corrective action is taken as needed.

10.1.5 Surrogate and internal standards (Cont'd)

e. Internal standards are run, when specified by the analytical method and reviewed by the department manager. Corrective action is taken as needed.

f. Certain data which does not fall within laboratory control limits may be qualified by the Department Supervisor or Laboratory Director.

10.1.6 Blanks

The blank is used to document contamination resulting from the analytical process.

a. A method blank consists of a clean matrix to which all reagents are added in the same volumes or proportions as used in the sample processing and is carried through the complete sample preparation and analytical procedure.

b. A system blank consists of a clean matrix in which no chemicals are added and no preparation is performed.

c. Trip blanks consist of a sample media which is brought to the sampling site and returned to the laboratory unopened and is used to document contamination attributable to shipping and field handling procedures.

d. For a blank to be acceptable for use with accompanying samples, the concentration in the blank of any analyte of concern can be no higher then the highest of either:
   (1) The method detection limit, or
   (2) Five percent of the regulatory limit, or
   (3) Five percent of the measured concentration in the sample.

10.2.2 Reagents, solvents, and gases (Cont'd)

b. Primary standards are purchased from reliable sources and stored in borosilicate glass bottles or polyethylene containers, as appropriate.

c. Standards and reagents which are prepared in the laboratory are dated and initialled by the preparer. When prescribed shelf lives are reached, solutions are discarded and freshly prepared.

d. All organic and inorganic chemicals are dated upon arrival and the following information is logged into a hardbound notebook.
   Date received
   Chemical name and grade
   Vendor name
   Quantity
   Lot Number
   Department using that chemical

e. All compressed gases purchased are of sufficient quality and grade for trace metal and trace organic analyses.

10.2.3 Glassware cleaning procedures

a. The cleaning method for glassware is dependent upon the use to which the glassware will be put.

b. Incoming sample bottles which are not precleaned by the manufacturer, are periodically checked by randomly selecting a bottle and filling it with deionized water. The bottle is left undisturbed for 24 hours, and checked to determine if any contamination exists.

c. Standard operating procedures have been developed for glassware cleaning procedures.

10.1.6 Blanks (Cont'd)

e. A blank which does not meet the above criteria may be subtracted from analytical data if it is determined that the contamination is part of the routine operations of the laboratory.

10.2 Laboratory Services

The quality of the laboratory services available to the analyst is included as an internal quality control function. A copy of the laboratory floorplan is included as attachment L.

10.2.1 Reagent water

a. Waukesha County water is passed through a carbon filter and three mixed bed deionizing tanks. Deionized water is available at every sink in the laboratory.

b. The reagent water is checked daily to determine that adequate quality is being maintained. A permanent record of the specific conductance and pH of the deionized water is kept in the laboratory.

c. Distilled water is purchased, as needed, from a reputable supplier.

d. An internal water quality study is performed on a yearly basis.

10.2.2 Reagents, solvents, and gases

a. The purity specified in analytical methods for all chemical reagents, solvents and gases is used in the laboratory. ACS analytical reagent grade chemicals are specified for most test methods.

11.0 PERFORMANCE AND SYSTEM AUDITS

Both internal and external performance and system audits are performed regularly.

11.1 Internal Audits

General internal laboratory auditing is accomplished by the QA/QC Director or Laboratory Director. This is an ongoing process, and is not limited to any particular time frame. If a particular problem arises, however, time will be devoted to those areas preferentially, until the problems are resolved.

11.1.1 Control charting

Controls charts are utilized for specified parameters to ensure that an analysis is proceeding according to present quality control objectives. A copy of a standard control chart (Attachment E) and QA worksheet (Attachment D) is provided.

a. Control charts are created for each parameter, sample matrix, and method in the following areas:
   - Matrix spike recoveries
   - QC check sample spike recoveries
   - Matrix spike duplicate RPD's
   - Sample concentration (Precision)
   - Surrogate recoveries

b. The control charts are further used to visually detect trends as well as outlying results.

c. Once twenty data points are established for a given chart, control charts are calculated and apply to the next set of twenty data points. If twenty points have not been established, interim limits will be used.

11.1.1 Control charting

d. Although the control charts are prepared by the QA/QC Department after twenty points have been established, limits are posted in each department for analysts to follow.

11.1.2 Internal performance evaluation samples

The QA/QC Director is responsible for administering an in-house performance evaluation program on a bi-annual basis. Reference standards are obtained from a reputable source and prepared by the QA/QC Department. The program involves analysis of a wide range of parameters, at varying concentration levels

a. One of the two performance evaluations consists of samples which are known to be checks by the analyst. The results, however, are not known to the analyst. This form of evaluation primarily checks method performance.

b. The second evaluation consists of check samples which are logged in as normal samples and are not known to be checks by the analyst. This evaluation is the best check of analyst performance

c. The QA/QC Director reviews all the check sample data and relays the results to the analyst. If data are not acceptable, corrective action is taken.

11.2 External Audits

External audits are a necessary quality control function and ensure, by an external association, that QA/QC requirements are being met.

11.2.1 External Inspections

External inspections and certifications are performed by the WDNR, Illinois EPA and other agencies, as well as, present and prospective clients. Copies of current certifications are included as attachment J.

11.2.2 External performance evaluation samples

The laboratory participates in the following external performance evaluation studies:

a. United States Environmental Protection Agency WS Study (Biannually).

b. United States Environmental Protection Agency WP Study (Biannually).

c. Milwaukee Metropolitan Sewage District Round Robin (Biannually).

d. Wisconsin State Laboratory of Hygiene (Annually).

12.0 PREVENTATIVE MAINTENANCE PROCEDURES

a. Preventative maintenance of all instrumentation is performed per manufacturer's instructions.

b. QC check standards double as instrument performance check standards and are analyzed each day the instrument is used.

c. Log books are kept to document maintenance schedules, maintenance performed, and details of each maintenance action.

d. Service contracts have been obtained for most instrumentation.

e. Instrument service or repair is performed by authorized service personnel.

f. Manufacturer operating and service manuals are kept on file for quick reference.

g. Critical spare parts are kept on hand as prior experience may dictate.

h. A list of laboratory instrumentation is included as attachment K.

13.0 PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

Specific procedures are set fourth to routinely assess data precision, accuracy, and completeness. An explanation of each term is given under section 4.0.

13.1 Sample Management

Before samples are logged into the LIMS, the Sample Custodian checks client chain-of-custodies, sample container labels, and laboratory quotations to ensure that the information provided is consistent. Discrepancies are brought to the clients attention and a Sample Discrepancy Form (Attachment G) is completed, if needed.

To monitor sample turnaround time, the laboratory prints out daily Late reports which highlight samples which are due or overdue. A copy of the report is given to each department and the status of samples is relayed to the sample management department, who then notifies clients. The LIMS system also has the ability to print out Hold Time reports which outline the "days until holdtime" for each incomplete sample.

13.2 Initial Data Review

The first level of analytical data assessment involves analyst review of precision and accuracy, at the bench level. At this point, quality control results are evaluated and compared with present control limits. If data are out of control, corrective action is taken.

13.3 Secondary Data Review

At the secondary review stage the sample and quality assurance data are reviewed by the Department Manager. The quality assurance data are evaluated to determine if results are acceptable.

The qualitative and quantitative sample results are examined and compared with historical sample data. Any revisions are made and data is checked for completeness. The data is put in final form and the reviewer signs and dates the data sheet.

13.4 Final Data Review

After the data are entered into the LIMS, the Laboratory Director, or his designate, checks the data entered against the data sheets primarily for typographical or transcription errors. The data is then verified and the final report is then printed. The final report is then checked by the Laboratory Director or his designate and the report is signed. File copies of the report are made and the report is mailed to the client.

14.0 CORRECTIVE ACTIONS

Incorrect test results of blind samples and quality control samples indicate that corrective action is necessary. The following are some general procedures taken when results are out of control.

14.1 Calibration Check Standard

1. Check method/instrument performance.
2. Check data calculations.
3. Rerun standard and blank.
4. Prepare new standards.
5. Prepare fresh reagents and rerun test.
6. Prepare new calibration curve and rerun.
7. Call for instrument service.

14.2 Duplicates

1. Check data calculations
2. Check possible matrix interferences.
3. Check method/instrument performance.
4. Rerun standard and blank.
5. If result does not fall within acceptable limits, the data associated with the unacceptable result is flagged as "estimated concentrations".

14.3 Matrix Spikes, Surrogate/Internal Standards

1. Check data calculations
2. Check the appropriateness of the spike.
3. Check possible matrix interferences.
4. Check method/instrument performance.
4. Rerun standard and blank.
5. If result does not fall within acceptable limits, the data associated with the unacceptable result is flagged as "estimated concentrations".

14.4 Performance Evaluation Samples

Out of range performance evaluation samples require review of the historical quality control data for any noncompliant parameters to determine if any problematic data trends exist. If feasible, samples will be rerun.

14.5 Documentation

SLI/WI makes every attempt to ensure the all aspects of corrective action are thoroughly documented in a bound corrective action notebook and include a minimum of the following information:

a. Date and initials of analyst

b. Analysis effected by problem.

b. An explanation of the problem.

c. Cause of problem, if known.

d. Steps taken to correct the problem.

Corrective action logs will be periodically reviewed by the QA/QA Department and/or Department Supervisors to verify that all procedures are being documented correctly.

15.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Formal quality assurance reports or memos will be written by the QA/QC Director as needed. They will include a description of any ongoing problems and their corrective actions. The reports will also contain results of performance evaluation samples and any other information relevant to the pursuit of quality.

Reports will be written to the President, Laboratory Director, and all department supervisors. The Laboratory Director will be kept informed of any unresolved problems on a daily basis, and will become involved in any situation as necessary.

A staff meeting is held once per month and is attended by the President, QA/QC Director, Laboratory Director, Technical Services Manager, and other pertinent individuals. The meetings are used to discuss laboratory operations, including QA/QC. Also, meetings are scheduled with department employees in order to discuss important QA/QC information.

ATTACHMENTS

The State of Wisconsin

DEPARTMENT OF NATURAL RESOURCES

Hereby grants

Certification

under the provisions of ch. NR 149, Wisconsin Administrative Code to:

Suburban Laboratories, Inc.
4140 Litt Drive
Hillside, IL 60162

999318210
Laboratory ID Number

Issued: October 27, 1993

Expires: June 30, 1994

for the following test categories:

* Oxygen Utilization
* Nitrogen
  Ammonia
  Nitrite
  Nitrate
  Kjeldahl Nitrogen
* Phosphorus
* Physical
* General I
* General II
  Chloride
  Cyanide
  COD
  Fluoride
  Phenolics
  Sulfate
* General III
  Ignitability
  Reactivity
  TCLP
  TOC
  TOX
* Metals I
  Silver
  Aluminum
  Arsenic
  Boron
  Barium
  Beryllium
  Calcium
  Cadmium
  Cobalt
  Chromium
  Copper
  Iron
  Hexavalent Chromium
  Mercury
  Potassium
  Magnesium
  Manganese
  Molybdenum
  Sodium
  Nickel
  Lead
  Antimony
  Selenium
  Tin
  Strontium
  Thallium
  Vanadium
  Zinc
* Metals II
  Titanium
* Organics; Purgeable
* Organics; Base/Neutral
  Semivolatiles by GC/MS
* Organics; Acid
* Liquid Chromatography
  Polynuclear Aromatic Hc
* Petroleum Hydrocarbons
  Diesel Range Organics
  Gasoline Range Organics
  Petroleum VOCs
  T Recov Petro Hydrocarbon
* Organics; Organochlorine
  PCBs
  Pesticides
* Any Single Analyte
  2,4-D and Silvex

George E. Meyer
Secretary

Administrator, Division for Environmental Quality

Director, Office of Technical Services

This certificate is valid unless revoked or suspended and supercedes all previous certificates.

Form 4800-10 Rev. 2-93

The State of Wisconsin

DEPARTMENT OF NATURAL RESOURCES

Hereby grants

Certification

under the provisions of ch. NR 149, Wisconsin Administrative Code to:

Suburban Laboratories of Wisconsin Inc
N8 W22520-B Johnson Drive
Waukesha, WI 53186

241178850
Laboratory ID Number

Issued: August 4, 1993

Expires: June 30, 1994

for the following test categories:

* Oxygen Utilization	Calcium
* Nitrogen	Cadmium
Ammonia	Cobalt
Nitrite	Chromium
Nitrate	Copper
Kjeldahl Nitrogen	Iron
* Phosphorus	Mercury
* Physical	Potassium
* General I	Magnesium
* General II	Manganese
Chloride	Molybdenum
Cyanide	Sodium
COD	Nickel
Fluoride	Lead
Phenolics	Antimony
Sulfate	Selenium
* General III	Thallium
Corrosivity	Vanadium
Ignitability	Zinc
Reactivity	* Petroleum Hydrocarbons
TCLP	Diesel Range Organics
* Metals I	Gasoline Range Organics
Silver	Petroleum VOCs
Aluminum	
Arsenic	
Barium	
Beryllium	

George E. Meyer
Secretary

Administrator, Division for Environmental Quality

Director, Office of Technical Services

This certificate is valid unless revoked or suspended and supercedes all previous certificates.

Form 4800-10 Rev. 2-93

STATE OF ILLINOIS

DEPARTMENT OF PUBLIC HEALTH

CERTIFICATE OF APPROVAL

FOR PUBLIC HEALTH LABORATORY SERVICE

SUBURBAN LABORATORIES, INC.

4140 LITT DRIVE, HILLSIDE, ILLINOIS 60162

---

is approved for the following laboratory examinations:

HETEROTROPHIC PLATE COUNT FOR WATER

TOTAL COLIFORM EXAMINATION OF SAMPLES OF WATER FROM PUBLIC WATER SUPPLIES AND THEIR SOURCES (MF & MTF)

FECAL COLIFORM AND FECAL STREPTOCOCCUS EXAMINATION OF SAMPLES OF WATER FROM PUBLIC WATER SUPPLIES AND THEIR SOURCES(MF)

Linda Foss, Michael Katamay, Ebtesam Samuel, and Priscilla Simons are approved for the above tests.

[redacted]

Registry No. 17585

Date February 11, 1993

For the period ending February 11, 1995

John R. Lumpkin, M.D.

Director of Public Health

STATE OF ILLINOIS
ENVIRONMENTAL PROTECTION AGENCY

AWARDS THIS

CERTIFICATE OF APPROVAL

TO

Suburban Laboratories, Inc.

4140 Litt Drive

Hillside, IL 60162-1183

FOR THE FOLLOWING CHEMICAL ANALYSES OF ENVIRONMENTAL SAMPLES:

Arsenic, Barium, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Mercury, Selenium, Silver, Zinc, Calcium, Sodium, Chloride, Sulfate, Total Alkalinity, Total Dissolved Solids, Cyanide, Fluoride, Nitrite, Nitrate, pH All Phase I, Phase II, and Phase V regulated VOCs, Aldrin, DDT, Dieldrin, Endrin, Heptachlor, Heptachlor Epoxide, Lindane, Methoxychlor, Toxaphene, and Chlordane in potable water.

CERTIFICATE NUMBER : 100225

DATE OF ISSUE : 5/93

DATE OF EXPIRATION : 5/96

DIRECTOR

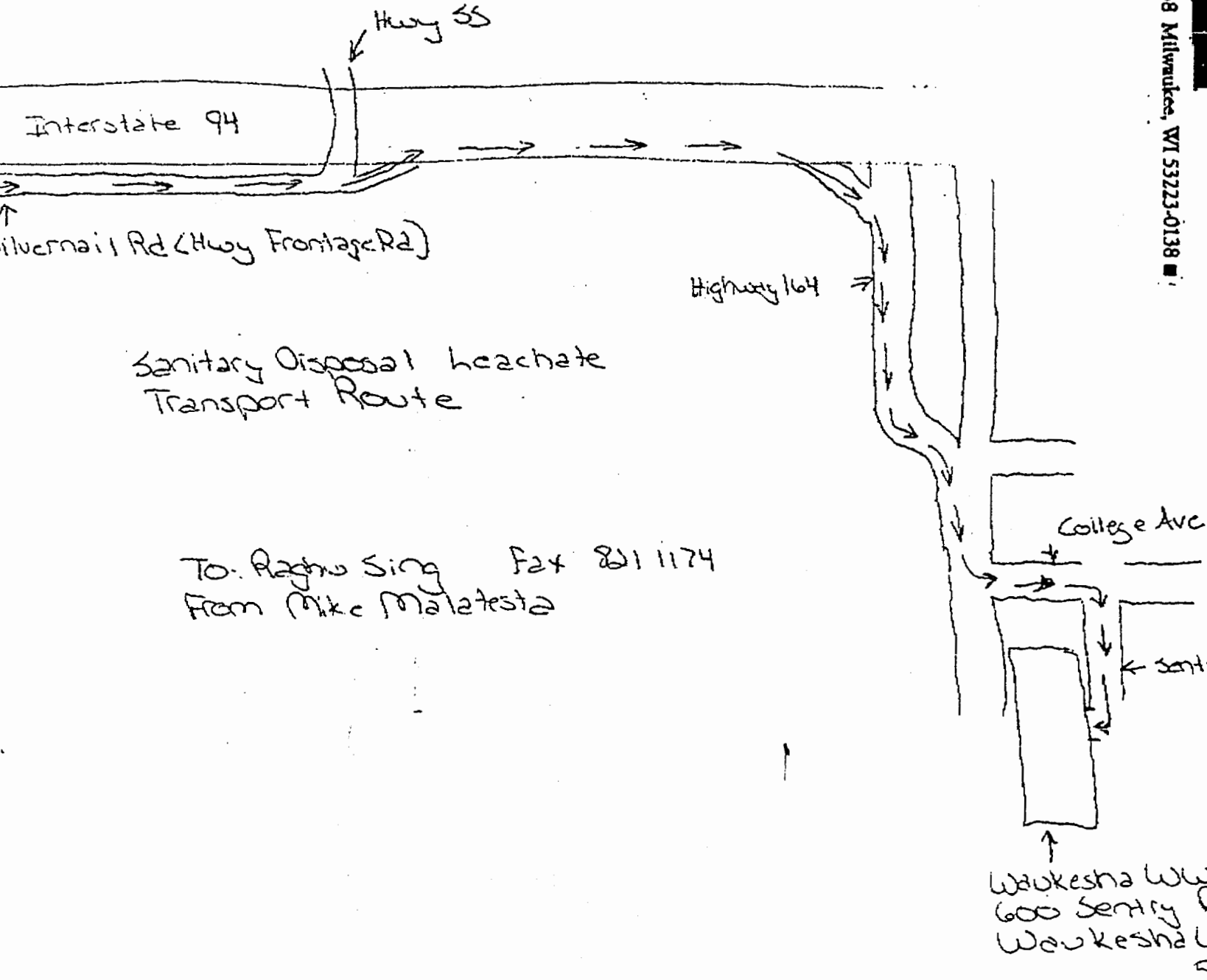
CERTIFICATION OFFICER

DIVISION MANAGER

Appendix D
Hauling Route for Waste

[redacted]

[redacted] P.O. Box 23138 Milwaukee, WI 53223-0138 [redacted]



Sanitary Disposal Leachate
Transport Route

To: Raghu Sing Fax 801 1174
From Mike Malatesta

Appendix E
Reporting Forms

WEEKLY GENERAL MONITORING REPORT

SANITARY TRANSFER & LANDFILL, DELAFIELD, WISCONSIN

Date	Name of Person	ACCESS ROAD LEADING TO LOADING AREA	LANDFILL COVER (DEPRESSIONS ETC.)	OTHER OBSERVATIONS
		Comments	Comments	Comments

WEEKLY METHANE MONITORING REPORT

SANITARY TRANSFER & LANDFILL, DELAFIELD, WISCONSIN

Date	Name of Person	WEST									EAST		Comments
		Per cent (%) Methane									% Methane		
		Location									Location		
		G-1	G-2	G-3	G-4	G-5	G-6	G-7	G-8	Blower # 1	Blower # 2	Blower # 3	

WEEKLY LEACHATE AND CONDENSATE HAULING REPORT

SANITARY TRANSFER & LANDFILL, DELAFIELD, WISCONSIN

Date	Hauling Company	10,000 GALLON TANK		2,000 GALLON TANK		CONDENSATE TANK	
		Gallons Pumped	No. of Loads	Gallons Pumped	No. of Loads	Gallons Pumped	No. of Loads
Weekly Total							
Weekly Total Gallons							
Weekly Total Loads							

GROUNDWATER MONITORING FOR ON-SITE WELLS, LYSIMETER (LP-2), & LEACHATE MANHOLE

SANITARY TRANSFER & LANDFILL, DELAFIELD, WISCONSIN Samplers .....

Date / Time	Well ID/ LP-2/ LMH	FIELD OBSERVATIONS													
		PVC Elevation feet,MSL	Depth to Water feet	GW Elevation feet,MSL	Sampling Device	Gallons Water Removed	Conductivity	Field Temper-ature	Odor	Turbidity	Color	pH	Deconta-mination Procedure	Well Condition	Other Comments
	E-2BR	1011.30													
	E-3R	1028.77													
	E-4	1036.02													
	E-5	1026.38													
	E-6	1065.34													
	E-6B	1064.45													
	E-7	1001.14													
	E-8	1030.69													
	LP-2	1022.57													
	Leachate	N/A	N/A	N/A											

GROUNDWATER MONITORING FOR OFF-SITE PRIVATE WELLS

SANITARY TRANSFER & LANDFILL, DELAFIELD, WISCONSIN Samplers .....

Date / Time	Well ID.	FIELD OBSERVATIONS							
		Sample Collection Location (Faucet, etc.)	Conductivity	Field Temperature	Odor	Turbidity	Color	pH	Other Comments
	PW # 4								
	PW # 5								
	PW # 11								
	PW # 13								
	PW # 15								
	PW # 16								
	PW # 17								
	PW # 21								
	PW # 54								
	PW # 55								

GROUNDWATER MONITORING FOR OFF-SITE PRIVATE WELLS

SANITARY TRANSFER & LANDFILL, DELAFIELD, WISCONSIN Samplers .....

Date / Time	Well ID.	FIELD OBSERVATIONS							
		Sample Collection Location (Faucet, etc.)	Conductivity	Field Temper-ature	Odor	Turbidity	Color	pH	Other Comments
	PW # 91								
	PW # 92								
	PW # 94								
	PW # 95								
	PW # 96								
	PW # 97								
	PW # 99								
	PW # 100								
	PW # 101								
	PW # 102								

GROUNDWATER MONITORING FOR OFF-SITE PRIVATE WELLS

SANITARY TRANSFER & LANDFILL, DELAFIELD, WISCONSIN Samplers .....

Date / Time	Well ID.	FIELD OBSERVATIONS							
		Sample Collection Location (Faucet, etc.)	Conductivity	Field Temperature	Odor	Turbidity	Color	pH	Other Comments
	PW # 103								
	PW # 104								
	PW # 105								
	PW # 106								

SANITARY TRANSFER & LANDFILL, DELAFIELD, WISCONSIN

LANDFILL GAS EXTRACTION SYSTEM MONITORING

WELL DESIGNATION	DATE	GAS TO VENTS					VELOCITY (FT/MIN)	CUMMULATIVE GAS FLOW (CUBIC FEET)	COMMENTS	MEASURED BY:
		PRESSURE (IN. OF H2O)	TEMP. (F)	OXYGEN (% O2)	CO2 (%)	METHANE (% CH4)				
G-1										
G-2										
G-3										
G-4										
G-5										
G-6										
G-7										
G-8										
BLOWER #1										
BLOWER #2										
BLOWER #3										

SAMPLER NAME _____

SEMI-ANNUAL METHANE MONITORING REPORT FORM

SAMPLING DATE _____

WELL DESIGNATION	METHANE READING	WELL DESIGNATION	METHANE READING	WELL DESIGNATION	METHANE READING
D-4		V-1		M-1	
D-5		V-2		M-2	
D-6		V-3		M-3	
D-7		V-4		M-4	
D-11		V-5		M-5	
D-12		V-6		M-6	
D-13		V-7		M-7	
D-14		V-8		M-8	
D-15		V-9		M-9	
D-16		V-10		M-10	
D-17		V-11			
D-20		V-12		L-2	
D-22					
D-24					
D-25					
D-26					
D-27					

LIST OF EXHIBITS

Exhibit : Figure 4. Project Location Map