## 2021 Hazardous Waste Scanning Project

## File Form Naming Convention.

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Gerry

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# QUALITY ASSURANCE/ QUALITY CONTROL PLAN

## PERIMETER SURVEY AND LONG TERM MONITORING PROGRAM IMPLEMENTATION

## PHASE I

## LOVE CANAL REMEDIAL PROJECT MONITORING PROGRAM (TASK VC) NIAGARA FALLS, NEW YORK

**PREPARED FOR**

**New York State**
**Department of**
**Environmental Conservation**
50 Wolf Road, Albany, New York 12233
Henry G. Williams, *Commissioner*

Division of Solid and Hazardous Waste
Norman H. Nosenchuck, P.E., *Director*

**E.C. JORDAN CO.**

**SEPTEMBER 1985**

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# QUALITY ASSURANCE/QUALITY CONTROL PLAN
FOR
LOVE CANAL REMEDIAL PROJECT
TASK V-C
PERIMETER SURVEY AND IMPLEMENTATION
OF THE LONG TERM MONITORING PLAN
PHASE I

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Date

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# 3.0 PROGRAM DESCRIPTION

## 3.1 PURPOSE

The purpose of this Quality Assurance/Quality Control (QA/QC) Plan is to indicate prime responsibilities and prescribe requirements for assuring that the investigation undertaken by E.C. Jordan Co. for the New York State Department of Environmental Conservation (NYSDEC) at Love Canal is planned and executed in a manner consistent with quality assurance objectives. This QA/QC Plan provides guidance and specifications to assure that:

1. field determinations and analytical results are valid through preventive maintenance, calibration and analytical protocols;
2. samples are identified and controlled through sample tracking systems and chain-of-custody protocols;
3. records are retained as documentary evidence of the quality of samples, applied processes, equipment, and results;
4. generated data are validated and their use in calculations is documented;
5. calculations and evaluations are accurate, appropriate and consistent throughout the projects; and
6. safety is maintained by requiring inclusion of the Health and Safety staff function in the project organization.

## 3.2 SCOPE

The requirements of this QA/QC Plan apply to all E.C. Jordan Co. and subcontractor activities as appropriate for each specific task undertaken for NYSDEC.

The prime responsibilities indicated in Section 4.0 extend to all quality-related controls and activities. The quality control and quality assurance elements in Sections 3, 5, 6 and 9 address essential project specific components, i.e, where the consequences of error or failure would be unacceptable. The project specific QA/QC requirements are aimed at preventing isolated sub-standard or erroneous actions from occurring in these essential areas.

The content and format of the QA/QC Plan is based on "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans - QAMS-005/80" prepared by U.S. Environmental Protection Agency's (USEPA's) Office of Research and Development.

## 3.3 PROJECT SUMMARY

Task V of the remedial action plans for the Love Canal site in Niagara Falls, New York, included a borehole investigation program along the perimeter of a proposed cutoff wall (Task VA), the design of a long term monitoring program (Task VB) and an option for the installation of the monitoring program with additional explorations as necessary to close data gaps (Task V-C). Tasks VA and VB have been completed, and the State of New York has contracted E.C. Jordan to perform Task V-C. Phase I of Task V-C includes the completion of a perimeter survey about the Canal (begun during the Task VA borehole program) to identify the outermost extent of contaminant migration, and the installation of wells and piezometers identified in the Task VB long term monitoring program design report.

NYSDEC has identified four objectives for the Task V-C Monitoring Program Implementation, Perimeter Survey and Long Term Monitoring Program (First Year). These four objectives are:

Objective A. Provide information for evaluation of the present and continuing effectiveness of remedial actions including: 1) the existing barrier drain; 2) the synthetic membrane and extended clay cap; and 3) the utility cutoff walls.

Objective B. To provide information for NYSDEC to facilitate implementation of system(s) to assess the present and long term environmental quality of the Love Canal area.

Objective C. Facilitate assessment of the extent of contamination outside the Canal as a result of chemical migration through the ground and groundwater.

Objective D. Provide data for NYSDEC to make an evaluation of remedial alternatives, including the no action alternative, to remediate any contamination identified outside the Canal.

Phase I activities, through the perimeter survey and from information gathered during the installation of the planned monitoring stations, will provide a large base of information toward the accomplishment of these objectives.

The field exploration programs have been designed to address the following areas of concern:

- further assess the extent of contamination beyond the limits of the Canal;
- evaluate the influence of the barrier drain on the groundwater levels within the Canal;
- further evaluate the zone of influence of the barrier drain on each of the geologic units adjacent to the drain;
- assess the influence of the fractures present in the weathered clay stratum on permeability;

- evaluate the hydrogeologic characteristics of the bedrock at selected locations both near the soil-rock interface and throughout the dolomite bedrock unit; and
- install a series of wells located beyond the areas of significant contamination for the purposes of the long term monitoring program.

The exploration program will include hollow stem auger borings, cased borings, and the installation of wells and test pits. The exploration for Phase I will include:

- borings and wells in contaminated areas;
- perimeter survey monitoring wells;
- nested wells for monitoring the barrier drain;
- test pits;
- bedrock wells; and
- monitoring wells on the 93rd Street School site.

Samples will be collected of soils and groundwater. Screening for volatile organics will be accomplished with a field gas chromatograph. Samples selected for further analyses will be forwarded to a NYSDEC-approved laboratory.

# 4.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

## 4.1 ORGANIZATION

Jordan operates under a matrix system in which personnel belong to functional departments and, at the same time, are assigned to projects. Functional departments are responsible for developing and maintaining Jordan's engineering and scientific disciplines. They also provide for personnel training and the establishment of engineering and scientific standards and services. Project organizations are responsible for achieving project objectives.

This portion of the Quality Assurance/Quality Control Plan addresses the project organization. Those who are assigned to a project organization are responsible for properly using functional organization resources. In this way, the resources of the entire Jordan Co. are made available to each project, but responsibility for initiating services and for ensuring acceptable results remains within the project organization.

The Technical Director (TD) will report to the Project Manager (PM), the primary client contact concerning contractural matters, and who will also serve as the secondary NYSDEC contact for daily project activities. The Project Review Board (PRB) will work directly with the TD and report administratively to the PM. The Health & Safety/QA coordinator and the PM will report to the Responsible Corporate Officer (RCO), who possesses the authority necessary to commit corporate resources to the project.

## 4.2 RESPONSIBILITY FOR QUALITY ASSURANCE

Quality assurance is an essential component of project management and is the responsibility of the Quality Assurance Coordinator. His role is to assist the Project Manager in meeting the goals set forth in the QA/QC Plan. The role of the Project Manager is to coordinate the separate yet interrelated activities of the QA Coordinator, the Technical Director, the Project Review Board, and the project staff.

The QA Coordinator is also assigned responsibility for quality assurance. This responsibility carries with it the authority to initiate, modify, and stop activities, as appropriate for the assurance of project quality.

## 4.3 SPECIFIC RESPONSIBILITIES

Figure 4-1 shows the project organization and its principal lines of communication. The responsibilities of the Jordan project positions and support organizations are summarized below.

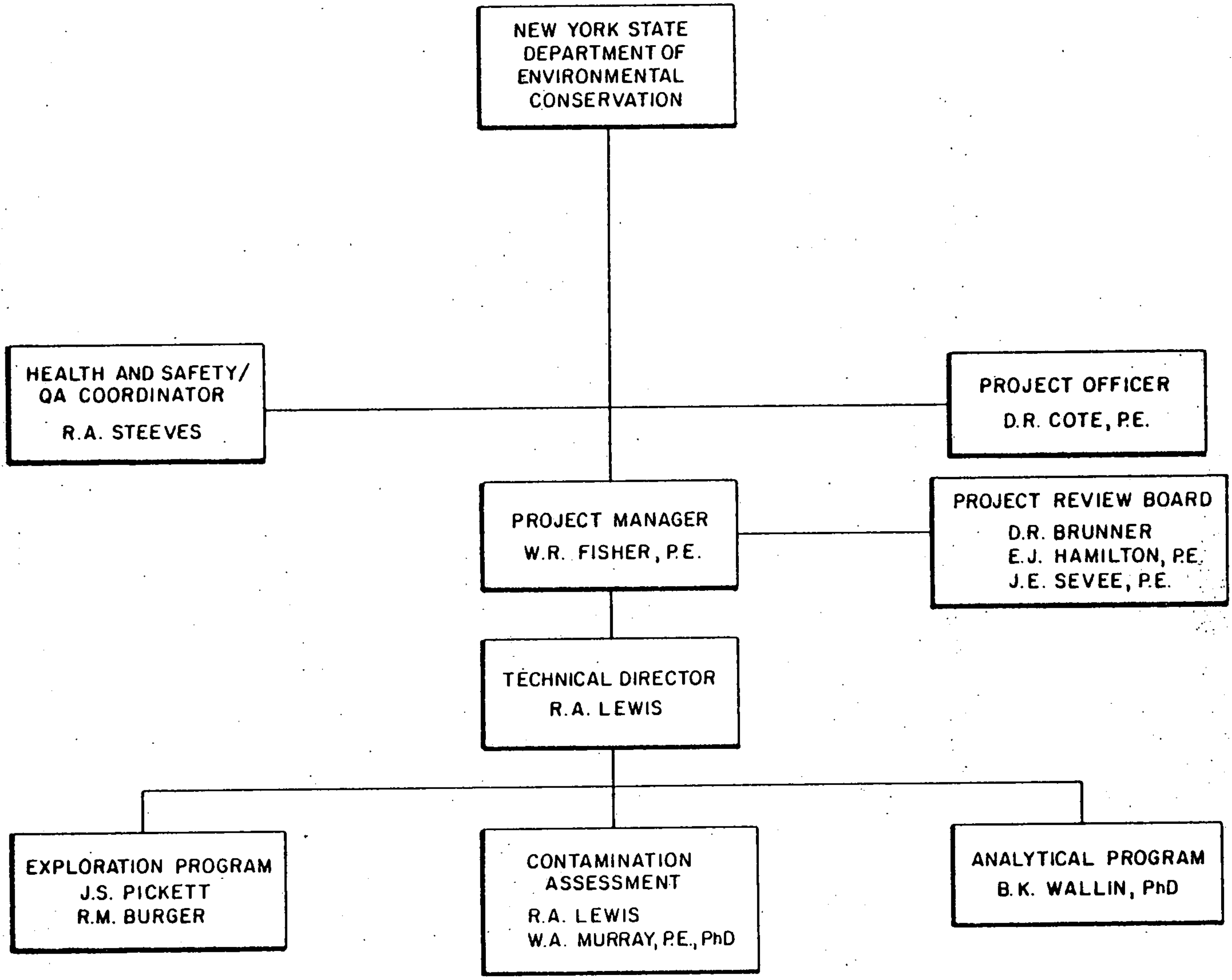

**FIGURE 4-1**
**PROJECT ORGANIZATION**
**LOVE CANAL REMEDIAL PHASE I PROJECT**
**TASK V-C**

E.C.JORDAN CO.

The Technical Director (TD) will be responsible for all technical activities on the project including interfacing with the NYSDEC on a day-to-day basis concerning technical project matters; scheduling; interfacing with contract laboratories as needed; monitoring the performance of project staff; and meeting with the NYSDEC Project Officer to discuss completed and planned project activities. The Technical Director will also be responsible for communicating unanticipated findings of an emergency nature directly to the NYSDEC Project Officer.

Jordan's Project Manager (PM) will be responsible for initiating project activities including the development of a project work plan and Health and Safety Plan; identifying and fulfilling project staff, equipment, and resource requirements, interfacing with the NYSDEC on all cost, contractural, and administrative matters; monitoring task activities to ensure compliance with established budgets, schedules, and the scope of work; briefing the Responsible Corporate Officer and other company officials regularly on the status of the project; and preparing monthly technical/cost progress reports.

The Project Review Board (PRB) will provide senior-level technical review of the completeness, consistency, and overall quality of work performed, any recommendations for additional work; and general technical guidance as needed throughout the duration of the project.

The Health and Safety/QA Coordinator (QAC) will be responsible for review and approval of the QA/QC Plan and Health and Safety Plans, as well as reviewing project activities to ensure that all provisions of the plans are being followed.

Finally, the Technical Staff will be responsible for conducting project activities in accordance with the procedures and protocols specified in this QA/QC Plan, the project work plan, and the Health and Safety Plan.

Jordan will provide additional support to the project:

> The Environmental Laboratory Services group will provide guidance and services related to field gas chromatographic (GS) analysis, will oversee the activities of the contract laboratory, and will be responsible for data validation.
>
> The Administration Group will provide support in the areas of graphics, reproduction, word processing, data processing, staffing and other administrative areas.

# 5.0 QUALITY ASSURANCE OBJECTIVES

## 5.1 GENERAL

The quality of measurements made during this study will be determined by the following characteristics: accuracy; precision; representativeness; completeness; and comparability. Specific objectives for each characteristic are established to develop sampling protocols, and identify applicable documentation, sample handling procedures and measurement system procedures. These objectives are established based on site conditions, objective of the project, and knowledge of available measurement systems. The subsequent use of these measurements in calculations and evaluations is also subjected to aspects of this QA/QC Plan as described in the following sections.

## 5.2 REPRESENTATIVENESS

Measurements will be made so that results are as representative of the media (e.g. - air, soil, water) and conditions being measured, as possible. Sampling protocols will be developed to assure that samples collected are representative of the media. Sample handling protocols (e.g., storage, transportation) are selected to protect the representativeness of the collected sample. Proper documentation will establish that protocols have been followed and sample identification and integrity assured.

All samples will be collected by Jordan for analysis in a NYSDEC certified contract laboratory (to be determined) except for those measurements made in the field such as screening for volatile organics via GC, pH, and specific conductance. Sample collection and handling will be in accordance with the procedures in this QA/QC Plan.

## 5.3 PRECISION AND ACCURACY

Precision, the ability to replicate a value, and accuracy, the ability to obtain a true value, are addressed for all data generated. Data quality objectives for precision and accuracy are established for each major parameter to be measured at the site. These objectives are based on prior knowledge of the capabilities of the measurement system to be employed, selected in accordance with the requirements of the project. The precision and accuracy requirements vary, dependent on their intended use. For example, a screening tool to identify the general extent of chemical distribution will not require the same precision and accuracy required to define the exact nature and amount of chemicals present at specific locations. Section 9.2 contains information regarding analytical procedures.

Calculations performed with the data generated are also checked for accuracy by the Task Leader or his designee, and precision, i.e. comparability of calculation efforts between tasks, is assured by the TD.

## 5.4 COMPLETENESS

The characteristic of completeness is a measure of the amount of valid data obtained compared to the amount that was expected to be obtained under normal conditions. The amount of valid data expected is established based on the measurements required to accomplish project objectives. The number of samples to be obtained is often specified for each site. Because sampling and waste characterization activities often rely on a field protocol, this plan provides an upper limit on the number of samples to be collected. For example, multiple depth soil sample collection may be specified, but rock outcroppings may be encountered prior to reaching the specified depth. In that case, it would not be possible to obtain a predetermined number of soil samples. The extent of completeness must therefore be reviewed on a relative basis for sample collection activities. Completeness of data handling systems is described in Sections 10.0, 12.0 and 14.0.

## 5.5 COMPARABILITY

The characteristic of comparability reflects both internal consistency of measurements made at the site and expression of results in units consistent with other organizations reporting similar data. Each value reported for a given measurement should be similar to other values within the same data set and within other related data sets. Comparability of data and measuring procedures must also be addressed. This characteristic implies operating within the calibrated range of an instrument and utilizing analytical methodologies which produce comparable results (e.g., data obtained for phenol (4AAP) is not comparable to data obtained for phenol (GC/MS)).

Measurements compared to similar measurements which appear as "outliers" will be reassessed. Units of measurement will be externally comparable by utilizing the appropriate standard units for each measurement system.

## 5.6 QUALITY ASSURANCE OBJECTIVES

The primary objective of the QA/QC plan is to provide protocol and procedures which will lead to the production of the highest quality data possible given the setting, the sampled media, the selected analytical parameters and the methodologies employed for analysis. Standard Jordan field protocol, as described herein, will be utilized in sample collection, screening and determinations of the approximate limits of contaminant migration during the perimeter survey. Once this boundary has been identified based on the field screenings, it will be confirmed by analyses of samples submitted to the NYSDEC-CLP. Samples of groundwater taken from wells and surface waters constituting portions of the long-term monitoring program will also be submitted to the NYSDEC-CLP. Specific objectives of the QA/QC plan for Task V-C of the Love Canal Remedial Project are:

- to collect sufficient field, sampler and trip blank samples and field duplicates to allow an assessment of sample representativeness and sample collection protocol precision;

- to analyze sufficient internal duplicates, blanks, reference standards and matrix spike samples to allow an assessment of analytical precision and accuracy. Sufficiency of analytical QC procedures is specified by the NYSDEC-CLP; and

- to produce documented, consistent and technically defensible analytical and project reports.

# 6.0 SAMPLING PROCEDURES

## 6.1 GENERAL

The quality of sample collection techniques is assured by keying the technique used to both the media/matrix to be sampled and the analytes of interest. For example, samples intended for semi-volatile organic analyses are collected in glass bottles; samples for volatile organic analyses are collected in Teflon-septum-capped glass vials with "zero" headspace to minimize diffusive and evaporative losses; and most samples for inorganic analyses are collected in linear polyethylene bottles. Sample containers provided by Jordan are prepared in a manner consistent with USEPA protocol, as noted in the following section.

Acquisition of environmental samples also requires specialized collection techniques to preserve their integrity and ensure that a representative portion of the source is collected. Media-specific sample collection techniques are specified in the following sections.

Further, unless the proper sample bottle preparation and sample preservation measures are taken in the field, sample composition can be altered by contamination, degradation, biological transformation, chemical interactions, and other factors during the time between sample collection and analysis. Typical sample bottle preparation protocols are presented in Section 6.2. Steps taken to maintain the in-situ characteristics required for analysis may include refrigeration of samples at 4°C, freezing, pH adjustment, and chemical fixation. Samples are preserved according to the protocol established for the specific analytical method selected to obtain the desired data. Table 6-1 provides more specific information.

Water sample containers are generally filled directly from the source, sampler or pump discharge without special considerations. A major exception is the collection of volatile organic analyte (VOA) samples. VOA samples must be collected as specified below. Each sample is taken in duplicate.

1. Uncap the sample bottle, taking care not to touch the teflon-faced septa. If the septa is contaminated in any way, the entire vial should be replaced.

2. If a chlorine residual is present, add three drops of 10 percent sodium thiosulfate to the sample container prior to filling the bottle.

3. Pour the sample slowly, minimizing air entrainment, into the sample bottle. Pour sample until the bottle slightly overflows.

4. Place the teflon-faced silicon rubber septa on the convex meniscus, teflon side (shiny side) down and screw cap on.

5. Invert the bottle, tap lightly, and check for air bubbles.

## TABLE 6-1
## SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS
## CERCLA/RCRA SAMPLES

| | Concentration | Container | Sample Size | Preservation | Holding Time |
|---|---|---|---|---|---|
| WATER | | | | | |
| Organics GC & GC/MS | VOA | glass | 2 x 40 mℓ | Cool to 4°C | 7 days |
| | Extractables | | | | |
| | Low | amber glass | 2 x 80 oz. or 4 x 1 ℓ | Cool to 4°C | 5 days to extraction<br>40 days after extraction |
| | Medium | wide-mouth glass | 4 x 32 oz. | None | Same as above |
| Inorganics | Metals | | | | |
| | Low | polyethylene | 1 ℓ | $HNO_3$ to pH $\leq 2$ | 6 months (Hg-30 days) |
| | Medium | wide-mouth glass | 16 oz. | None | 6 months |
| | Cyanide | | | | |
| | Low | polyethylene | 1 ℓ | NaOH to pH >12 | 14 days |
| | Medium | wide-mouth glass | 16 oz. | Cool to 4°C | |
| Organic/Inorganic | High Hazard | 8-oz. wide-mouth glass | 6 oz. | None | 14 days |
| COD | -- | polyethylene | 0.5 ℓ | $H_2SO_4$ to pH <2 | 28 days |
| TOC | -- | polyethylene | 0.5 ℓ | HCl to pH <2 | 28 days |
| Oil & Grease | -- | glass | 1.0 ℓ | $H_2SO_4$ to pH <2 | 28 days |
| Phenols | -- | polyethylene | 1.0 ℓ | $H_2SO_4$ to pH <2 | 28 days |
| General Chemistry | -- | polyethylene | 1.0 ℓ | None | -- |
| SOIL | | | | | |
| Organics GC & GC/MS | VOA | 2 x 120 mℓ wide-mouth glass | 240 mℓ | Cool to 4°C | 10 days |
| | Extractables | | | | |
| | Low/Medium | 8 oz. or 2 x 4 oz. wide-mouth glass | 6 oz. | Cool to 4°C | 10 days to extraction<br>40 days after extraction |
| Inorganics | Low/Medium | 8 oz. or 2 x 4 oz. wide-mouth glass | 6 oz. | Cool to 4°C | NA |
| Organic/Inorganic | High Hazard | 8 oz. wide-mouth glass | 6 oz. | None | NA |
| Dioxin | All | 4 oz. wide-mouth glass | 4 oz. | None | NA |
| EP Toxicity | All | 250 mℓ polyethylene | 200 grams | None | NA |
| AIR | | | | | |
| Volatile Organics | Low<br>Medium | Charcoal Tube 7 cm long, 6mm OD, 4mm ID | 100 ℓ air | Cool to 4°C | NA |

6. If air bubbles are present, open the bottle, add sample to eliminate air bubbles, and reseal. Repeat this procedure until the bottle is filled and no air bubbles are detected.

## 6.2 PREPARATION OF SAMPLE CONTAINERS

### 6.2.1 Containers For Analyses To Be Performed By Contract Laboratory

Containers required for analyses to be performed by the Contract laboratory include those for volatile organics, semi-volatile organics, PCB/pesticides and dioxin. These will be prepared by the selected contract laboratory in accordance with the protocol specified by the NYSDEC-CLP.

### 6.2.2 Field GC - Volatile Organic Analytes (VOA) Sample Containers

The procedure for cleaning the 40-ml glass vials, caps, and teflon-faced silicon rubber septa is as follows:

- Wash the vials and septa thoroughly with hot detergent[1] water.
- Rinse the above items thoroughly with hot tap water.
- Rinse the above items thoroughly with blank[2] water.
- Place the vials (upright) and septa in an oven at 105°C for one hour or until dry, whichever is longer.
- Remove vials and septa from oven and cool in a hood located in an area protected from organic and other sources of contamination.
- After the bottles have cooled, place the septa (shiny surface down) and the cap on the bottle and seal screw cap on bottle. The septa should be handled with stainless steel tweezers.
- Do not open bottles until they are to be filled with sample.
- Label each case lot with date of cleaning.

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[1] Liqui-nox or equivalent.

[2] The "blank water" used is identical to the reagent water (ASTM Type II or better) used to prepare sample blanks and is certified monthly by ELS and the State of Maine Public Health Laboratory.

### 6.2.3 Preparation of Pump Tubing

Adequate lengths of 3/8 inch ID teflon tubing and 3/8 inch ID silicon tubing will be prepared if pump tubing is specified for the sampling episode. The tubing preparation procedure is:

- Pump detergent solution through system for 2 minutes.
- Pump clean hot water through system for 2 minutes or until clear, whichever is longer.
- Pump blank water through system for 2 minutes.
- Pump methanol or isopropanol through system for 2 minutes.
- Pump blank water through system for 2 minutes.
- Seal tubing ends, wrap and label with date of cleaning.

## 6.3 SAMPLE SITE LOCATION

Sample site locations are depicted in Figure 6-1. These locations were selected to meet the objectives stated in Section 3.3. A detailed description of the sample location selection process may be found in "Love Canal Remedial Project - Long-Term Monitoring Program Design, Volume 1" prepared by E.C. Jordan Co. in April 1985.

Each borehole/test pit sample site will be located by a New York State certified surveyor.

Photographs of sample sites should also be taken.

## 6.4 SOIL SAMPLING

### 6.4.1 General

Soil sampling programs are undertaken to define the location, nature and concentration of contaminants in a site subsurface. The location and distribution of contaminants at a given site are governed by many factors, including:

- site operation or waste disposal practices
- site design
- site closure

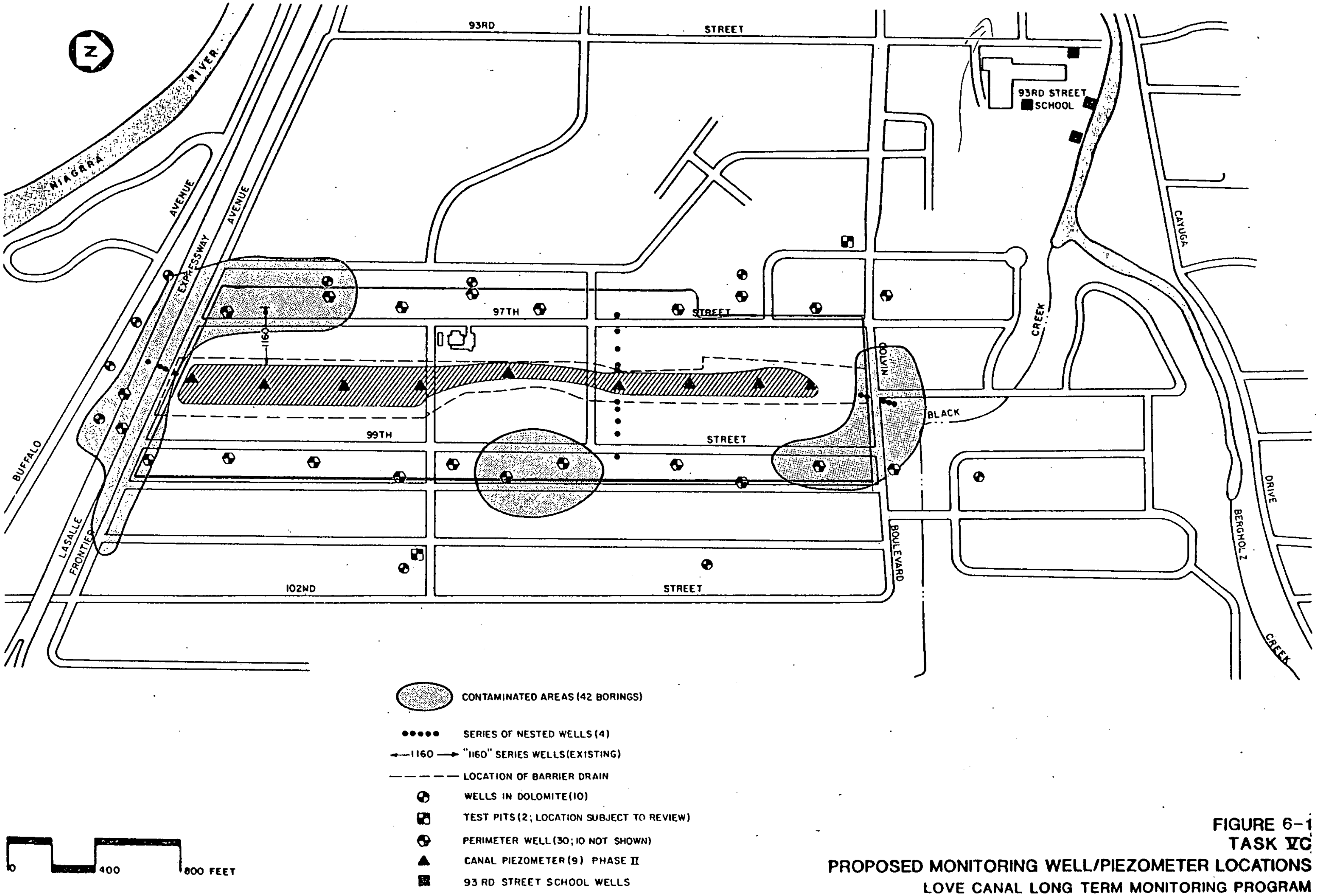

FIGURE 6-1
TASK VC
PROPOSED MONITORING WELL/PIEZOMETER LOCATIONS
LOVE CANAL LONG TERM MONITORING PROGRAM

- waste characteristics
- site topography and surface drainage
- climate
- site geology.

Development of a soil sampling plan that will effectively reveal the distribution and magnitude of contamination at a specific site requires at a minimum:

- an assessment of the factors listed above,
- evaluation of the methodology and results of any previous sampling and analysis programs which may have been completed at the site, and
- definition of the scope and objectives of the project.

A number of techniques have been developed to obtain samples from various depths below the ground surface. The techniques described herein are those normally employed by Jordan. They have been selected to provide practical, efficient means of obtaining samples in a manner consistent with safety protocol and QA/QC requirements. Additionally, they employ equipment that is normally available for use.

The selection of sampling techniques to be employed at a given site is based upon the depth from which samples must be obtained and the nature of the soils to be sampled. The sampling techniques are categorized by the depths at which each is applicable:

- shallow samples are from depths of less than about 5 feet, usually less than 2 feet,
- intermediate samples are from depths of 5 feet to about 15 feet, and
- deep samples are from depths greater than 15 feet.

Maintaining proper records is a significant aspect of sample taking. At the time samples are obtained, the following must be recorded by the sampler:

- sample site location (e.g., grid coordinates baseline station and offset, or the location plotted on a map or aerial photograph)
- sample type, depth and soil description
- date and time of sampling
- project and sample designations
- sampler identification
- Preservative

- analyses requested.

Additionally, the sampler must initiate chain-of-custody procedures and describe the sample site in adequate detail to allow the analytical results to be properly interpreted and, if necessary, to allow collection of additional samples from the same sample site. Jordan normally employs preprinted labels, standarized record forms and of the sample site at the time it is established to expedite this process and ensure uniformity of records. The sampling protocols and recordkeeping requirements for the types of samples described in the following pages vary according to the sampling techniques. Additional requirements may also be established on a site-specific basis. The entire soil sampling process is designed and conducted in a manner that provides samples suitable for the intended analyses and that are properly documented.

### 6.4.2 Deep Samples

Objective. To obtain deep soil samples suitable for chemical analysis.

Approach. For soil sampling from depths greater than about 15 feet, borings are usually employed.[3] Borings are normally completed as either cased or augered holes.

Boring Methods. The boring methods employed at a given site are selected on the basis of the site's subsurface conditions. Jordan has prepared detailed drilling specifications that govern the drilling subcontractor's efforts. These specifications are modified on a site specific basis to reflect the needs of each project. Principal boring methods are described in the following section.

#### Cased Borings

Casing is used to support the boring as it is advanced. The casing is driven or drilled to the sample elevation and soil remaining in the interior of the casing is washed out with drilling fluid. Potable water or air is normally used to wash out the casing. The samples are retrieved from undisturbed soils below the bottom of the casing. The advantages of this drilling technique are:

- relative simplicity of procedure,
- relatively low risk of personnel exposure,
- can be used to obtain soil samples from a wide range of subsurface conditions,

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[3] Backhoes can excavate test pits considerably deeper than 15 feet, however, such deep pits are very difficult to sample at discrete depths. Further, deep test pits can pose significant safety risks. Thus, Jordan does not normally use such pits.

- can be used to obtain samples from any depth, and
- good availability of equipment.

The disadvantages of cased borings arise from the need to use a drilling fluid. When sampling pervious soils, such fluids can permeate ahead of the casing. This can result in contamination of the underlying pervious soils if drilling fluids are recirculated. To prevent contamination, drilling fluids may be used only once. Further, the drilling fluids and cuttings removed from the hole may require collection, containerization, and transportation to a suitable disposal site. When drilling fluids are recirculated, as may be done when drilling through relatively low permeability soils, each borehole will generate relatively small quantities of spoils. However, when new fluid must be continually introduced into the hole, management of drilling fluids and spoils can result in significant cost and effort.

### Auger Borings

With this technique, hollow stem augers are advanced into the soil. Drill cuttings are compressed laterally and carried upwards on the auger flights. The bottom of the auger is blocked with a plug while the auger is advanced. When the desired sampling depth is reached, the plug is withdrawn and a sample is obtained from below the bottom of the augers. The advantages of the hollow stem auger technique include:

- relative simplicity of procedure,
- relatively low risk of personnel exposure,
- can be used to obtain soil samples from a wide range of subsurface conditions,
- drilling fluids are generally not required, and
- good availability of equipment.

The disadvantages of the hollow stem auger technique include:

- difficulty in penetrating excessively cobbley or bouldery soils, and
- difficulty in sampling granular soils below the water table since without drill fluids there is no practical means to maintain hydrostatic equilibrium in the borehole. When the plug is withdrawn, water and sediment from outside the augers may enter the borehole, potentially causing contamination and difficulty in sampling undisturbed soil below the bottom of the augers.

### Other Methods

Other methods (casing advancer systems, cable tool, mud rotary, and bucket auger) are available in certain geographic areas. These methods, however, are either similar to those already discussed or not readily applicable to work at contaminated sites. They may, however, be considered for use on a site-specific basis.

## Sampling of Test Borings.

### Types of Samplers

Test boring samples are normally taken from undisturbed soil below the depth of the casing or auger with either a thin wall tube or split spoon sampler.

- Thin Wall Tube Sampler - Thin wall tube samplers are used in fine-grained or cohesive soils. The sampler is lowered to the bottom of the borehole and pushed into undisturbed soil. When the sampler is withdrawn, it contains a cylinder of soil. A thin wall tube consists of thin steel with a sharpened edge, usually about 30 inches long. Typical tubes range from about two inches to four inches in diameter. The tube is attached to a sampler head, containing a check valve which is in turn coupled to the drill rods. After the thin wall sampler has been withdrawn from the boring, it is removed from the drill rod and placed in a frame. The cylinder of soil is then forced from the tube with a hydraulic jack.

- Split Spoon Sampler - A split spoon sampler may be used to sample all types of soil. This sampler consists of a split steel tube or sample barrel threaded at both ends. A sharpened drive shoe secures the bottom of the barrel and an adaptor secures the top. The adaptor is threaded to connect directly to the drill rods and contains a check valve (see Figure 6-2). The split spoon is driven into undisturbed soil below the casing or hollow stem auger (see Figure 6-3). After the sampler has been driven, it is withdrawn from the borehole and the sampler is opened by removing the drive shoe and adaptor.

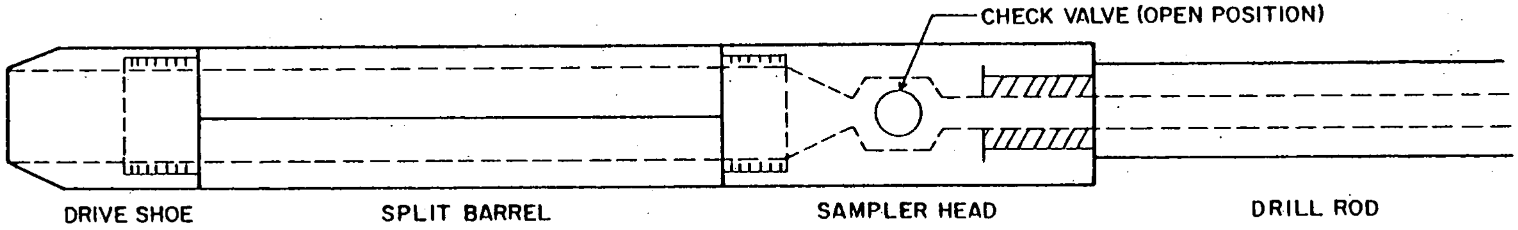
### Sample Collection

The drilling monitor will take charge of the sampling device as soon as it is withdrawn from the borehole and opened. He will collect and document the sample employing the procedures as outlined below.

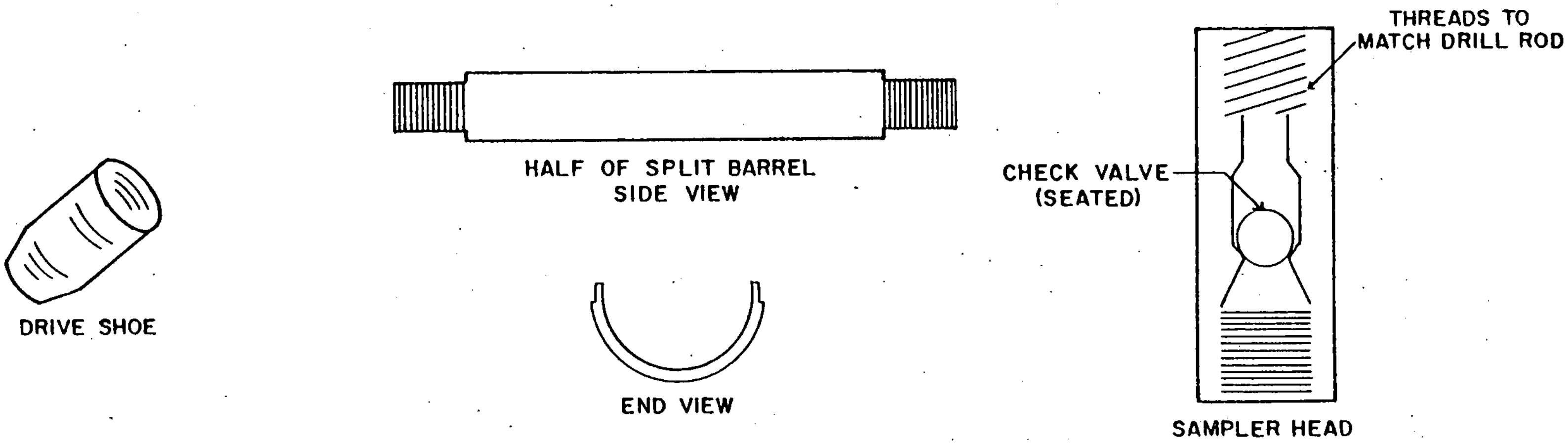
1. Scan the soil with a photoionization detector and record measurements.

2. Photograph any portions selected for chemical analysis, showing an appropriate visual scale (optional).

SPLIT SPOON SAMPLER



SPLIT SPOON SAMPLER DISASSEMBLED



NOTE: NOT TO SCALE

FIGURE 6-2
SPLIT SPOON SAMPLER

E.C.JORDAN CO.

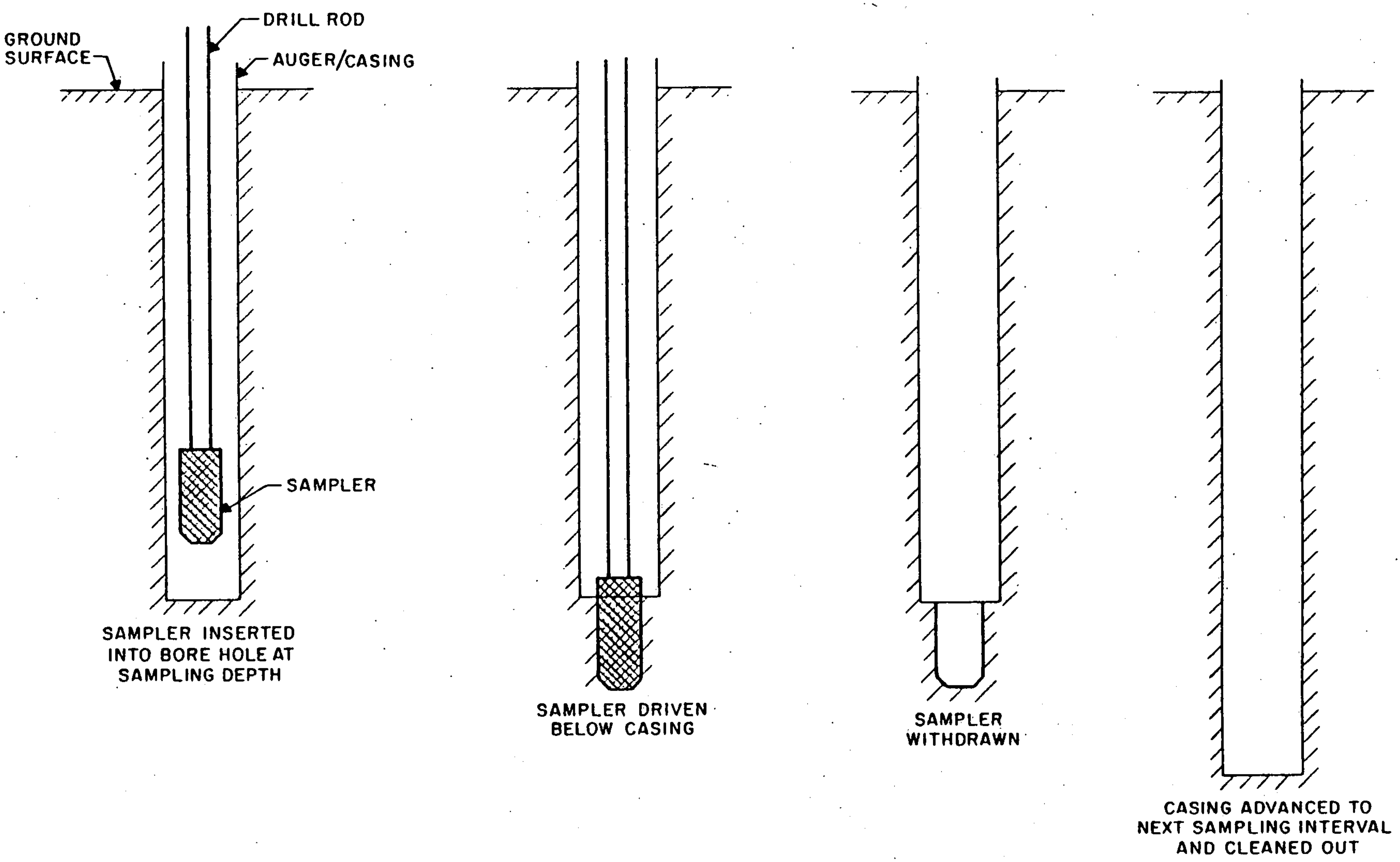


FIGURE 6-3

STEPS IN SAMPLING A TEST BORING

E.C.JORDAN CO.

3. Remove the portion(s) of the sample selected for chemical analysis and place it into appropriate containers (as listed in Table 6-1) using a clean stainless steel spatula. Soil intended for VOA analysis should be placed in 40-mℓ containers and capped as quickly as possible. Soil intended for other types of analyses should be placed in appropriate containers and capped.

4. Visually examine the sample and record its characteristics (e.g. texture, color, consistency, moisture content, layering and other pertinent data).

5. Place the remainder of the sample in a 16-ounce "soil jar" with a metal seal cap. This sample portion will be used for headspace photoionization measurement and for any physical materials testing that is required.

6. Discard any excessively disturbed or loose material found in the sampler which may not be representative of the interval sampled. This material will be discarded with any boring spoils at each boring location.

7. Decontaminate the sampling device in accordance with the procedure specified in the site Health and Safety Plan.

In some instances, none of the samples from a given boring will be prepared for chemical analysis. In these instances, steps 2 and 3 of the procedure listed above are omitted and the entire sample is placed in one or more "soil jars."

Immediately after the samples are collected, all prelabeled vials and jars are checked for completeness and chain-of-custody procedures are initiated. The boring log is also updated at this time by the drilling monitor. Boring logs are normally completed by the driller, but for purposes of completeness and documentation a separate boring log is also compiled by the drilling monitor. The boring logs will include interpretations of subsurface materials and conditions encountered, sample locations, and other notes pertinent to how the boring was conducted. The drilling monitor's boring log can be completed in a site field book or on a boring log form (see Figure 6-4).

The sampler must exercise considerable care while collecting samples for analysis. Some methods to assure that high quality samples are collected are described below.

1. Make sure that the sample is obtained from undisturbed soil below the casing or auger. This is accomplished by monitoring or checking the drill crew's measurements, observing the sampling process and examining the sample once it is retrieved.

BORING NO. ________

# SOIL BORING LOG

Page ___ of ___

Project No. ____________________

Drilling Contractor ____________ Described by ____________________

Rig No. ________ Checked by ____________________

Driller ____________________ Date Started ____________________

Date Finished ____________________

Ground Elev. ________ Bit Size ______ Casing Size ____________

Depth To Water (Date) ________ Core size ____ Inclination ____________

Depth: Soil ________ Rock ______ Total ________

| Sample No. | Depth ft | No. Blows per 6 in. | Rec. in. | Description |
|---|---|---|---|---|
| | | | | |

FIGURE 6-4

2. Carefully remove and discard any portions of the sample that may have become contaminated by contacting the casing, auger, or drilling fluids.

3. Conserve sample volume since under certain soil conditions it may be difficult or impossible to achieve good sample recovery with either split spoons or thin wall tubes.

Procedures employed to prevent cross-contamination during test boring sampling operations include the following:

- Samples are taken immediately after the boring is advanced to the desired sampling elevation.
- The sampling tools are decontaminated prior to taking each sample.
- The drilling contractor is not permitted to use oil, grease or other petroleum based lubricants on the drill rods, casing or sampling tools.
- The drilling technique and procedures to be utilized, particularly the use of drilling fluids, are carefully evaluated for each site.

Preprinted labels are generally employed for test boring samples selected for chemical analysis. The preprinted label system provides sample control and allows assessment of sampling completeness.

### 6.4.3 Intermediate Depth Samples

Objective. To obtain soil samples from depths of up to 15 feet for chemical analysis.

Approach. Although test borings can be employed to obtain samples from any depth, backhoe excavated test pits are often more practical and cost effective at intermediate depths.

The major advantages of test pit sampling programs are:

- Samples of any size can be obtained.
- The subsurface is exposed in the test pit revealing the sample site geology and facilitating sample collection and recovery.
- Availability of equipment is good.

There are two factors that must be considered when designing a test pit sampling program:

- The depth at which samples can be effectively obtained, and

- Site-specific safety issues, including contamination potential and test pit stability.

Sampling Procedures. To expedite the sampling and recordkeeping efforts and to minimize periods of potential exposure during the excavation of test pits, the sampling crew should have sufficient tools and equipment to sample each pit prior to requiring decontamination. The backhoe and tools will be decontaminated between each test pit. The backhoe bucket and boom will be decontaminated as required during excavation of each test pit.

The actual layout of each test pit, temporary staging area and spoils pile will be predicated on site conditions and wind direction at the time the test pit is made. During excavation, sampling and logging of each test pit, the backhoe operator and all site personnel will remain upwind or crosswind of the test pit and spoils pile. Wind direction will be monitored by means of a wind sock or other banner located in a prominent position visible to all personnel.

Preselection and the use of hand and horn signals is important during completion of test pits due to noise levels around the machine. The sampling crew and backhoe operator will rehearse appropriate signals ahead of time and be thoroughly familiar with their meaning. All personnel should be equipped with air blast horn devices, especially when wearing respiratory safety gear which hinders communication.

Sampling of unopened buried drums is excluded from this test pitting protocol. Jordan undertakes such work on a site-specific basis and utilizes appropriate safety and sampling protocols for each instance.

Preprinted test pit sample labels will be prepared prior to initiation of work. Each sample will consist of one or more containers as required by the analyses to be performed.

Test pits are logged as they are excavated. Records of each test pit will be made on prepared forms or in a field book. If the log is made in a field book it will be transcribed to prepared forms. These records include plan and profile sketches of the test pit showing all materials encountered, their depth and distribution in the test pit and sample locations. These records will also include safety and sample screening information. An example test pit record form is shown as Figures 6-5 and 6-5A. Jordan has found this format useful since it provides all necessary sampling, monitoring and subsurface records for each test pit in a concise and uniform manner. This format also provides a cross-check with chain-of-custody records and sample label counts.

The actual depth and type of samples obtained from each test pit will be selected at the time the test pit is excavated. Sufficient samples are usually obtained and analyzed to quantify contaminant distribution as a function of depth for each test pit. Additional samples of each waste phase and any fluids encountered in each test pit may be collected.

Test pits are excavated and sampled in the following manner:

# TEST PIT RECORD

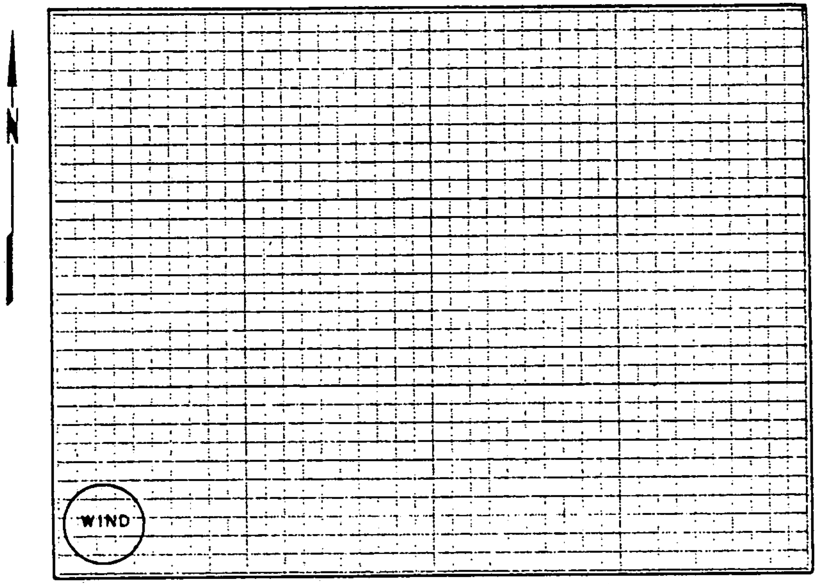
1 OF 2

SITE ______________________________

TEST PIT ____________ DATE ____________ TIME ST. ____________ END ____________

COORDINATES ______________________ GRID ELEMENT ______________________

SKETCH MAP OF TEST PIT SITE
(SHOW SURFACE MONITORING RESULTS)



SCALE 1" = _____ FT

CREW MEMBERS

1.
2.
3.
4.
5.
6.

MONITOR EQUIPMENT

| | | |
|---|---|---|
| PI METER | Y | N |
| EXPLOSIVE GAS | Y | N |
| AVAIL. OXYGEN | Y | N |
| OVA | Y | N |

OTHER ______________
______________

PHOTOGRAPHS, ROLL ________

EXPOSURE ____________

NOTES ______________________________

FIGURE 6-5

E.C.JORDAN CO.

# TEST PIT RECORD
# PROFILE ALONG TEST PIT-___

2 OF 2

SITE ______________________________

DEPTH (FT)        SCALE 1" = _____ FT

NOTES:

SAMPLES OBTAINED

| NO. | DEPTH (FT) | INIT. SER. NO. | HD. SP. VOA PPM |
|---|---|---|---|
| S-1 | | | |
| S-2 | | | |
| S-3 | | | |
| S-4 | | | |
| S-5 | | | |
| S-6 | | | |
| S-7 | | | |
| S-8 | | | |
| | | | |
| | | | |
| | | | |

REFERENCE: FIELD BOOK, PG. ________
ATTACHMENTS ________

SIGNATURE

FIGURE 6-5A

1. The sampler and backhoe operator will plan the excavation.

2. The backhoe operator will excavate the test pit in several depth increments.

3. After each increment, the operator will wait while the sampler inspects the test pit to decide if conditions are appropriate for sampling. Practical depth increments range from 2 to 4 feet.

4. The backhoe operator, who will have the best view of the test pit, will immediately cease digging if:

   - any fluid phase or groundwater seepage is encountered in the test pit,

   - any drums or other potential waste containers are encountered, or

   - distinct changes of material are encountered.

   This action is necessary to permit proper sampling of the test pit and to prevent a breach of safety protocol.

   For instance, should any fluids or seepage be encountered, they could, after suitable screening and monitoring, be sampled. Waste and sludge deposits could likewise be sampled before proceeding. Should uncollapsed drums be encountered, the test pit would be terminated, backfilled and redug at an adjacent location.

5. The test pit is sampled as described in the following sections.

   <u>Sampling from Ground Surface</u>

   To sample the pit from the ground surface, two methods have been used. The method is selected in the field at the time the test pit is sampled.

   a. Samples can be obtained from the backhoe bucket. The sampler or crew chief will direct the backhoe operator to remove material from the selected depth or location within the test pit. The bucket will be brought to the surface and moved away from the pit. The sampler will approach the bucket and monitor its contents with the PI meter. If granular or loose soils and/or uniform materials are encountered, the sample will be obtained directly from the bucket. The sample is collected from the center of the bucket and placed in sample jars using a clean stainless steel trowel or spatula.

      If a composite sample is desired, several depths or locations within the pit are selected and a bucket is filled from each area. A sample bottle is filled from each bucket and then emptied into a mixing surface (e.g., butcher paper or plastic sheet) and thoroughly stirred prior to being placed into the sample jars. The disposable mixing surfaces are discarded into the test pit when it is backfilled.

If cohesive soils or multiphase conditions are encountered (e.g., the bucket contains a mixture of soil and sludge) the sampler will proceed as above if practical; if not, he will direct the backhoe operator to empty the bucket onto the ground. He will then obtain the sample from the interior of soil clods or lumps of sludge using a clean trowel or spatula.

b. Samples can be obtained directly from the test pit. This is necessary when soil conditions preclude obtaining suitable samples from the backhoe bucket (e.g., caving or excessive mixing of soils or wastes within the test pit) or when samples from relatively small discrete zones within the test pit are required. This approach is also required to sample seepage occurring at discrete levels or zones in the test pit. In these circumstances, samples will be obtained by means of extendable handled tools: scrapers, trowels, spoons or cups. The face of the test pit is scraped to remove the smeared zone that has contacted the backhoe bucket. The material to be sampled, if a solid, is then removed from the test pit wall by means of long handled scoops or trowels. The sample is then thoroughly stirred on a clean disposable mixing surface and placed in sample jars. If fluids are removed from the pit they are placed in a mixing jar as obtained. They are then decanted into sample jars.

In-Pit Sampling

Samples can be obtained directly from the test pit. This is necessary when soil conditions preclude obtaining suitable samples from the backhoe bucket (e.g., caving or excessive mixing of soils or wastes within the test pit) or when samples from relatively small discrete zones within the test pit are required. This approach is also required to sample any seepage occurring at discrete levels or zones in the test pit. It is Jordan policy that personnel will sample and log pits from the ground surface except as provided for by the following criteria:

- The project will benefit significantly from the improved quality of the test pit logging and sampling data obtained if personnel enter a test pit rather than conduct such operations from the ground surface.
- There is no practical alternative means of obtaining such data.
- The site safety officer determines that such action can be accomplished without breaching site safety protocol. This determination will be based on actual monitoring of the test pit after it is dug (including, at a minimum, measurements of volatile organics, explosive gases and available oxygen).
- An experienced geotechnical professional determines that the test pit is stable or is made stable prior to entrance of any personnel.

If these conditions are satisfied, one person will enter the test pit. On potentially hazardous waste sites, this individual will be dressed in safety gear as required by the conditions in the pit, usually Level B. He will be affixed to a safety rope and continuously monitored while in the pit. A second individual will be fully dressed in protective clothing including a self-contained breathing device and on stand-by during all pit entry operations. The individual entering the pit will remain therein for as brief a period as practical commensurate with performance of his work. After removing the smeared zone, samples are obtained with a trowel or spoon.

Sampling in the Vicinity of Drums

Should collapsed or highly-corroded drums be encountered which are obviously empty and pose no unusual threat, the test pit could be continued after appropriate monitoring. If possible, the test pit is sampled from the ground surface by means of long-handled scoops or trowels. As described above, the face of the test pit must be first scraped to remove the smeared zone that has contacted the backhoe bucket. Attempts to sample drums or containers also could be made from the ground surface, with appropriate safety procedures. After sampling, the test pit would be backfilled.

### 6.4.4 Shallow Samples

Objective. To obtain samples of surface and near surface soils suitable for chemical analysis.

Approach. Shallow soils samples are usually obtained by using one of the following devices:

- hand auger or corer
- trowel or spoon
- spade.

Two distinct types of hand augers are available: a cup-type auger and a screw-type auger. Use of either device is generally limited to the upper portion of the soil profile (less than five feet). These augers are best suited for obtaining composite samples from relatively shallow depths. Use of trowels or spades is straightforward but usually limited to sampling very shallow depths (less than 18 inches).

Soil samples can be either grab or composite, depending on the objective of the sampling program. In grab sampling, the soil jar can be filled directly which is usually desirable for VOA samples. In composite sampling, several methods are available:

- Samples can be composited over depth at a single spot.
- Samples can be composited laterally, in which one sample is comprised of several (usually three or four) soil specimens in the vicinity of the sampling site.

Composite samples are mixed in the same manner as composite test pit samples.

Immediately after taking a sample, the sampler fills the containers required for the requested analyses, attaches the preprinted labels, initiates chain-of-custody procedures and completes the sample data form.

## 6.5 GROUNDWATER

### Objective

To obtain samples of groundwater from new and existing wells suitable for chemical analysis.

### Approach

The groundwater sampling locations are selected to delineate the extent of and quantify the contaminated groundwater plume in the aquifers underlying the site. The actual sampling points are then selected following review of the location of the existing groundwater wells (monitoring and domestic) in the vicinity of the site. New monitoring wells may be installed to supplement the existing array. The rationale for their location is normally described in the site work plan.

Monitoring and sampling of groundwater wells will proceed from the upgradient or background wells to the downgradient or contaminated wells as best as can be determined. The monitoring procedure is as follows:

The sampling locations are indicated on a site map. Samples will consist of various containers for each location and will be analyzed for the parameters selected for the project. The pH and specific conductance of each sample will be determined in the field. Selection of either glass or plastic containers is dependent on the types of analyses that are to be performed. Appropriate containers are specified in Table 6-1.

### 6.5.1 Monitoring of Groundwater Wells

1. Check the well for proper identification and location.

2. Measure and record the height of protective casing.

3. After unlocking the well and removing any well caps, measure and record the ambient and well-mouth organic vapor levels using the photoionization meter. If the ambient air quality at breathing level reaches 5 ppm, the sampler shall utilize the appropriate safety equipment as described in the Health and Safety Plan.

4. Using the electronic water level meter, measure and record the static water level in the well and the depth to the well bottom to the nearest 0.01 foot. Upon removing the water level wire, rinse it with laboratory-grade methanol or isopropanol and then distilled water.

5. Calculate the volume of stagnant water in the well casing. Volume in liters equals 0.154 times the square of the inside diameter of the casing (in inches) times the depth of water (in feet).

### 6.5.2 Sampling of Groundwater Monitoring Wells

Following the measurements and calculations described above, sampling will commence in the sequence below:

1. Lower the submersible pump or peristaltic pump intake into the well. For shallow groundwater situations, the intake of the suction tubing or of the submersible pump will be lowered to the top of the well screen and the well purged three to five times the calculated volume. Alternatives to this procedure may be necessary if one of the following conditions exist:

    a. If the well screen is very large, making pumping from the top impractical, the suction line or submersible pump should be lowered to the approximate mid-point of the screened portion of the well.

    b. If the well is situated in tight formations such as tills, clays or rock, the purging of the well should be performed from very near the bottom of the well screen. This will facilitate complete removal of standing well water.

2. Connect the instrumentation header to the pump discharge and begin flushing the well. Monitor the in situ parameters (pH, Eh, temperature, and specific conductivity) and measure the volume of groundwater being pumped. Alternately, in situ parameters may be monitored in a beaker filled from the pump discharge. Purging of the standing well water is considered complete when one of the following is achieved:

    a. at least three well volumes have been purged and in situ parameters have stabilized, or

    b. five well volumes have been purged, or

    c. the well has been pumped dry.

3. Record the in situ parameters.

4. After purging, lower the pump intake or bailer (as appropriate for the parameters of concern) to the middle of the screened interval or mid-point of the static water level. If the analysis to be performed is for lighter-than-water chemical species, then the pump or bailer should be lowered to the top of the water column for sample collection.

5. Collect the sample(s).

    VOA samples are filled directly from the submersible pump discharge tubing or bailer with as little agitation as possible.

Other samples will be placed directly into the appropriate container from the discharge tubing of the pump or bailer.

6. Remove the pump from the well and decontaminate the pump and tubing by flushing with isopropanol; up to one gallon of the solvent is used as needed. Rinse the pump and tubing with one gallon of distilled water.

7. Complete sample data records (Figure 6-6) after each well is sampled.

8. Secure the well cap and lock.

PAGE ______ OF ______

FIGURE 6-6

## FIELD SAMPLE DATA AND QUALITY ASSURANCE RECORD

PROJECT ______________________________ JOB NO ______________

STATION NO/LOCATION ______________________ DATE ______________

SKETCH ON BACK YES ☐ NO ☐ PHOTOGRAPHS YES ☐ NO ☐ ROLL NO/EXPOSURE NO ________

### FIELD DATA

TIME __________ AIR TEMP __________ WEATHER ______________________

WELL DEPTH __________ WATER DEPTH __________ SAMPLE DEPTH __________ SAMPLE METHOD ______________

VOL. PURGED __________ SAMPLE TEMP. __________ °C ☐ IN SITU ☐ IN BOTTLE SP. COND. __________ / __________ @ 25° C ☐ IN SITU ☐ IN BOTTLE

pH __________ ☐ IN SITU ☐ IN BOTTLE Eh __________ ☐ IN SITU ☐ IN BOTTLE DISSOLVED $O_2$ __________ ppm ☐ IN SITU ☐ IN BOTTLE

VOA LEVEL (ppm) AMBIENT __________ SAMPLE LOCATION __________ HEADSPACE __________

| BOTTLE ID | LAB ID | VOL | MATERIAL | FILTERED | PRES./VOL. | ANALYSIS REQUESTED |
|---|---|---|---|---|---|---|
| | | | | | | |
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REMARKS/OBSERVATIONS ______________________________________________

______________________________________________

### FIELD EQUIPMENT QUALITY ASSURANCE CHECKLIST

pH METER BUFFER CHECK pH 4 ________ pH 7 ________ pH 10 ________

SP. COND. METER STANDARDS CHECK ______________ Eh PROBE ______________

PUMP TUBING RINSED __________ CHANGED __________ SAMPLER BLANK __________

FILTRATION BLANK WITH PRES. __________ FILTERS ACID WASHED ______________

SAMPLER ______________

# 7.0 SAMPLE CUSTODY

The E.C. Jordan Co. has established a program of sample chain-of-custody that is followed during sample handling activities in both field and laboratory operations. This program is designed to assure that each sample is accounted for at all times. To maintain this level of sample monitoring, computer-generated sample container labels, and shipping manifests are normally employed. Sample field data sheets, chain-of-custody records, and laboratory receipt sheets must also be completed by the appropriate sampling and laboratory personnel.

The objective of sample custody identification and control is to assure that:

- all samples scheduled for collection, as appropriate for the data required, are uniquely identified,
- the correct samples are analyzed and are traceable to their records,
- important sample characteristics are preserved,
- samples are protected from loss or damage,
- any alteration of samples (e.g., filtration, preservation) is documented, and
- a record of sample integrity is established for legal purposes.

The advantages of a computer-based chain-of-custody system over field marking systems are:

- all required samples are indicated on preprepared labels and shipping manifests, and
- once the computer-generated label is affixed to the bottle and covered with clear plastic tape, sample identification is virtually unalterable.

The chain-of-custody protocol followed by the sampling crews involves:

- Documenting procedures and amounts of reagents or supplies (e.g., filters) which become an integral part of the sample for sample preparation and preservation.
- Recording sampling locations and specific sample acquisition measures on the appropriate forms.
- Using preprepared sample labels to document all information necessary for effective sample tracking.

- Completing standard field data record forms to establish sample custody in the field before sample shipment.

Preprepared labels are developed for each sample to be collected. Each label is numbered to correspond with the appropriate sample(s) to be collected. Examples of preprepared labels are shown in Figure 7-1. The sample data record is used in some projects, particularly waste stream composite sampling, to record the sample location, sampling method, type of sample, date of sample collection, weather conditions, temperature, sample pH, the name of the sampling crew member responsible for the sample, and other relevant information. An example field data sheet is presented in Figure 7-2.

The chain-of-custody record is used to:

- document sample handling procedures including sample location, sample number and number of containers corresponding to each sample number,
- describe the sample, and
- describe the chain-of-custody process.

The chain-of-custody description section requires:

- the sample number,
- the names of the sampler(s) and the person shipping the samples,
- the date and time that the samples were delivered for shipping, and
- the names of those responsible for receiving the samples at the laboratory.

A sample chain-of-custody record is shown in Figure 7-3.

The field data record and the chain-of-custody record are completed in triplicate. Two copies accompany the samples to the laboratory, another is kept by the sample crew chief, and the third is maintained in the project file. Additional copies can be provided if needed for the project.

A sample custodian at the laboratory signs for incoming samples, obtains shipment documents, assigns a unique sample identification number and verifies data entered in sample custody records. Based on the type of sample collected and the analysis required, further procedures for sample handling, storage, and disbursement for analysis are specified. Specific internal chain-of-custody procedures used by the contract laboratory are specified by NYSDEC's contract laboratory program.

```
E C JORDAN CO          P O BOX 7050
PORTLAND ME  04112     207-775-5401
WELL   R13-29
VOA        4 DEG C
40 ML GLASS            SHIP TO E C JORDAN

       397112          000001


E C JORDAN CO          P O BOX 7050
PORTLAND ME  04112     207-775-5401
WELL   R13-29
VOA        4 DEG C
40 ML GLASS            SHIP TO E C JORDAN

       397112          000002


E C JORDAN CO          P O BOX 7050
PORTLAND ME  04112     207-775-5401
WELL   R13-29
DMF        4 DEG C
40 ML GLASS            SHIP TO BORRISTON LAB

       397112          000003


E C JORDAN CO          P O BOX 7050
PORTLAND ME  04112     207-775-5401
WELL   R13-29
DMF        4 DEG C
40 ML GLASS            SHIP TO BORRISTON LAB

       397112          000004


E C JORDAN CO          P O BOX 7050
PORTLAND ME  04112     207-775-5401
WELL   R13-29
SVOA       4 DEG C
1 LITER GLASS          SHIP TO E C JORDAN

       397112          000005
```

FIGURE 7-1

EXAMPLE COMPUTERIZED LABELS

# FIELD SAMPLE DATA SHEET

PLANT ____________________

____________________

CREW ____________________ CHIEF

____________________

| SAMPLE TYPE | | | | | | | | | | | | | | | | | SAMPLE NUMBER | PRESERV-ATIVE | | DATE | | | COMPOSITE ENDING DATE | | | TEMP °C | pH @ POINT OF SAMPLING | RCDR'S INITIALS | SAMPLING POINT DESCRIPTION | NOTES: |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OIL & GREASE | CHLORIDES | SULFIDES | TOTAL SOLIDS/TVS | TOTAL PHENOL | SAMPLE BL | VOL ORG BL | VOL ORG | MERCURY | CYANIDE | BOD/TSS | NON-VOL ORG | METALS (TOTAL) | ASBESTOS | COD/TOC/TKN/NH3 | | | | ml | CHEMICAL | MONTH | DAY | TIME | MONTH | DAY | TIME | | | | | |
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FIGURE 7-2

PAGE ____ OF ____

# CHAIN OF CUSTODY RECORD

PROJECT NO.

PROJECT NAME

SAMPLERS (SIGNATURE)

| STA. NO. | DATE | TIME | COMP. | GRAB | STATION LOCATION | NO. OF CONTAINERS | SAMPLE TYPE | | | | | | | | | | | | REMARKS<br>INDICATE SOIL/WATER/AIR SEDIMENT/SLUDGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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FIGURE 7-3

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# 8.0 CALIBRATION PROCEDURES AND FREQUENCY

## 8.1 CALIBRATION PROCEDURES FOR LABORATORY EQUIPMENT

The calibration procedures used by the contract laboratory are specified by the NYSDEC-CLP.

## 8.2 CALIBRATION PROCEDURES AND FREQUENCY FOR FIELD INSTRUMENTS

Each piece of equipment will be calibrated prior to each day's use. The procedures described below apply to the specific instrument noted. If other instruments are used, follow the manufacturer's calibration procedures.

### 8.2.1 Y.S.I. S-C-T Meter (Model No. 33)

Temperature Probe.

1. Using a National Bureau of Standards-approved thermometer, immerse both probes into a beaker of water and note any differences for the field probe.

2. Recalibrate as necessary.

Specific Conductance Meter.

1. Calibrate meter and probe using the calibration control and the red-line on the meter dial (Y.S.I. S-C-T Meter, Model No. 33).

2. Turn the function switch to read conductivity x 10 and then depress the cell test button, noting the deflection. If the needle falls more than 2 percent of the reading, clean the probe and retest.

3. Using at least two buffer solutions, which will most likely bracket the expected values for conductivity, note accuracy of the water and probe and clean probe if necessary.

### 8.2.2 Specific Ion Meter

pH Probe.

1. Place electrodes and buffer solutions in a water bath at the temperature of the water to be sampled. After temperature equilibrium, measure temperature and adjust the temperature compensation knob for this temperature.

2. If using refillable probes, remove electrode cap and check that filling solution is above the filling mark.

3. Immerse the probe in the pH 7 buffer solution and adjust the calibration control to read the appropriate pH. Check the pH buffer solution for correct pH value at the equilibrated temperature.

4. Remove the probe, rinse with distilled water and then immerse in either the pH 4 or pH 10 buffer solution, depending on the expected pH of the sample.

5. If the meter does not register the correct pH for that buffer solution, adjust the calibration knob on the back of the instrument to obtain the pH of the buffer.

6. After rinsing, insert the pH probe into the flow cell and allow the probe to come to equilibrium with the sample water.

7. The pH probe is stored in the ambient air overnight.

Eh Probe.

1. Check that the platinum probe is clean and the platinum bond or tip is unoxidized. If dirty, polish with emery paper.

2. Immerse the standard solution, Zobell solution, and probe in a water bath at the temperature of the water to be sampled. After the temperature has equilibrated, increase the probe and the reference probe, if required, into the Zobell solution. Record the mV reading and the temperature and compare with the expected value (±10-20 mV).

3. Rinse the probe with distilled water or probes and insert into the flow cell. Allow for temperature equilibration and record the sample Eh.

4. At the end of the day, the probes should be stored in water.

### 8.2.3 Tripar Analyzer

Temperature Calibration.

- Temperature Zero Adjustment - Connect the temperature sensor and select temperature as the display parameter. Remove the rear access cover exposing the sensor calibration potentiometers.

  Prepare an ice water slurry and place the temperature sensor in the solution. Allow the temperature sensor to stabilize for approximately one minute while stirring the sensor in the solution vigorously. Using the adjustment tool provided in the rear cover, adjust the temperature "zero" potentiometer for a reading of 0.00°C on the system display.

- Temperature Span Adjustment - Prepare a test solution to be used for temperature calibration. A beaker of water at room temperature works well as it will not be changing rapidly in temperature. Place the Tripar temperature sensor in the test solution and allow to stabilize for approximately one minute. Using a precision laboratory thermometer, measure the temperature of the test solution. At the Tripar rear panel, adjust the temperature "CAL" potentiometer until the Tripar display reads the value of the calibration solution.

Best results will be obtained if the temperature "ZERO" and "SPAN" calibration procedures are repeated.

Conductivity Calibration. From time to time, it will be required to calibrate the Tripar conductivity circuit. A simple two-point calibration procedure is utilized by first adjusting the conductivity zero and then the span.

- Conductivity Zero Adjustment - With the conductivity sensor clean, dry, and in air, adjust the conductivity "zero" potentiometer for a reading of 0000 on the Tripar display.

- Conductivity Span Adjustment - Totally immerse the Tripar conductivity sensor in calibration solution of known conductance. Note that the reading displayed on the Tripar is a temperature corrected value to 25°C. Therefore, the value of the standard solution must be calculated to 25°C. Also, the value of the calibration solution should fall in the upper 50 percent of the ranges to be calibrated; i.e., adjustment of the 1000 micromho range should be accomplished with a 500 to 1000 micromho standard. Once the sensor has stabilized in the solution for approximately one minute, adjust the conductivity "CAL" potentiometer at the Tripar rear panel for a reading on the display equal to the temperature corrected value of the standard solution.

  Best results will be obtained if the conductivity zero and span procedures are repeated.

pH Calibration.

- pH Standardization - The pH sensor should be standardized before each use after long storage. First, moisten the electrode body with tap water and carefully remove the plastic storage cap covering the tip of the electrode. Care should be taken not to bend the body of the electrode as this can result in damage to the internal element.

  For first time use after long storage, immerse the lower end of the electrode in tap water for 30 minutes. This hydrates the pH bulb and prepares the ceramic wick for contact with test solutions. If air bubbles are present in the pH bulb, shake the electrode downward to fill the bulb with solution.

  Prepare a small sample of pH 7.00 buffer solution and measure the temperature of the buffer. Rinse the pH electrode with distilled water and immerse the pH bulb in the reference buffer. Set the compensation dial in the Tripar front panel to the temperature of the buffer, allow several minutes for the sensor to reach equilibrium and stir the sensor slightly to dislodge any possible air bubbles from the electrode tip. Using the

"Standardize" potentiometer, adjust for a reading of 7.00 on the Tripar display.

- o <u>pH Slope Adjustment</u> - Very infrequently, the pH slope adjustment may require re-calibration. This adjustment is available at the Tripar readout rear panel. To accomplish this adjustment, prepare a test solution of pH 4.00 or 10.00. Measure the temperature of the solution and make the appropriate setting at the pH "Compensation" dial. Rinse the pH electrode in distilled water and immerse in the buffer solution. Allow several minutes for the sensor to equilibrate and stir the electrode slightly. Using the pH "Slope" potentiometer available at the rear panel, adjust the Tripar readout module for a reading equal to the value of the buffer solution. For best results, the pH "Standardize" and "Slope" adjustments should be repeated at least once.

  Note that some interference may be seen on the pH reading if the Tripar conductivity sensor is present in the same test solution as the pH sensor.

### 8.2.4 HNU Photoionization Meter

With the probe attached to the instrument turn the function switch to the battery check position. The needle on the meter should read within or above the green battery area on the scale plate. If the needle is in the lower position of the battery arc, the instrument should be recharged prior to any calibration. If red LED comes "on", the battery should be recharged. Next, turn the function switch to the on position. In this position the UV light source should be on.

To zero the instrument, turn the function switch to the standby position and rotate the zero potentiometer until the meter reads zero. Clockwise rotation of the zero potentiometer produces an upscale deflection while counterclockwise rotation yields a downscale deflection. If the span adjustment setting is changed after zero is set, the zero should be rechecked and adjusted if necessary. Wait 15-20 seconds to ensure that the zero reading is stable. If necessary, readjust the zero.

The instrument is now ready for calibration by switching the function switch to the proper measurement range.

Using non-toxic analyzed gas mixtures available from the manufacturer in pressurized containers, connect the cylinder with the analyzed gas mixture to the end of the probe with a piece of tubing. Open the valve of the pressurized container until a slight flow is indicated and the instrument draws in the volume of sample required for detection. Now adjust the span potentiometer so that the instrument is reading the stated value of the calibration gas.

If the instrument span setting is changed, the instrument should be turned back to the standby position and the electronic zero should be readjusted if necessary. If the instrument does not calibrate, it may be necessary to clean the probe or the lamp connection.

## 8.2.5 Organic Vapor Analyzer

Set up the Photovac 10A10 in a temperature-stable environment at least eight to ten hours before beginning analyses. Attach AC power cord to Photovac and plug into 110V power outlet. Attach recorder AC power cord to Linear recorder and plug into 110V power outlet. If fully charged, internal battery packs provide 6 to 8 hours operation as a portable instrument.

Connect coaxial cable to "output" jack on Photovac, and plug opposite end into +/- input jacks on records. If positive meter reading on the Photovac gives negative recorder response, reverse polarity of recorder by reversing plug in +/- jacks. Attach gas supply to either "carrier in" port and test for proper flow rate on "vent" and "out" parts with a bubble flow meter. Record actual flow rate. Proper flow rate is 10-15 mℓ/min during analysis; ~5 mℓ/min on standby or overnight. Reduce flow rate for overnight flush by adjusting the air tank pressure regulator. Note: Use only "Zerograde" or better air as carrier. Plastic tubing is preferred for the connection.

Set Photovac attentuation on 100 and range on x1. Start gas flow at 10 mℓ/min. Place "charge" switch in off position and turn detector switch on 30 minutes prior to beginning of analysis. Turn recorder chart drive off, and with the input voltage switch set at 100 mV, turn the recorder power on. Using the "zero" and "attenuation" knobs on the recorder, set so that a zero reading on the Photovac meter gives zero plot on the recorder, and so that 100 reading on Photovac gives full scale reading on recorder. (Turn the "offset" knob on the Photovac to make photovac meter reading change.)

Turn the "offset" knob fully counterclockwise. Meter reading should be 20-50 percent of full scale. If higher, either the air supply is contaminated or the column needs to be flushed. The instrument can still be used in this condition, but the detector can easily be overloaded. Wait until reading is 20-50 percent if possible before analysis. Set the attenuation on the Photovac to the desired setting (e.g., 100 for "unknown" or dirty samples; 10 for low ppm standards or clean samples).

Rotate the offset knob clockwise until meter (and recorder) reads ~10 percent of full scale. Set the column selector switch to the desired column. Use column #1 (10 inches long) for screening unknown samples by injecting a small (~ five-μℓ) amount in port #1 to determine how much sample to inject in column #2 (four feet long) for analytical purposes. Use the results of this initial small injection on column #1 to avoid overloading column #2. If column #2 is overloaded, it may take hours or even days before it is useful again.

Reset the offset (if necessary) to give 10 percent full scale reading. Wait for meter to stabilize. Set recorder chart speed to 1 cm/min and turn chart drive on (flip switch up to cm/min setting). Inject sample or standard into proper port in a smooth motion and note on the recorder chart the moment of injection. Note on the chromatogram the sample or standard identification, volume injected, column #, range and attenuation (e.g., 100 x 1), chart speed and date.

Let chromatogram run until all compounds have eluted and the baseline has stabilized before making another injection (~15-20 minutes for column #1, ~30-60 minutes for column #2). Run standard mix every five or six samples to monitor changes in retention times or response. To interpret chromatograms, measure retention times from point of injection (1 cm = 1 min, or appropriate scale). Measure peak height from baseline to estimate quantity of a given compound, relating sample peak retention time and height to that of known standards. Peak height is directly proportional to concentration and to volume injected (e.g., if a 50 µℓ injection of a 5 ppm standard gives a 5 cm peak with retention time of 114 seconds, a sample with a 3 cm peak at 112 seconds may contain 3 ppm of the same compounds if 50 µℓ was injected).

Miscellaneous. Use only air-tight syringes with sharp pointed needles to introduce samples into the Photovac. Any bend in the needle will damage the septum and analyzer will not be reliable. Pierce the septum of the sample container and rinse the syringe three or four times by working the plunger back and forth before filling with sample. Remove syringe and quickly adjust volume and make injection with no hesitation. Never remove or loosen caps or valves on sample containers. Once the septum on a sample container is pierced, complete all analyses on that sample as soon as possible, as some loss of contaminants may occur.

Never interrupt the carrier gas (air) supply without first turning the detector off! Change air tanks when pressure reaches ~300 psig, or at the end of the day if analyses are to be performed the following day (detector off while changing).

Typical Standards, Retention Times, Response Factors for the Photovac 10A10. The retention times and response factors below are estimates based on laboratory work under controlled conditions (20°C and a carrier flow of 10-15 mℓ/min). Actual retention times and response factors must be acquired in the field under identical conditions to those under which samples will be run.

A table like that shown below must be generated prior to analysis of actual samples. Documentation must also include attenuation settings, column identification, head pressure and ambient conditions.

| Compound | Mixed Standard Concentration (ppm) | Retention Time (seconds) | Response 50 µℓ Injection (cm) |
|---|---|---|---|
| methylene chloride | 5.0 | 50 | ~10 |
| 1,1-dichloroethane | 10.0 | 63 | 4.5 |
| 1,2-dichloroethane | 20.0 | 100 | 4.5 |
| benzene | 1.0 | 110 | 6.5 |
| toluene | 2.0 | 285 | 5.8 |
| 1,1,2,2-tetrachloroethylene | 2.0 | 340 | 7.1 |
| chlorobenzene | 2.0 | 435 | 7.3 |
| xylenes (3 isomers) | 10.0 | 615,665,800 | 1.0,4.3,1.3 |

### 8.2.6 Gas Chromatograph

The Perkin-Elmer Sigma 3B Dual FID chromatograph includes a temperature programmable oven, glass-lined injector and detector transfer lines, dual packed columns, and dual compensating flame ionization detectors. Prior to installation in the field, the P-E Sigma 3B's calibration curves will be verified through injection of standards and surrogates. Calibration standards will be prepared and assayed at three levels. Since the field screening is intended to determine the location of non-contaminated areas, minimization of false negatives is important to this program. Daily, in the field, a quality control sample containing the analytes of interest at or about twice the MDL will be injected after a blank sample. Failure to detect the near MDL standard would indicate increased likelihood of false negatives, and sample analysis would cease until the instrument regained sensitivity. More detailed information is presented in Appendix A.

# 9.0 ANALYTICAL PROCEDURES

## 9.1 SELECTION OF PARAMETERS

Water and soil samples will be analyzed by the selected contract laboratory for: volatile organics, semi-volatile organics, polychlorinated biphenyls (PCB)/pesticides, and dioxin. the sampling and analytical program is described in Table 9-1. These analytes were selected for the following reasons.

Volatile organic compounds have been selected because of their significant presence in the leachate collected by the barrier drain system and because of their relative mobilities (as a result of their relatively higher solubilities in water) in the groundwater regime. Aromatic compounds, such as toluene and benzene, as well as halogenated hydrocarbons, e.g., trichloroethylene and 1,1,1-trichloroethane, are present in significant concentrations in the collected leachate as well as in samples of groundwater from wells positioned near the barrier drain.

Semi-volatile organic compounds (base-neutral and acid fractions) have been selected because they include some of the chlorinated species commonly found associated with dioxin, such as chlorobenzenes, and some other compounds of concern such as chlorophenols and polynuclear aromatic compounds (PNA). PNAs have been detected in groundwater and in soil in many locations around the Canal.

Pesticides have been selected because of the presence of BHC (especially the gamma isomer), one of the more toxic compounds known to have been deposited in large quantities in the Canal. Samples of groundwater and soils around the Canal have shown a variety of pesticides, some not known to have been deposited at the Canal. Analysis for such compounds, therefore, also may help further evaluation of whether or not contamination detected at a location is likely to have originated at the Canal.

Dioxin is selected because it has been determined to be present in some of the media at the Canal and is currently considered an extremely toxic chemical. Predominant locations for dioxin presence have been in sewer and stream bed sediments. Dioxin is not anticipated to be a very frequent analyte at many locations once baseline conditions have been determined because of its low solubility in water, high partitioning relative to soils and its low mobility in soils. Other compounds will be keys to detecting significant migration and allow some analyses, such as for dioxin, to be performed at a much lower frequency than others.

Parameters to be screened by the field GC/FID include:

- 1,2-trans-dichloroethene;
- chloroform;
- carbon tetrachloride;
- trichloroethene;
- benzene;
- tetrachloroethene;

- toluene;
- chlorobenzene;
- ethylbenzene;
- 1,2-dichlorobenzene;
- 1,3-dichlorobenzene;
- 1,4-dichlorobenzene;
- 1,1,2,2-tetrachloroethane; and
- 1,1,2-trichloroethane.

These parameters have been selected by NYSDEC from historical data indicating their predominance in the volatile organics fraction, thus providing a reliable indicator of the limits of contamination. It should be noted that several of these compounds exhibit retention times sufficiently close that differentiation may be impossible if all components are present.

## 9.2 SELECTION OF PROCEDURES

The analytical procedures to be used by the contract laboratory are specified by NYSDEC's Contract Laboratory Program.

The field screening procedure for volatile organics is a modification of USEPA Method 624 in that nearly identical gas chromatography conditions are used, but a flame ionization detector is substituted for the mass spectrometer detector. The screening procedure is described in detail in Appendix A.

## TABLE 9.1

## SUMMARY OF ANALYTICAL PROGRAM

| Media | Type of Analysis | Contract Laboratory | Sampling Location<br>Perimeter Wells | <br>Contaminated Areas | <br>Test Pits | <br>Well Nests | <br>Bedrock Wells | Total[1] |
|---|---|---|---|---|---|---|---|---|
| Water | Volatile Organics | Yes | 24 | 12 | - | - | 25 | 67 |
| | Semi-Volatile Org. | Yes | 24 | 12 | - | - | 25 | 67 |
| | PCB/Pesticides | Yes | 24 | 12 | - | - | 25 | 67 |
| | Dioxin | Yes | - | - | - | - | - | - |
| Soil | Volatile Organics | Yes | 48 | 24 | - | - | - | 79 |
| | Semi-Volatile Org. | Yes | 48 | 24 | - | - | - | 79 |
| | PCB/Pesticides | Yes | 48 | 24 | - | - | - | 79 |
| | Dioxin | Yes | 48 | 24 | - | - | - | 79 |

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[1] Total includes 10% for field duplicates.

# 10. DATA REDUCTION, VALIDATION AND REPORTING

Data reduction is the process of converting measurement system outputs to an expression of the parameter which is consistent with the comparability objective (identified in Section 5 of this QA/QC Plan).

Validation of measurements is a systematic process of reviewing a body of data to provide assurance that the data are adequate for their intended use. The process includes the following activities:

- editing,
- screening,
- checking,
- auditing,
- verification,
- certification, and
- review.

Data validation activities will be documented and records kept of any necessary corrective or remedial action.

Laboratory reports of data from the contract laboratory will be validated by comparing the data documentation package with the NYSDEC-CLP validation criteria. Data validation will be in accordance with "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses," Technical Directive Document No. HQ-8410-01, prepared for USEPA, Hazardous Site Control Division, by NUS Corporation in April 1985. Subsequent data tabulations will be edited by comparing with the laboratory reports. The data will be screened to determine compliance with the quality assurance objectives identified in Section 5.

Field data collection and validation will follow the process illustrated as Figure 10-1. Prior to data collection, determinations are made regarding the data which is required to be gathered in the field and the methodology to be used. Once the data are obtained, they will be reviewed and assessed as to their adequacy. If it is determined that the initial data collection concept did not provide adequate data, the entire process may be repeated.

Results reported for each sample are verified to assure proper identification by comparing the original sample collection log sheets (see Section 6) with chain-of-custody forms and laboratory log books. Based on the results of this validation procedure, the laboratory certifies that the results are in compliance with the quality assurance objectives for accuracy and precision. Upon certification by the laboratory manager, the reported values are received and reviewed by the technical staff and the QAC (if deemed necessary).

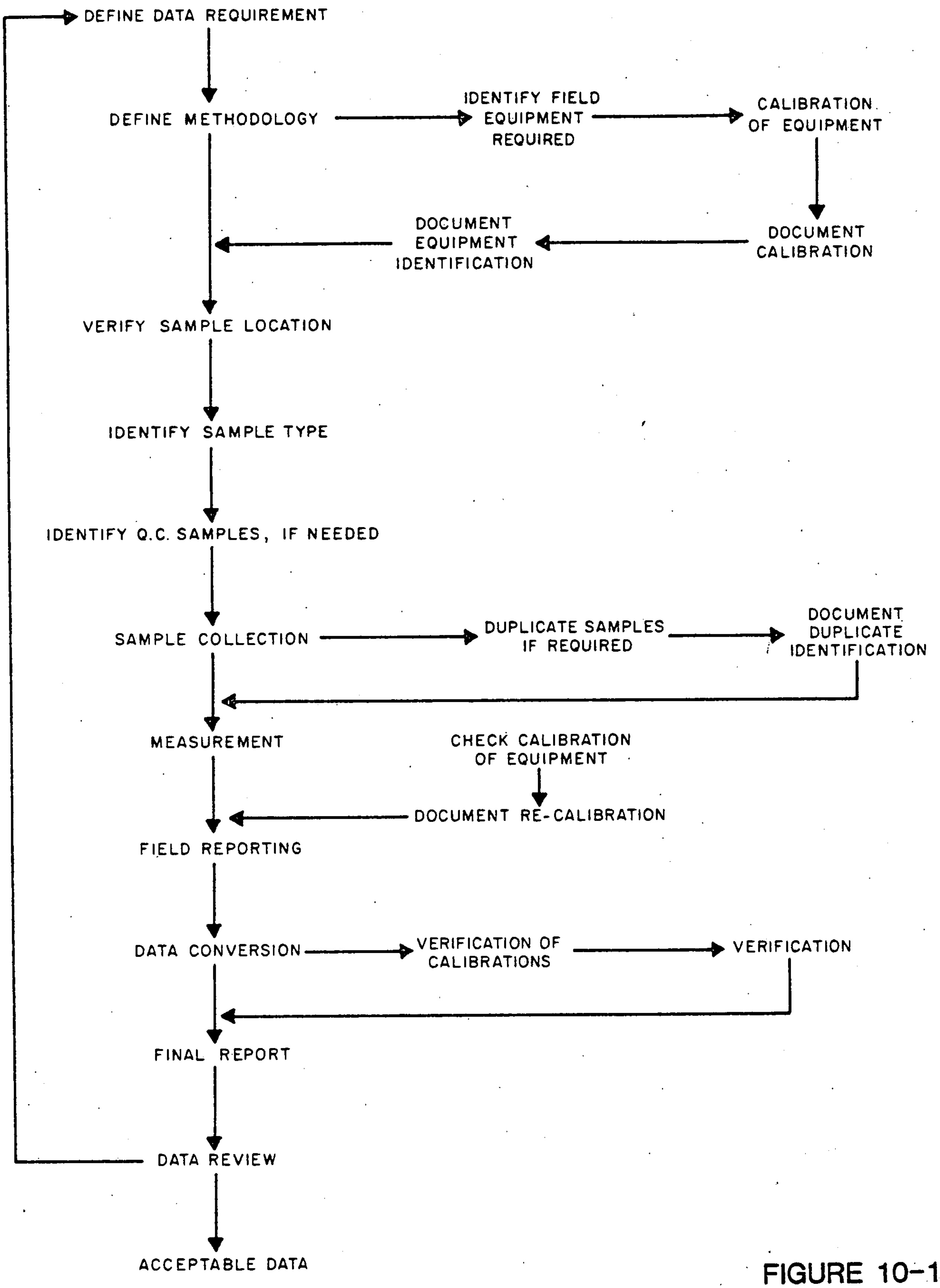
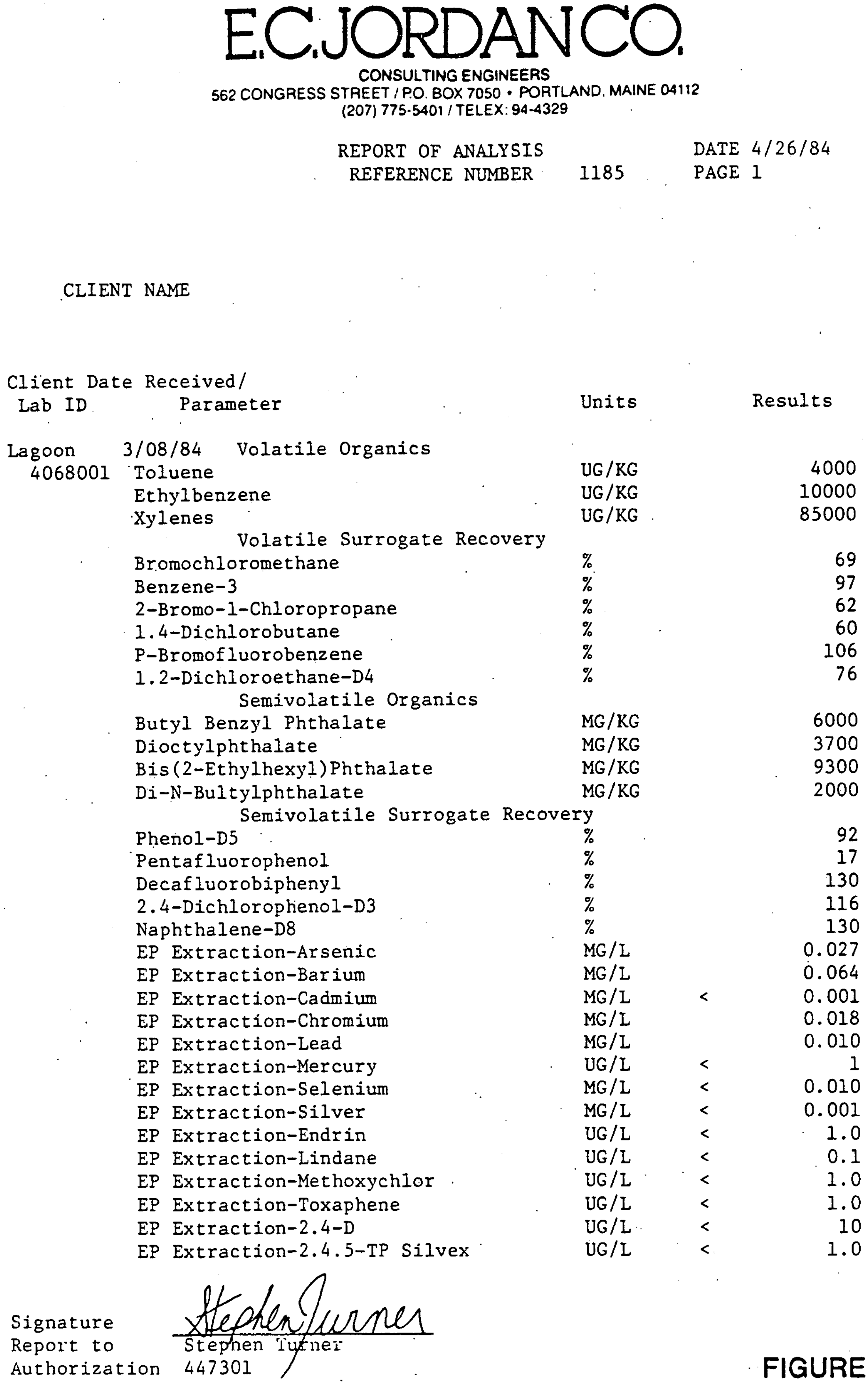


FIGURE 10-1

FIELD DATA COLLECTION AND VALIDATION



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(207) 775-5401 / TELEX: 94-4329

REPORT OF ANALYSIS DATE 4/26/84
REFERENCE NUMBER 1185 PAGE 1

CLIENT NAME

| Client Lab ID | Date Received/ Parameter | Units | | Results |
|---|---|---|---|---|
| Lagoon | 3/08/84 Volatile Organics | | | |
| 4068001 | Toluene | UG/KG | | 4000 |
| | Ethylbenzene | UG/KG | | 10000 |
| | Xylenes | UG/KG | | 85000 |
| | Volatile Surrogate Recovery | | | |
| | Bromochloromethane | % | | 69 |
| | Benzene-3 | % | | 97 |
| | 2-Bromo-1-Chloropropane | % | | 62 |
| | 1.4-Dichlorobutane | % | | 60 |
| | P-Bromofluorobenzene | % | | 106 |
| | 1.2-Dichloroethane-D4 | % | | 76 |
| | Semivolatile Organics | | | |
| | Butyl Benzyl Phthalate | MG/KG | | 6000 |
| | Dioctylphthalate | MG/KG | | 3700 |
| | Bis(2-Ethylhexyl)Phthalate | MG/KG | | 9300 |
| | Di-N-Bultylphthalate | MG/KG | | 2000 |
| | Semivolatile Surrogate Recovery | | | |
| | Phenol-D5 | % | | 92 |
| | Pentafluorophenol | % | | 17 |
| | Decafluorobiphenyl | % | | 130 |
| | 2.4-Dichlorophenol-D3 | % | | 116 |
| | Naphthalene-D8 | % | | 130 |
| | EP Extraction-Arsenic | MG/L | | 0.027 |
| | EP Extraction-Barium | MG/L | | 0.064 |
| | EP Extraction-Cadmium | MG/L | < | 0.001 |
| | EP Extraction-Chromium | MG/L | | 0.018 |
| | EP Extraction-Lead | MG/L | | 0.010 |
| | EP Extraction-Mercury | UG/L | < | 1 |
| | EP Extraction-Selenium | MG/L | < | 0.010 |
| | EP Extraction-Silver | MG/L | < | 0.001 |
| | EP Extraction-Endrin | UG/L | < | 1.0 |
| | EP Extraction-Lindane | UG/L | < | 0.1 |
| | EP Extraction-Methoxychlor | UG/L | < | 1.0 |
| | EP Extraction-Toxaphene | UG/L | < | 1.0 |
| | EP Extraction-2.4-D | UG/L | < | 10 |
| | EP Extraction-2.4.5-TP Silvex | UG/L | < | 1.0 |

Signature Stephen Turner
Report to Stephen Turner
Authorization 447301

FIGURE 10-2
EXAMPLE ANALYTICAL DATA REPORT

# 11.0 INTERNAL QUALITY CONTROL

## 11.1 MEASUREMENT SYSTEMS

Quality control procedures have been established for both laboratory and field activities. The NYSDEC-CLP provides internal quality control criteria for their selected contract laboratory. Field quality control activities include the use of calibration standards and blanks for pH, specific conductance, temperature, photoionization, and flame ionization measurements. Special samples to be submitted to the laboratory include:

- trip blanks
- blind replicates
- sampler blanks
- filtration blanks

These samples provide a quantitative basis for validating the data reported.

### Trip Blanks

Trip blanks are required for assessing volatile organic priority pollutants reported in water samples. The trip blank consists of a VOA sample container filled with reagent water which is shipped to the site with the other VOA sample containers. Two trip blanks are included with each shipment of water samples scheduled for volatile organic analysis. One of the two trip blanks will be analyzed with the other VOA samples. The other may be analyzed if VOA are detected in the first VOA trip blank.

### Replicates

Replicates of soil and groundwater samples will be submitted for analysis of all parameters specified for those samples according to the following schedule:

| Media | Number |
|---|---|
| groundwater | 10% of samples analyzed or a minimum of 1 per event |
| soil | 10% of samples analyzed or a minimum of 1 per event |

The identity of the replicate samples will not be revealed to the laboratory.

A sampling event is defined as a roundtrip visit to a site, regardless of the number of samples collected. Thus, a five day site visit which resulted in the collection of two samples should include one replicate. True replicates of soil samples are not possible because chemicals are typically not uniformly distributed in these materials. A modification of ASTM C702, Method B "Reducing Field Samples of Aggregate to Testing Size" will be used to split soil and sediment samples. Samples for volatile organic analysis, however, must be grab samples to avoid the loss of volatile constituents, which may be expected during sample splitting.

## Sampler Blanks

A minimum of one sampler blank for the bailer, sampling pump, and/or tubing assembly is scheduled during monitoring well sampling. Volatile or semi-volatile organics present within the bailer, pump apparatus, or discharge tubing are assessed by collecting a sample of reagent water passed through the sampling apparatus after washing with the decontamination solution followed by a rinse with reagent water.

## Filtration Blanks

Groundwater monitoring well samples scheduled for analysis of inorganic parameters are to be filtered. In order to assess the cleaning procedures of the filtration apparatus, the potential for cross-contamination, and the potential contribution to the sample from the filter itself, a filtration blank will be collected for every 15 samples filtered. The filtration blank will be prepared by passing reagent water through a freshly-cleaned filtration apparatus, then preserving the sample if required for the analyses planned.

## Completeness

Completeness of scheduled sample collection will be controlled in the field by comparing a computer generated label inventory with samples actually collected each day. Daily checking of field data sheets and comparison of transport and chain-of-custody logs will provide further control on documentation and completeness.

## Criteria Used in Evaluating Laboratory Assays of Internal Quality Control Samples and Field (Sample) Replicates

Establishment of specific criteria depends on the number of field and quality control samples for each media sampled, the quality of chemical data and how the data will be used in interpreting, evaluating and assessing the site. Chemical assay results of a particular sample may be used for more than one purpose. Chemical assay results of quality control samples may be considered differently depending on how the data will be used.

The following general criteria are to be considered by the professional responsible for assessing site conditions:

- Quality of Laboratory Data:
  - acceptable
  - provisional
  - unacceptable

- Method Limitations:
  - detection range

  - accuracy
  - method detection limits (MDL)
  - minimum reportable concentration (MRC)
  - precision

- Sampling/Analysis Scope and Results:
  - number of replicates at one location
  - number of samples on site/media
  - background/downgradient distribution
  - consistency/trends of chemical assay data collected at site
  - agreement with existing site information

- Use of Data:
  - chemical distribution and transport at the site (generally order of magnitude comparisons)
  - compliance with standards, regulations, response objectives
  - presence or absence of chemical
  - treatability
  - disposal method for media containing chemicals

## 11.2 QUALITY REVIEW OF STUDIES AND REPORT PREPARATION

The purpose of quality reviews through the course of studies, designs and reports is to ensure that the service, designs and documents produced by each department meet currently accepted professional standards. The level of effort for each assignment will vary depending on type of assignment, duration and size. Review of small projects may entail periodic discussions between Technical Staff, the Technical Director and Project Manager. Quality control on larger assignments may require that other review personnel be involved. Quality control reviews should be scheduled on a routine basis, but the option of holding a quality control review at any time is always open. The time required to plan, schedule, and conduct quality control reviews should be considered part of all other design, writing and checking phases of a project.

Each assignment is divided into phases for internal quality control reviews. At each phase, the review should include client goals, contractual commitments, technical merit, timing, budget, assignment of appropriate personnel, department coordination, project problem resolution, documentation, and consistency with company policy. Key elements to the success of any quality control review are identification of problem areas, communication to implement solutions, and follow-up.

Quality control during the preparation of studies and reports relies on documentation of data utilized and peer review of conclusions drawn from the assembled data base. The comparability objective established for the project is of particular importance when data are derived from many sources (i.e., the data base is comprised of secondary measurements). Documentation of secondary data typically is accomplished via data verification/tracking checklists with accompanying written criteria describing "acceptable" data to insure consistency in data selection. This allows all data base components to be traced to the primary generator and forces a review of data quality as the data base is developed. All project personnel are responsible for utilization and monitoring of this process; compliance is audited by the QAC. Upon completion of the data base, data interpretation, evaluation, and report preparation commence. Interpretation may require consultation with Jordan's statistician and/or use of computerized statistical routines. Documentation is also prepared for statistical manipulation methodologies. Data evaluation incorporate peer review to provide broad-based insight to data correlations and interactions.

To enhance the professional quality of the company's studies and reports, discipline managers will also:

- require that reports refer to and are consistent in scope with the project proposal and contract; and
- require that report language and contents be chosen to foster client's understanding of risks and uncertainties by distinguishing fact from opinion and identifying risks and limitations in a clear and informative manner.

# 12.0 AUDITS

Quality assurance audits are performed to assure and document that quality control measures are being utilized to provide data of acceptable quality and that subsequent calculations, interpretation and other project outputs are checked and validated. Both scheduled and unscheduled audits are provided for in the QA program.

System and performance audits may be conducted by the Quality Assurance Coordinator (QAC) or NYSDEC Quality Assurance staff. The Project Review Board (PRB) may conduct project audits of calculations, interpretations and reports which are based on the measurement system outputs.

## 12.1 SYSTEMS AUDIT

A system audit may be conducted on all components of measurement systems to determine proper selection and utilization. The systems audit includes evaluation of both field and laboratory procedures.

Organization and Personnel. The project organization is reviewed for compliance with the proposed organization and for clarity of assigned responsibility. Personnel assigned to the project will be reviewed to determine that assigned responsibility, skill and training of the personnel are properly matched. The Technical Director maintains firsthand knowledge of his team's capabilities and will discuss the organization's efficacy with the QAC. Assigned personnel may be interviewed by the QAC during an audit.

Facilities and Equipment. The audit will address whether field tools and analytical instruments are selected and used to meet requirements specified by the project objectives stated in the QA/QC Plan. Equipment and facilities provided for personnel health and safety will also be evaluated. Calibration and documentation procedures for instruments used in the field will receive special attention.

Analytical Methodology. Routine external performance evaluations as well as blind internal performance evaluations are generally conducted by NYSDEC through the CLP. A review of analytical methodology in regard to the data requirements for the project may also be performed. An on-site observation of analyst technique, data reduction and record keeping may be performed if determined necessary. Periodic review of precision and accuracy data is essential.

Sampling and Sample Handling Procedure. An audit of scheduled samples vs samples collected vs samples received for analysis will be performed. Field documentation will be reviewed. If deemed necessary, a site visit will be made to assure that designated control procedures are practiced during sampling activities.

Data Handling. During a system audit, the QAC will review data handling procedures with the TD and Task Leaders. Accuracy, consistency, documentation and appropriate selection of methodologies will be discussed.

## 12.2 PERFORMANCE AUDIT

These audits are intended primarily for analytical and data generation systems. The contracted laboratory will be, or has been, audited by the NYSDEC-CLP.

## 12.3 PROJECT AUDIT

Project audits encompass the aspects of both the systems audit and the performance audit. The project audit typically occurs once but may be more often during special projects. Timing is keyed to the systems involved and the project objectives.

## 12.4 QA AUDIT REPORT

A written report of the QA project audit is prepared to include:

- an assessment of project team status in each of the major project areas;
- clear statements of areas requiring improvement or problems to be corrected. Recommendation and assistance will be provided regarding proposed corrective actions or system improvements. If no action is required, the report will state that the QA audit was satisfactorily completed;
- a timetable for any corrective action required; and
- a follow-up to assure that recommendations have been implemented.

Figure 12-1 provides an example Quality Assurance Audit Report. Distribution of the report should include the Project Review Board, Responsible Corporate Officer, Technical Director, Project Manager, and NYSDEC QA section staff.

## FIGURE 12-1

## QUALITY ASSURANCE AUDIT REPORT

Project: ____________________

Project No.: __________ Quality Assurance Coordinator: ____________________

Project Aspects Audited: ____________________

Laboratory/Technical Director: ____________________

Audit Conducted By: ______________ for the period __________ to __________

Date of Audit: ____________________

Personnel Interviewed: ____________________

Purpose and Objectives of the Project Aspects Audited

Brief Description of the Sampling and Analytical Requirements

## FIGURE 12-1 (Continued)

## RESULTS OF THE QUALITY ASSURANCE AUDIT

### Organization and Personnel

### Facilities Utilized

### Analytical Methodologies

FIGURE 12-1 (Continued)

RESULTS OF THE QUALITY ASSURANCE AUDIT

Sampling and Sample Handling

Quality Control Measures Utilized

Data Handling

FIGURE 12-1 (Continued)

Quality Assurance Deficiencies

Recommended Corrective Actions and Schedule

Signed Date

Title

Distribution:

Reviewed by Date

Title

# 13.0 PREVENTIVE MAINTENANCE

## 13.1 ANALYTICAL INSTRUMENTATION

Preventive maintenance is performed contractually on Jordan's major analytical instrumentation. Preventive maintenance for contract laboratory instrumentation is specified in that organization's QA program.

### Perkin-Elmer Sigma I FID/ECD Gas Chromatograph, Perkin-Elmer Model Sigma 3-B Dual FID Gas Chromatograph and Hewlett Packard Model 5880 FID/ECD Gas Chromatograph

These systems are under service agreements with Perkin-Elmer which cover all repair parts, extended parts, labor and travel. The preventive maintenance visits involve cleaning, adjusting, inspecting, and testing procedures designed to reduce product failure and/or extend useful product life. Between visits, routine operator maintenance and cleaning is performed according to manufacturer's specifications.

## 13.2 FIELD INSTRUMENTS

Preventive maintenance of field equipment is performed by analysts and staging area staff and routinely precedes each sampling event; more extensive maintenance is performed on the basis of hours in use. Sampling crews report on the performance of the equipment after each sampling event. Critical spare parts are kept in stock.

# 14.0 DATA ASSESSMENT

## 14.1 GENERAL

The purpose of data quality assessment is to assure that data generated under the program are accurate and consistent with project objectives. The quality of data will be assessed based on the precision, accuracy, consistency and completeness of the data that are measured or generated.

Data quality assessment will be conducted in three phases:

### Phase 1

Prior to data collection, sampling and analysis procedures are evaluated in regard to their ability to generate the appropriate, technically acceptable information required to achieve project objectives. This QA/QC Plan meets this requirement by establishing project objectives defined in terms of parameters, analytical methods, and required sampling protocols.

### Phase 2

During data collection, results will be assessed to assure that the selected procedures are efficient and effective and that the data generated provide sufficient information to achieve project objectives. Precision and accuracy of measurement systems will also be evaluated. In general, evaluation of data will be based on performance audits, results of duplicate and spiked sample analyses, and review of completeness objectives.

Documentation may include:

- number of replicate samples collected;
- number of replicate, spike and field blank samples analyzed;
- identification of statistical techniques, if used, to measure central tendency, dispersion, or testing for outliers;
- use of historical data and its reference; and
- identification of analytical method.

### Phase 3

Following completion of data collection activities, an assessment of the adequacy of the data base generated in regard to completing project objectives will be undertaken by the QAC, PRB or NYSDEC QA section. Recommendations for improved quality control will be developed, if appropriate. In the event that data gaps are identified, the auditor may recommend the collection of additional raw data to fully support the project's findings and recommendations.

Each phase of the assessment will be conducted in conjunction with appropriate project staff.

## 14.2 PROCEDURES TO ASSESS PRECISION AND ACCURACY

Assessment of precision and accuracy of analytical data is accomplished via review of duplicate analyses (precision) and surrogate spike recovery (accuracy) both in reagent water and sample matrices. Precision is generally expressed as the coefficient of variation (CV). Accuracy is expressed as percent recovery. Precision must be assessed for each matrix since distribution of contaminants may be non-homogeneous, especially in non-water matrices. Precision in samples must be reviewed with knowledge of the matrix and level of analyte present. Corrective action or documentation of substandard precision is a laboratory responsibility. Accuracy, too, must recognize the impact of matrix interferences. Optional surrogate/spike recoveries are generally specified by the analytical method for reagent water under defined conditions. Each method which provides quality control requirements and acceptance criteria also specifies the method of generating the data to be reviewed. It is the laboratory's responsibility to attempt to identify the source of substandard recoveries and either take corrective action or document the cause.

Calculations are presented below:

$$\%R = \frac{\text{observed value}}{\text{theoretical value}} \times 100$$

$$CV = (S/x) \times 100$$

where %R = percent recovery

CV = coefficient of variation

S = sample standard deviation

x = mean value of data set

Completeness is generally assessed as a percentage of data intended to be generated, and is most often utilized in Phase 3 of the data assessment process.

## 15.0 CORRECTIVE ACTION

Corrective or preventive action is required when potential or existing conditions are identified that may have an adverse impact on data quantity or quality. Corrective action could be immediate or long-term. In general any member of the program staff who identifies a condition adversely affecting quality can initiate corrective action by notifying in writing his or her supervisor and the QAC. The written communication will identify the condition and explain how it may affect data quality or quantity.

### 15.1 IMMEDIATE CORRECTIVE ACTION

This type of corrective action is usually applied to spontaneous, non-recurring problems, such as an instrument malfunction. The individual who detects or suspects nonconformance to previously established criteria or protocol in equipment, instruments, data, methods, etc., will immediately notify his/her supervisor. The supervisor and the appropriate task leader will then investigate the extent of the problem and take the necessary corrective steps. If a large quantity of data is affected, the task leader must prepare a memorandum to the Project Manager and the QAC. These individuals will collectively decide how to proceed. If the problem is limited in scope, the task leader will decide on the corrective action measure, document the solution in the appropriate workbook and notify the Project Manager, and the QAC in memorandum form.

### 15.2 LONG-TERM CORRECTIVE ACTION

Long-term corrective action procedures are devised and implemented to prevent the recurrence of a potentially serious problem. The QAC will be notified of the problem and will conduct an investigation to determine the severity and extent of the problem. The QAC will then file a corrective action request with the Project Manager and Project Review Board.

In case of dispute between the PRB and the PM, the Responsible Corporate Officer (RCO) will make a final determination for the company.

Corrective actions may also be initiated as a result of other activities, including:

- Performance Audits;
- System Audits;
- Laboratory/field comparison studies; and
- QA project audits conducted by the PRB or QAC.
- QA audits conducted by NYSDEC QA section staff.

The QAC will be responsible for documenting all notifications, recommendations, and final decisions. The PM and the QAC will be jointly responsible for notifying program staff and implementing the agreed upon course of action. The QAC will be responsible for verifying the efficacy of the implemented actions. The development and implementation of preventative and corrective actions will be timed, to the extent possible, so as to not adversely impact either project schedules or subsequent data generation/processing activities. The QAC will also be responsible for developing and implementing routine program controls to minimize the need for corrective action.

## 16.0 REPORTS TO MANAGEMENT

Summary reports will be prepared (typically on a quarterly basis) to inform management of project status. A final project audit report should also be prepared. Duplicates of any reports will be provided to NYSDEC. The reports may include:

- periodic assessment of measurement data accuracy, precision and completeness;
- results of performance audits and/or systems audits;
- significant QA problems and recommended solutions; and
- status of solutions to any problems previously identified.

Additionally, any incidents requiring corrective action will be fully documented. Procedurally, the QAC will prepare the reports to management. These reports will be addressed to the Project Manager and the PRB. The summary of findings shall be factual, concise and complete. Any required supporting information will be appended to the report.

# APPENDIX A

# FIELD SCREENING ANALYTICAL PROTOCOL FOR VOLATILE ORGANICS IN SOILS

# FIELD SCREENING PROTOCOL
# SELECTED VOLATILE ORGANIC ANALYTES IN SOIL

## 1.0 INTRODUCTION

This protocol is intended for use as a field screening tool to limit the number of samples submitted to a contract laboratory for more in-depth analysis. For the Love Canal V-C project, identification of the extent of contaminant migration has been stated as an objective; thus the protocol described herein has been biased to avoid false negative results at the expense of quantitation at higher levels.

The following compounds are included in the calibration and reporting portions of this screening protocol:

| | CAS NO. | | CAS NO. |
|---|---|---|---|
| o 1,2-trans-dichloroethene; | 156-60-5 | o 1,2-dichlorobenzene; | 95-50-1 |
| o chloroform; | 67-66-3 | o 1,3-dichlorobenzene; | 541-73-1 |
| o carbon tetrachloride; | 56-23-5 | o 1,4-dichlorobenzene; | 106-46-7 |
| o trichloroethene; | 79-01-6 | o 1,1,2,2-tetrachloroethane; and | 79-34-5 |
| o benzene; | 71-43-2 | o 1,1,2-trichloroethane. | 79-00-5 |
| o tetrachloroethene; | 127-18-4 | | |
| o toluene; | 108-88-3 | | |
| o chlorobenzene; | 108-90-7 | | |
| o ethylbenzene; | 108-41-4 | | |

These compounds have been selected by NYSDEC based on review of historical data. Several of these compounds exhibit similar chromotographic behavior which may preclude differentiation. Additional purgeable organic compounds may be detected by this analytical method. Unknowns will be noted and quantified on the basis of an averaged response.

## 2.0 SUMMARY OF METHOD

The method of analysis is an adaption of USEPA Method 624 with heated purge and trap to facilitate recovery of VOA from soil, and flame ionization detector, rather than a mass spectrometer to simplify field analytical equipment. Contaminants are transferred from soils to water via an extraction process described herein and referenced to "New York State Department of Environmental Conservaton - Superfund and Contract Laboratory Protocol, January 1985". Method detection limits are currently estimated to be 10 μg/kg (to be updated following initial calibration).

## 3.0 APPARATUS, MATERIALS AND REAGENTS

3.1 Purge and Trap Device - Perkin-Elmer Model LSC-2 Liquid Sample Concentrator. The purging section of this device consists of a glass sample vial capable of accepting 25 ml of sample. All fittings and tubing are either stainless steel or Teflon. UHP helium purge gas is introduced through a needle sparger entering the top of the purge tube. The trap is a section of 0.10 inch I.D., 12 inch long stainless steel tubing which is packed with an adsorbent material which retards the flow of the volatile organic analytes while allowing the purge gas to vent. The desorber, a temperature-controlled heating coil around the trap, rapidly heats the trap; the heat transfers the volatile organic pollutants from the adsorbent media to the carrier gas (UHP helium) which is then directed to the gas chromatographic column.

3.2 Gas Chromatograph - Perkin-Elmer Sigma 3B FID chromatograph. The gas chromatograph includes a temperature programmable oven, glass-lined injector and detector transfer lines, dual packed columns flame ionization detectors.

3.3 5 Microliter Micro syringes

3.4 25 Milliliter Macro syringes

3.5 GC Columns. Six feet long by 2 mm I.D. silanized pyrex glass packed with 1.0 percent SP 1000 on 80/100 mesh carbopack B

3.6 Hewlett-Packard 3392A integrator and recorder

3.7 Trap Materials - Chromatographic grade Tenax GC (2,6-diphenylene oxide) 60/80 mesh (Supelco, Inc., Bellefonte, PA 16823)

3.8 Stock standard solutions - stock standard solutions of the purgeable compounds listed in Section 1 are prepared in methanol at a concentration of 50 ng/µℓ from reference standards for use in daily quality control.

3.9 Surrogate solution - a solution containing:
bromochloromethane
bromochloropropane
dichlorobutane
at a concentration of 25 ng/µℓ is prepared in methanol from reference standards (Supelco, Inc., Bellefonte, PA 16823).

## 4.0 EXTRACTION

Approximately five grams (5.0±0.01 g) of soil is weighed into a clean purging chamber and 10 µℓ of the surrogate spiking solution mixed in 5 mℓ of reagent water added.

The sample is heated to 40°C ± 1°C and purged for 12 ± 0.1 minutes.

## 5.0 CALIBRATION

Initial calibration will occur in the laboratory; calibration verification will occur daily in the field. Initial calibration consists of multiple analyses of purged standards and surrogates. Standards are analyzed at concentrations of 10, 50, and 100 parts per billion of each compound listed in Section 1, prepared in water. Calibration curves will be prepared, or should response factors remain nearly constant (<10% RSD) average response factors will be calculated. In addition 4 replicates of the 50 ppb solution will be analyzed to provide initial precision data.

## 6.0 ANALYSIS

The trap, containing the purgeables acquired in Section 4.0, is heated and the purgeables analyzed under the conditions presented in Table 1.

## 7. IDENTIFICATION AND QUANTIFICATION

### A. Identification

1. The retention times of the individual volatile analytes in the standard and surrogate solutions will be recorded.
2. Analytes and surrogates in the samples will be identified based on matching retention times, using a 1 minute window.
3. Peaks with retention time not matching those windows estabished for the compounds of interest and surrogates will be noted as unknown.

### B. Quantitation

1. Equal amounts of surrogates will be spiked into reagent water (reference value) and samples. Calculate percent recovery for each surrogate as Area (surrogate in sample)/Area (surrogate in reagent water) x 100.
2. When a compound is identified in a sample, it will be quantitated using the method of external standards based on the standard run(s) performed daily prior to analysis. Calculation will be as follows:

$$\text{concentration } (\mu g/kg) = \frac{(As)}{(RF)(gm)}$$

As = peak area of component
gm = grams of soil extracted
RF = response factor, based on standard runs, in area/nanogram

3. Areas of unknown peaks will be summed and quantitated based on the mean of the average response factors detemined during calibration (5.0) as follows:

$$\text{Estimated total unknown concentration, } \mu g/kg = \frac{\Sigma Av}{(\overline{RF})(gms)}$$

where: $\Sigma Av$ = Summed areas of unknowns
$\overline{RF}$ = mean of average response factors (5.0).
gms = grams of sample analyzed.

# TABLE 1

## FIELD VOLATILE ORGANIC ANALYSIS
## GAS CHROMATOGRAPH OPERATING PARAMETERS

### SPARGING CONDITIONS - PERKIN-ELMER LSC-2

Sample size - 5 grams
Sparge rate - 40 ml/min
Sparge gas - UHP Helium
Purge chamber - heated to 40°C ± 1°C

### DESORB CONDITIONS - BACK FLUSHING

Adsorbent Media - 60/80 Mesh Tenax GC/Silica Gel/OV-1
Trap Dimensions - 12 inches long x 0.1 inch I.D. Stainless Steel

Desorb at 200°C with 30 ml/min helium backflush for 4 minutes, GC oven at 45°C.

### GAS CHROMATOGRAPH - PERKIN-ELMER SIGMA 3B

Temperature Program of 45°C to 220°C at 8°C/min; hold at 220°C for 16 minutes.
Helium Carrier flow - 30 ml/min.
Column - 6 ft x 2 mm I.D. glass packed with 1.0% SP1000 on 80/100 mesh Carbopack B
Detector System: FID

## 8. QUALITY CONTROL

Daily quality control will include analysis of a reagent water blank and a calibration verification sample. The calibration verification sample will be two times the MDL (see Section 1) to confirm sensitivity and stability. Should the calibration verification fail to confirm sensitivity, correction of the cause or recalibration is required (see Section 5).

At least ten (10) percent of analyses will be duplicate analyses. All samples will be spiked with the surrogate solution.