DRAFT RI WORK PLAN - VOLUME I (HLA 8/94)

Draft
Remedial Investigation Work Plan
Island Chemical Company, Inc.
St. Croix, U.S. Virgin Islands

Prepared for

Island Chemical Company, Inc.

HLA Project No. 24231 2.C.1

Jason M. Schindler
Senior Geologist

Edward A. Nemecek, R.G., C.P.G.
Principal Hydrogeologist

August 5, 1994

Harding Lawson Associates
Engineering and Environmental Services
131 North Third Street
Philadelphia, PA 19106 – (215) 627-4505

CONTENTS

CONTENTS

CONTENTS

CONTENTS

TABLES

FIGURES

APPENDIXES

CONTENTS

1.0 BACKGROUND

1.1 Introduction

This *Remedial Investigation Work Plan* (RIWP) has been prepared by Harding Lawson Associates (HLA) to address environmental conditions at the former Island Chemical Company, Inc. (ICC) facility located on Route 66 (Melvin Evans Highway) near the intersection with Route 64 in St. Croix, U.S. Virgin Islands. This document has been prepared to be consistent with the requirements of the National Contingency Plan (NCP). This RIWP discusses the site, summarizes work performed to date and describes the scope of work intended to document current conditions at the site. Pursuant to discussions with the U.S. Environmental Protection Agency Region II (USEPA), supporting documents have been included as appendices to this RIWP. The project *Sampling and Analysis Plan* (SAP) is included as Appendix A, the project *Health and Safety Plan* (HASP) is included as Appendix B, and the project *Quality Assurance Project Plan* (QAPP) is included as Appendix C.

1.2 Objectives

The objectives of this Remedial Investigation are:

- To evaluate whether onsite conditions currently pose a cause for environmental concern;
- To evaluate whether potential source areas not previously identified are present onsite;
- To identify potential contaminant pathways;
- To assess the possible presence of a shallow clay layer reported by others;
- To determine the horizontal direction of shallow groundwater flow; and
- To generate data of sufficient quality (1) to be compared to ARARs identified; (2) to be used in development of a baseline human health and/or ecological risk assessment, if necessary; and (3) to be used to develop a feasibility study, if necessary.

The Remedial Investigation tasks described in Section 5 of this RIWP are designed to achieve these objectives. A report will be prepared following completion of the Remedial Investigation tasks. The report will include recommendations for further actions, if any.

Should evidence of affected soil and/or groundwater be identified during the RIWP, supplemental Remedial Investigation tasks may be implemented to the extent necessary for

remediation purposes. The objectives of supplemental Remedial Investigation tasks would be:

- To evaluate the extent of onsite source areas, if any, for the purposes of remedial actions;
- To assess the risk posed by conditions at the site, if warranted; and
- To develop, screen and analyze potential remedial alternatives, if necessary.

2.0 SITE BACKGROUND

2.1 Site Description

On July 2, 1993, HLA performed a preliminary inspection of the site. At that time, the site was found to be abandoned and overgrown with heavy vegetation.

2.1.1 Site Location

The site occupies approximately three acres in south central St. Croix, U.S. Virgin Islands (Figure 2-1). The site is located on Route 66, approximately 1,500 feet north of the Alexander Hamilton Airport. The property is located on Plot 13Q of Estate Bethlehem Middle Works at 17°42'26" north latitude, 64°47'25" west longitude.

The site is bordered to the northeast and southeast by an intermittent stream (River Gut). The site is bordered to the northwest by an asphalt batch plant and to the southwest by Route 66. A concrete or cement batch plant and an automobile body repair shop are located to the east of the site, across the River Gut.

2.1.2 Site Structures

The current layout of the facility is shown in Figure 2-2. Major onsite structures include the following:

- Laboratory and Warehouse Building which housed the analytical laboratories, rest rooms, offices, storage, the dryer area and a cafeteria;
- Maintenance Building which houses two boilers, refrigeration units, air compressors and a maintenance shop;
- Above-ground Storage Tank (AST) farm.
- Loading Dock (former location of laboratory pit)
- Concrete Pad Adjacent to Tank Farm
- Concrete Storage Pad
- Production Area which includes a centrifuge and a dryer building;
- Reactor Area;
- Two cooling towers;
- Generator Building;
- Generator and Fire Pump Building;

- Two 4,000-gallon ASTs;
- One 250,000-gallon fire water AST; and
- Reduction/oxidation Unit and Water Storage Building.

2.2 Site Setting

2.2.1 Topography and Drainage

The site is located in a valley. Surface elevations at the site range from approximately 30 to 40 feet above mean sea level (MSL). Land to the southwest (approximately 200 feet) and to the east (approximately 1,000 feet) of the site slope steeply upward to roughly 150 to 200 feet above MSL. A preliminary review of U.S. Geological Survey (USGS) 7½ topographic quadrangles for the area suggests that this valley receives drainage from approximately 6,300 acres to the northwest of the site. Based on drainage area comparisons, the gut adjacent to the site appears to receive approximately one third of that flow. The remainder is drained by another intermittent stream that joins the gut approximately 800 feet southeast (downstream) of the site (Bethlehem Gut). All of the stream channels in the drainage basin are identified as intermittent. Ogden (1974) reported that there are no permanently flowing streams on the island.

The surface slopes gently across the site from southwest to northeast. Ground surface just beyond the northeastern and eastern fence lines slopes steeply downward approximately 12 to 15 feet into the gut. A berm partially separates the aboveground storage tanks in the western part of the facility from the remainder of the site. On the western side of the berm, runoff drains from southwest to northeast. Surface drainage on the eastern portion of the site is controlled by the buildings, concrete paved areas and two storm drains that channel runoff to the gut along the southeastern site boundary. All surface runoff from the site drains to the gut. The gut drains to the Caribbean Sea, approximately 4,500 feet to the south.

Flow in the River Gut is intermittent and generally only occurs during the rainy season which occurs between September and December. According to Enviro-Science, Inc. (ESI), a sewage outfall discharges to the gut downstream from the site. HLA did not observe the sewage outfall during a preliminary site walk on July 2, 1993.

2.2.2 Climate and Air Quality

The climate is dry and tropical with average monthly temperatures between 75 and 83°F. Throughout much of the year, the trade winds blow steadily out of the northeast at 10 to 20 miles per hour (Multer, 1974).

Data on precipitation and temperature were obtained from the Alexander Hamilton Airport, approximately 1/2 mile southwest of the site. Average total annual precipitation is 44.57 inches. Greatest rainfall occurs between August and November. Average annual and

monthly rainfall for the area are summarized in Appendix D. According to Forman (1974), long term average rainfall has not changed over the past 112 years.

On April 5, 1979, ICC submitted information regarding air emissions to the USEPA. Because the potential hydrocarbon emissions were calculated to be less than 100 tons per day, the USEPA determined that the facility was not subject to Federal Prevention of Significant Air Quality Deterioration. A copy of the USEPA correspondence is included in Appendix E.

2.2.3 Soil

Soil type was determined from a soil map constructed by the Cartographic Division of the United States Department of Agriculture (USDA) Soil Conservation Service (SCS) using 1962 and 1963 aerial photographs. The map was taken from the 1970 SCS Soil Survey of the U.S. Virgin Islands. Figure 2-3 shows the soil types in the vicinity of the site.

The entire site lies on Coamo clay loam with slopes of 2 to 5 percent. The Coamo series consists of gently sloping, deep, well-drained soils over volcanic and limestone rocks. These soils formed sediments derived from the rocks they overlay, and therefore occur as alluvial fans and terraces. These soils range in texture from sand to clay.

A typical profile has an approximately eight-inch thick surface layer consisting of very dark grayish-brown clay loam, containing rock fragments. The subsoil is a very dark grayish- to yellowish-brown clay, also containing rock fragments. The substratum begins at a depth of approximately 2 feet and consists of a yellowish- to dark yellowish-brown, friable, calcareous clay loam stratified with sand and gravel.

According to the SCS, since the field work for the 1970 survey was performed almost 30 years ago, the information in the report may be out of date. However, this is the only existing soil survey of St. Croix, and a new survey will not be published for at least two years. The new survey will be more detailed and reflect changes in taxonomy, wetlands, and land use.

2.2.4 Geology and Hydrogeology

2.2.4.1 Regional Geology

St. Croix is an island composed primarily of limestone and volcaniclastic sediments. It is located at the juncture of the Greater Antilles and Lesser Antilles Geologic Provinces in the northeastern corner of the Caribbean Sea. The island lies upon a submarine platform that is separated from Puerto Rico and the Virgin Islands Platform by the Virgin Islands Basin and the Anegada Passage (Gill, 1989).

The ICC site is located in the central basin of St. Croix. The central basin is a graben structure containing primarily late Cretaceous Age and younger calcareous sediments. Figure 2-4 is a generalized geologic map of the island. A brief discussion of the major geologic formations of the central basin follows.

Mt. Eagle Group

The deepest formations reached through soil borings in the central basin consist of tuffaceous and volcaniclastic sediments of the Mt. Eagle Group. These sediments are believed to have eroded from nearby islands during the Cretaceous.

Jealousy Formation

The Jealousy Formation is believed to unconformably overlie the Mt. Eagle Group in the central basin. According to Gill (1989), "the Jealousy Formation is remarkably uniform, consisting of blue grey foramniferal marls." Gill reports that in the central basin, the bottom of the Jealousy Formation has never been reached. However, based on gravity surveys, Shurbet et al. (1956) estimated a total thickness greater than 6,000 feet. Gill (1989) noted that the Jealousy Formation is entirely subsurface. Areas mapped by previous researchers as outcrops of the Jealousy Formation (Figure 2-4) are believed to be the overlying Kingshill Limestone.

Kingshill Limestone

The Kingshill Limestone includes a variety of sedimentary facies. It includes beds of sandy, limy clay and siltstone and beds of nearly pure to clayey limestone (Robinson, 1972). It conformably overlies the Jealousy Formation and ranges up to 600 feet in thickness. The contact between the Kingshill Limestone and the Jealousy Formation is reportedly readily visible in soil borings. The upper Kingshill Limestone is exposed less than one mile north of the site (Gill, 1989)

Alluvium

The site is situated on alluvial deposits which have filled many of the valleys on the island. A minimum thickness of 50 to 100 feet of alluvium is believed to be present in the axial parts of the valleys (Cederstrom, 1941). A maximum thickness of approximately 100 feet reportedly occurs at the lower reach of River Gut (Geraghty & Miller, 1983). The alluvium is composed primarily of montmorillinitic clay. It is similar in appearance to the Kingshill formation, because both contain soft sandy, silty buff to white material (Robinson, 1972). The alluvium, however, lacks limestone beds and has more sand and gravel deposits than the Kingshill.

2.2.4.2 Site Geology

Geotechnical soil borings were completed at the site by Caribbean Drilling Services, Inc. (CDS) on April 18, 1979 and July 21, 1980 prior to expansion of the laboratory facility and construction of the fire water storage tank. Three soil borings were completed in each area. The borings in the laboratory expansion area were 20 to 25 feet deep. The borings in the fire water tank area were drilled 10 to 15 feet below grade. Copies of the soil boring reports are included in Appendix F.

Borings in the vicinity of the laboratory expansion encountered 0 to 2.5 feet of silty clay. The silty clay was underlain by 3.5 to 7 feet of sandy silt and silty sand with gravel and rock fragments which extended from approximately 12 to 14.5 feet below grade. A 1.5 to 3 foot thick layer of tough sandy clay was encountered beneath the sandy silt/silty sand in two of the soil borings identified as B-2 and B-3 in this area (CDS, 1979). Although the sandy clay was not reported in the third boring, B-1, a soil sample was not collected at the bottom of the sandy silt/silty sand layer. It is therefore possible that the sandy clay is present in this location at a depth not sampled, possibly between 10 and 13 feet below grade. Four to nine feet of silty sand and gravel was encountered at the bottom of all three soil borings in this area.

The fire water tank area is underlain by at least 10 to 13 feet of sandy silts and clays. A layer of silty sand and gravel was encountered in two borings at 12 and 13 feet below grade. The third boring did not extend to this depth.

2.2.4.3 Regional Hydrogeology

Geraghty & Miller performed an aquifer pumping test in the nearby Fairplain well field between March 9 and 11, 1982. Based on results of the pumping tests, the alluvial aquifer appears to be under semi-confined conditions. Estimated specific capacities for the five wells monitored ranged from 1.5 to 3.4 gallons per minute per foot of drawdown (gpm/ft) (Geraghty & Miller, 1983). Results of previous testing performed by Cederstrom (1950) on two wells, possibly located in the Old Golden Grove well field, indicated specific capacities of 4.5 to 5.6 gpm/ft. Insufficient data are available to determine the exact location of the wells tested by Cederstrom. Geraghty & Miller postulated that the wells may be existing Golden Grove wells, abandoned wells or they may have been damaged and covered during construction in the area.

The alluvium is predominantly low permeability, montmorillinitic clay with relatively higher permeability layers of sand and gravel, ranging from one to eight feet in thickness. The interconnection between the higher permeability layers is unknown. Geraghty and Miller (1983) noted that during the pumping test, ponded water in the River Gut exhibited no change. They suggested that water in the gut may be perched above groundwater.

According to Geraghty & Miller (1983) the Fairplain and Golden Grove well fields "apparently derive all of their water from the sand and gravel layers present in the alluvium." Most groundwater appears to be under partially confined conditions.

Robinson (1972) reported that it is possible to construct wells which yield a few hundred gallons per minute (gpm) in one area of the Kingshill aquifer. However, more often yields are closer to 5 to 40 gpm for other areas in the Kingshill and the alluvium. Reported yields for wells identified within one mile of the site range from less than 2 gpm to 62 gpm. Information on wells within one mile of the site is summarized on Table 2-1 and is further discussed in Section 2.4.

It is estimated that groundwater recharge is approximately 3% of rainfall, or 1.75 million gallons per day (Robinson, 1972). The remainder of the rainfall is lost to evaporation and

transpiration. Robinson estimated that the Kingshill Formation and overlying alluvium contain 130 billion gallons of water. However, very little of the ground water is potable because most of it is too high in dissolved solids, due to mixing with the underlying sea water.

2.2.4.4 Site Hydrogeology

There are two pumping well fields located near the ICC site: the Fairplain and Adventure fields. Both pump from alluvial deposits and the underlying Kingshill formation. Both had declining well yields as of 1972 (Robinson, 1972).

Groundwater was encountered in the borings that were drilled in the laboratory expansion area (see Section 2.2.4.2). The water table was reported at approximately 20 feet below grade. (approximately 10 to 20 feet above MSL).

2.2.4.5 Regional Groundwater Quality

During the pumping test in the Fairplain well field, Geraghty & Miller detected sewage odors in some of the wells. They noted that groundwater contamination from sewage is a primary concern at the Fairplain well field and that "well construction and operational practices in St. Croix's public-supply well fields are not fully adequate to insure the quality and quantity of the groundwater source," (1983).

Geraghty & Miller indicated that lubricating oils from the well pumps have accumulated in the wells and distribution system. "As much as eight feet of black oil was detected floating on top of the water [in wells in the Fairplain and Barren Spot well fields] in 1982." The oil also reportedly coated the inside of many of the water storage tanks in the well fields.

High concentrations of chloride, from salt water intrusion, have been detected in much of the groundwater on the island. Geraghty & Miller (1983) reported that "almost all of the groundwater in the Kingshill Limestone contains chloride concentrations in excess of 250 mg/L and total dissolved solids (TDS) in excess of 500 mg/L, the maximum levels set in the USEPA secondary drinking water standards."

It is possible that the high chloride and TDS concentrations reported may affect analyses of inorganic substances. The effect of these conditions on groundwater quality has not been determined.

2.3 Potential Receptors

2.3.1 Surrounding Facilities

The location of the three nearest well fields are shown in Figure 2-5. The closest residences are approximately 0.1 miles east of the site.

2.3.2 Exposure

The facility is currently abandoned. A chain link fence surrounds the site, however there is no security, the front gate is damaged and trespassing has been documented in the past. Actual and potential exposure pathways onsite will be evaluated during this investigation.

2.3.3 Sensitive Populations

No sensitive populations were identified during previous work at this site.

2.4 Water Supply

Potable water is supplied from both municipal well water and desalinization plants. However, roof-catchments and cisterns are required for all houses (Multer, 1974). Most private dwellings have their own cistern systems for water supplies (ESI, 1987d).

There are 37 potable water wells located in eight major well fields on St. Croix. Approximate locations and available information on wells identified within one mile of the site are summarized on Table 2-1 and Figure 2-5. The quality of water obtained from the well fields is generally poor due to mineralization and oil contamination from pump lubrication. These contaminants are often pumped into the supply system (ESI, 1987d).

Two onsite wells were used to supply process water and the fire fighting system. Both wells were installed by Schuster Services, St. Croix. Well logs, construction, and operations information is not available. HLA was able to locate one of the production wells (P-1) during the site inspection on July 2, 1993. Heavy vegetation obscured the location of the second well (P-2). The current condition of the onsite supply wells is unknown.

Water cisterns are located beneath the cafeteria in the main building, beneath the warehouse and near the maintenance shop. All water is collected from roof drains.

2.5 Site History

Facility ownership and significant environmental activities are summarized on Table 2-2.

2.5.1 Owners and Operators

The site is currently unoccupied. It is owned by CHS Holding Corporation (CHS). On May 1, 1969, CHS leased the site to Houston Chemical Industries, Inc (Houston). Caribe Chemical Co. Inc. (Caribe), a wholly-owned subsidiary of Houston operated the facility. In March 1972, Pierrel International S.A. acquired all of the shares of Caribe. Caribe's name was subsequently changed to Pierrel America, Inc. Information regarding the use of the facility by Houston and Caribe is currently unavailable. Information regarding Pierrel operations has recently become available. It will be discussed in the proposed report at the end of this investigation.

On June 30, 1978, Pierrel assigned the ground lease to Cooper Laboratories (Cooper). ICC, a wholly-owned subsidiary of Cooper incorporated in Delaware on July 21, 1978, operated the facility.

In 1979, Cooper assigned the lease to its subsidiary, ICC. On November 1, 1979, Cooper sold its stock in ICC to Berlex Laboratories, Inc. (Berlex).

On September 14, 1984, ICC sold its assets to Virgin Island Chemical Company (VICHEM).

In January 1989 the USEPA conducted a Preliminary Assessment and Removal Evaluation at the site. At that time the site was operated by St. Croix Security Kennels and VIAG Fuels, Inc. (VIAG). The operator of the kennel, Kate Wesp, was evidently living onsite. VIAG used some office space in the main building and stored ethanol in four of the aboveground tanks. Activities performed by the USEPA are discussed in Section 3.8.

2.5.2 Chemical Processes

ESI reported that prior to acquisition by Cooper, it is believed the facility was used to manufacture phenacetin and ethoxyquin. Before Berlex acquired ICC, the facility was being used by Cooper to perfect a process to convert quinine to quinidine. Cooper's process used both toluene and pyridine. For approximately one year during Berlex's ownership of ICC, ICC attempted to develop a quinidine processing operation at the facility. The process that ICC sought to develop during the period of Berlex's ownership used toluene, but did not use pyridine. (A detailed discussion of the process and substances generated is presented in Appendix G.)

However, this operation never got beyond the developmental stage. From 1980 until the end of 1982, ICC experienced problems related to the purity and yield of the product. Early in 1982 ICC abandoned plans to use the site and the plant was permanently closed by the end of 1982. In 1982, ICC sent materials from the facility for disposal.

During an inspection in May 1983, Robert P. van Eepoel of the Government of the Virgin Islands (GOVI). stated that no hazardous waste was onsite. A copy of the inspection form is included in Appendix H.

2.5.3 History and Nature of Waste Handling

Information on waste handling procedures of operators other than ICC under Berlex was not available at the time this document was prepared.

2.5.3.1 Sanitary Wastes

Septic tanks were used for all sanitary wastes. According to available information, no process or laboratory drains were connected to the septic system. Reported septic tank locations are shown in Figure 2-2.

2.5.3.2 Process Wastes

Wastes drained from the laboratories to a cobble-filled tank or pit located beneath a concrete pad west of the warehouse (Figure 2-2). This pit was connected via a 4-inch diameter PVC pipe to a second cobble-filled pit near the fence. However, during excavation activities in the area, in June 1985, ESI reported that no tank was present beneath the loading dock (ESI site description document, page 9, item 2).

Spills in the process area were channelled to an 8,000-gallon underground concrete pit (Process Pit). The spilled liquids were collected in the pit and reportedly reprocessed or recycled. The Process Pit was connected to a storm drain by a 4-inch PVC Pipe. The storm drain was constructed of 55-gallon steel drums that had been welded end to end. Surface runoff from the concrete pad between the Maintenance Building and the Laboratory was channelled to this drain through three inlets.

2.5.3.3 Waste Removal

During the period from 1980 through 1982, when ICC operated under Berlex, the only wastes regularly generated were those stemming from the process and analytical laboratories. Waste volumes reported exceeded no more than a few gallons per quarter (ESI, 1985b).

When Berlex acquired the facility, ICC discovered hazardous materials had been left onsite by the previous occupant. ICC analyzed the material and removed it from the site in 1982 and 1983. Waste removal actions performed by ICC are summarized on Table 2-3.

The facility was permanently closed in the end of 1982. Between November 27, 1982 and February 1, 1983, ICC removed 26,748 gallons of toluene and 6,946 gallons of xylenes from the facility for offsite disposal. These waste liquids were shipped via eight bulk tanker loads to Inland Chemical on Puerto Rico. Copies of waste classification analyses are included in Appendix I. Copies of waste manifests are included in Appendix J.

Following closure of the facility, the GOVI inspected the site on May 17, 1983. According to the inspection report, no hazardous waste was present onsite at that time. A copy of the inspection report is included in Appendix H.

During limited investigation and remediation activities performed by ESI, various wastes were generated. 192 drums containing various wastes were shipped offsite to Chem-Waste Management, Inc. (CWM) on December 2, 1985.

A variety of wastes were apparently generated by subsequent operators of the facility between 1986 and 1989. Surficial hazardous waste was removed from the site by the USEPA in 1989 and 1990. Copies of USEPA reports documenting removal activities are included in Appendix L.

2.6 *Description of Known Contaminants*

Based on previous work at this site, toluene and pyridine represent the largest volume releases at the site. These compounds were used by many of the occupants and were detected in soil samples collected by ESI.

After the waste removal, waste likely remaining onsite consists of impacted soils and groundwater. The current conditions of soil and groundwater have not been fully characterized.

Substances reported at the site during waste inventory activities performed by ESI and OHM as well as environmental testing performed by ESI and Halliburton NUS Corporation (NUS) are summarized on Table 2-4. Available information regarding the toxic effects of these substances is included in Appendix BA (see HASP).

Most, if not all, of these substances were removed from the site. Therefore, current conditions at the site would likely consist of affected soil, if any, impacted by the residual waste. The only suspected groundwater contaminant identified at the site is chloroform. This substance was detected in samples collected from the two onsite wells and from other wells near the site. The source of the chloroform has not been identified.

Areas of potential environmental concern are summarized in Section 3 of this RIWP. The summary includes descriptions of the areas, results of previous environmental testing and other activities performed.

HLA observed no obvious evidence of hazardous waste onsite during the site visit on July 2, 1993.

2.7 Contaminant Migration Pathways

Information regarding contaminant migration pathways, if any, is not available at this time. Potential migration pathways will be evaluated preliminarily during the site investigation.

2.8 Human Health and Environmental Assessments

Information regarding human health and environmental assessment of site related contamination, if any, is not available at this time.

3.0 EXISTING DATA

In September and October 1984, ESI began investigation activities. Results of this work were documented in a Progress Report, including a preliminary cleanup plan, submitted to USEPA in December 1984 (ESI, 1984b).

Through March 1986, ESI performed a number of supplemental investigations, culminating in the Remedial Investigation Work Plan (ESI, 1987c). The work plan prepared by ESI generated a number of comments by USEPA. Where appropriate, the USEPA comments have been incorporated into this RIWP. A summary of activities performed between September 1984 and March 1986 was prepared by ESI.

NUS investigated the site on February 28, 1991. Results of work performed by NUS are described in the *Final Draft Site Inspection Report - Island Chemical Company/VI Chemical, St. Croix, U.S. Virgin Islands* (NUS, 1991).

Six areas of potential environmental concern were identified through the work performed by ESI and NUS. These areas are identified as:

Area A	Laboratory and Warehouse Building
Area B	Above-Ground Storage Tank Farm
Area C	Former Process Pit
Area D	Loading Dock and Former Lab Pit Area
Area E	Soil Beneath Concrete Pad Near ASTs
Area F	Concrete Storage Pad

Locations of the areas of concern are shown on Figure 3-1. Descriptions of these areas are summarized on Table 3-1 Results of work performed and data generated are described in the following sections. Analytical results for samples collected from each area are summarized on Tables 3-2 through 3-8. Chemical abbreviations used in the tables are defined on Table 3-9. Copies of original lab reports and/or results reported by other parties are included in Appendix M.

3.1 Area A - Laboratory and Warehouse Buildings

Based on the inspection report generated by GOVI on May 17, 1983 (Appendix H), no hazardous waste was present in this area when ICC ceased operations. On January 31, 1989 the USEPA responded to a complaint and found approximately 400 drums containing various materials and wastes in the laboratory and warehouse. Between March 1989 and April 1991, USEPA contractors removed the drums and waste. Activities associated with the removal action are further discussed in Section 3.8.

Based on available information, the only samples collected from this area were used for waste classification. No environmental samples were collected.

3.2 Area B - Above-Ground Storage Tank Farm

Between October 25 and November 2, 1982, ICC analyzed samples from four ASTs (Identified as Tanks 7, 8, 9 and 13) to identify their contents. Contents identified were toluene, xylene, para-phenetidine and 9-fluorenone. Copies of the analytical reports are included in Appendix I.

3.2.1 Description

The tank farm is located along the northwestern site boundary. According to available information, twenty 8,500-gallon ASTs were originally located here. Six tanks were reportedly sold locally in the 1980s. At the time ICC acquired the site, the following substances were present in the ASTs.

- Approximately 6,900 gallons of xylene mixed with p-phenetidine left by a previous operator. After the plant shutdown, this material was shipped to Philip Brothers Chemicals, Inc. in New York for sale. Because the sale was not completed and no other purchaser was found, the material was manifested as a hazardous waste and shipped to Inland Chemical, Puerto Rico, for burning.

- Xylenes from the tank farm from previous ownership were shipped to Phillip Bros. Chemical Co.

- According to the February 7, 1983 ICC in-house memorandum regarding waste disposition, all benzophenone/toluene solutions were shipped to Inland Chemical Co. in Puerto Rico for burning.

Based on liquid samples collected from nine of the ASTs by ESI on March 12, 1986 (see Table 3-2), the tanks contained the following liquids:

- Tank 4 contained a solution of benzoquinone and fluorenone

- Tanks 7, 8 and 14 contained solutions of benzophenone and fluorenone with traces of volatile organic compounds

- Tanks 9 and 13 contained p-phenetidine (the solution in Tank 9 included 10.9% aromatics)

- Tanks 10 and 11 contained hydroxyfuranocoumarin

- Tank 12 contained a mixture of hydroxyfuranocoumarin and p-phenetidine

At the time of the USEPA investigation (January 1989), 14 ASTs were present. Four of the tanks were filled with ethanol. The other ten were empty.

According to USEPA Pollution Report No. 2, dated June 7, 1989 (Appendix L), on May 25, 1989 the USEPA visited the site. At that time the "first four tanks contain[ed] ethanol and the fifth tank contain[ed] diesel fuel."

Four tanks were apparently removed and one was relocated sometime between 1990 and the present. Ten tanks remain onsite in the Above-Ground Storage Tank Farm.

3.2.2 Previous Investigations

Between September 11 and October 28, 1984, ESI completed twelve test pit trenches at the site. Locations of the trenches are shown on Figure 1 in the ESI Progress Report (1984b). A copy of the figure is included in Appendix N. Three of the trenches, identified as Trenches 1, 2 and 3 were located near the tank farm. Soil samples from the trenches were screened in the field for volatile organic compounds (VOC) using a portable flame-ionization detector (FID). Based on these results, ESI concluded that "the entire area between and in front of Tanks 8 and 9 was contaminated with toluene which escaped from Tank 8 during cleaning. (ESI 1987c). One sample of soil, identified as T8-1, was analyzed for toluene, pyridine, quinidine gluconate (QG), and quinine sulfate (QS). Three of these compounds were detected in the sample: toluene at 694 parts per million (ppm), QG (274 ppm) and QS (101 ppm).

A hard clay layer was reported beneath the excavated material. ESI collected one sample, identified as T8-2 from the clay. The sample was analyzed for the four parameters previously noted. Toluene, pyridine and QS were not detected, however, ESI did not report the method detection limit. QG was reported in the clay sample at 47 ppm.

Soil and liquid samples collected from this area are summarized on Table 3-2.

3.2.3 Previous Remediation Activities

ESI excavated the affected soil between Tanks 8 and 9 to a depth of approximately one foot. According to ESI, the excavated soil and the contents of Tank 8 were placed in 55-gallon drums and placed in the warehouse. Between June 6 and July 3, 1985, ESI placed the contents of eight drums containing toluene contaminated soil on drying trays. The trays were placed in the dryer building at 42°c.

ESI collected samples of the soil in the dryer roughly every two weeks between June 14 and August 7, 1985. Reported results of samples from the soils in the dryer are summarized on Table 3-3. Reported results indicate that toluene concentrations in the soil declined from a maximum of 1,500 ppm in June to 0.66 ppm in August.

The USEPA collected two composite samples from the dryer on September 9, 1985. The two composite samples were analyzed for "purgeable and non-volatile organic priority pollutants," (USEPA, 1985). Toluene was detected at 0.46 to 0.56 ppm. Other semi-volatile compounds were detected at higher concentrations, including benzophenone at 15,000 ppm. The USEPA report noted that "confirmation of on-site treatment of soil by Berlex (ICC) for toluene and pyridine was made" (USEPA, 1985).

Two 20 gallon drums containing soil and water were placed in the dryer in an attempt to evaporate the water before putting the soil on the trays for drying.

3.3 Area C - Former Process Pit

The Former Process Pit consisted of an 8,000-gallon (ESI, 1987d) or 17,000-gallon (USEPA, 1985) underground concrete pit located in the central portion of the site (Figure 3-1). The pit received waste water from spills (ESI, 1987d) and cooling water (USEPA, 1985) from production operations. During plant operations, the contents of the pit were sampled to determine whether any product had been released. The water was then reused in the system (ESI, 1987d) or, if the sample results were negative, the waste water was discharged through the central storm sewer (USEPA, 1985). The central and southern storm sewers exited the site via a drain line constructed of drums which had the tops and bottoms removed and were welded end to end.

Waste generated from the pit, including water and sludge, as well as drums and soil used to construct the two storm sewers, were removed from the site on December 2, 1985. This waste was included in the shipment of 192 drums previously discussed in Section 2.5.3.3 and summarized on Table 3-4. "One line [presumably the central storm sewer] was replaced with 10-inch PVC pipe" (ESI, 1987a)

ESI collected samples from the Process Pit on June 14 and July 19, 1985. The Process Pit was then abandoned and sealed with concrete later in 1985 (USEPA, 1989a). On February 28, 1991, NUS collected a sediment sample from the central storm drain. Based on Figure 3 from the NUS report (1991), the sample was located at the connection between the Former Process Pit and the storm sewer. NUS sample locations are shown on Figure 3 of the NUS Report (1991). A copy of the figure is included in Appendix N. Results of samples collected by ESI and NUS are summarized on Table 3-4.

3.4 Area D - Loading Dock and Former Lab Pit Area

3.4.1 Description

Area D is located to the north of the warehouse (Figure 3-1). It consists of the loading dock area and drains leading toward the River Gut. The Former Lab Pit was located beneath the loading dock. It consisted of a cobble-filled pit that received wastes drained from the laboratory (ESI, 1987d). The cobble-filled pit beneath the loading dock was connected to a second pit near the fence line by a 4-inch PVC pipe. A diagram showing the layout of the Laboratory pit area was included as Figure 9 in the ESI Progress Report (ESI, 1987d). A copy of the diagram is included in Appendix N.

According to ESI, former facility personnel reported that, prior to construction of the loading dock, the Lab Pit was open. During the rainy season, the pit occasionally overflowed and discharged to the River Gut. The pit was later filled and the area covered by the loading dock (ESI, 1987d).

ESI reported that a clay underlies the stone filled pit and the soil in the loading dock area. ESI did not state the depth to, or the thickness of, the clay layer. However, because the soil borings drilled by ESI were reportedly 4 to 8 feet deep, it is presumed that the clay is less than 8 feet below grade in this area. ESI noted that "the underlying clay material has probably prevented downward percolation since the FID reading [sic] for clay samples [were] low. Also the materials are highly volatile," (ESI, 1987d).

3.4.2 Previous Investigations and Remediation Activities

On or about September 17, 1984, ESI excavated a trench, identified as Trench No. 9, in this area. During excavation, the PVC pipe was ruptured and a release of pyridine was reported. They noted that "a strong pyridine odor was prevalent during the excavation and sampling period," (ESI, 1987d). Surface samples, identified as D-1 through D-5 were collected and analyzed for toluene, pyridine, QG and QS. Pyridine and QG were detected in three of the samples. QS was detected in one of the samples. Sample locations are shown on Figure 9 of the ESI progress report (1987d), which is included in Appendix N. Analytical results are summarized on Table 3-5.

On September 18 and 19, 1984, ESI completed 22 soil borings through the Loading Dock area, in an effort to locate and investigate the Lab Drain. The borings were drilled to field selected depths ranging from 4 to 8 feet below grade. Soil samples were screened in the field for VOCs using an FID. ESI collected four soil samples for analysis of VOCs by Industrial Corrosion Management Incorporated (ICMI) of Randolph, New Jersey. In October 1984, ESI returned to the site and completed 18 additional soil borings in the area. ESI collected two soil samples for analysis of toluene and pyridine and nine additional samples for analysis of toluene, pyridine, VOCs and oil and grease. Soil boring locations are shown on the previously referenced figure. Analytical results for the samples collected from this area are summarized on Table 3-5.

ESI also reportedly performed further excavation activities in this area in October 1984. They stated that at that time "the pyridine odor was no longer noticeable."

In June 1985, ESI returned to the site to remediate the affected soils. The method used to treat the soils appears to have been a form of biodegradation. During the treatment program, pyridine concentrations were monitored through sample collection and analysis on June 14, July 1, July 17, and August 7, 1985. Sampling locations for these dates are not available. Reported pyridine concentrations fluctuated throughout this period.

In September 9, 1985, the USEPA collected samples from the site. USEPA collected four composite samples from the area for analysis of "purgeable and non-volatile organic priority pollutants." Results indicated that several phthalates and toluene were present in the soil samples.

On March 13, 1986, USEPA returned to the site to collect additional samples. ESI obtained splits of the USEPA samples for independent analysis. One sample, identified as 085252, was collected from the River Gut sediments at the discharge point of the Lab Drain. The other two samples, identified as 085284 and 085285, were collected from the loading dock

area. Sample locations are shown on Figure 3 of the USEPA report (1986). Several metals and di-n-octyl phthalate were detected in the samples.

On February 28, 1991, NUS collected two samples from this area. Sample SED 2 (and duplicate sample SED 4) was collected from the River Gut at the Lab Drain discharge point. Sample S1 was collected from the Lab Pit area near the center of the loading dock. Results were generally consistent with the data collected by USEPA in 1986, discussed above, with the exception that several pesticides were detected at estimated concentrations.

3.5 Area E - Soil Beneath Concrete Pad Near ASTs

A concrete pad, constructed of seven slabs is located in the northern corner of the site. During the investigation in late September 1984, ESI completed three trenches, identified as Trench 4, 6 and 7, along the edge of the concrete pad near the ASTs. ESI noted evidence of affected soil in Trench 4, adjacent to and beneath the third slab. ESI collected five soil samples from the area and submitted them to for analysis of toluene. Analytical results are summarized on Table 3-6.

Although toluene was not detected, ESI noted that the samples were held for three weeks prior to analysis. This period exceeded analytical holding times. The conditions under which the samples were held are unknown. ESI noted that "the time lag....may account for the difference between field readings and laboratory analytical results." (ESI 1984b).

ESI excavated approximately 4 cubic yards of soil from this area. The excavation was backfilled with clean soil.

3.6 Area F - Concrete Storage Pad

A concrete storage pad is located north of the Laboratory and Warehouse building. The pad was used for storage of drums of raw materials when the facility was operating. Miscellaneous debris were observed on the pad during HLA's July 1993 inspection.

3.7 Other Areas

3.7.1 Storm Drains and River Gut

Two storm drains are located on the site (Figure 3-1). The central storm drain runs beneath the paved area between the laboratory and maintenance buildings. The southern storm drain, where observed, is a concrete lined depression along the southern wall of the Maintenance Building and the edge of the Reactor Area. Both storm drains discharge to the River Gut along the eastern side of the site.

According to ESI, the two storm drain lines were excavated and replaced between June 6 and 15, 1986 (ESI, 1987d). The old lines were constructed of 55-gallon drums that were welded together. According to ESI, the drums from one line contained an oily sludge, however ESI did not specify which line.

The drums that formed the drain lines were placed in containers for later disposal. One line was reportedly replaced with a 10 inch PVC pipe by ESI.

The River Gut borders the northeastern and southeastern sides of the site. Several drain lines reportedly discharged from the site to the River Gut. Samples were collected from the drain lines and from the gut by ESI, USEPA and NUS. Analytical results for these samples, as well as results for a background soil sample collected by NUS, are summarized on Table 3-7 and are discussed below.

On June 7, 1985, ESI collected two soil samples identified as "Drain Line #1" and "Drain Line #2." Although information regarding the actual sample locations is not available, it is presumed that these samples were collected from drain lines that discharged to the River Gut. The two samples were split and submitted to ICMI and YWC, Inc. York Laboratories Division (York) of Monroe, Connecticut for laboratory analysis. Based on available information, ICMI analyzed sample Drain Line #1 for benzene, toluene, ethylbenzene and xylenes (BTEX) and analyzed sample Drain Line #2 for VOCs. York apparently only analyzed the samples for toluene.

Toluene was detected in all of the samples at concentrations ranging from 140 mg/kg to 5,600 mg/kg. Chloroform and methylene chloride were reported in sample Drain Line #2 at 68 mg/kg and 1,260 mg/kg, respectively; these VOCs were not analyzed in sample Drain Line #1. Other VOCs including benzene, carbon tetrachloride, ethylbenzene and xylenes were detected at concentrations 0.1 to 10 mg/kg.

On February 19, 1986, ESI collected sediment samples from 11 locations along the gut. The samples were submitted to ICMI for analysis of metals, cyanide, phenols and VOCs. ESI sample locations are shown on Figure 13 of the Progress Report (ESI, 1986d). A copy of this figure is included in Appendix N.

Several metals, including cadmium, chromium, copper, lead, and zinc, were detected in the sediment samples from the River Gut. Cadmium was detected in samples G-6 and G-7 at 1.0 mg/kg and 2.4 mg/kg respectively. Cadmium was not detected in any of the other samples from the gut. Chromium, copper, lead and zinc were detected in all of the gut samples. With one exception, the concentrations of these metals were lowest in sample G-4 and highest in sample G-11. Chromium was detected only at concentrations ranging from 12 mg/kg in sample G-4 to 41.1 mg/kg in G-11; copper was detected at concentrations ranging from 25.3 mg/kg in G-4 to 69.7 mg/kg in G-11; lead concentrations ranged from 13.2 mg/kg in G-4 to 46.7 mg/kg in G-7; zinc concentrations ranged from 37.1 mg/kg in G-4 to 871 mg/kg in G-11. The metal concentrations reported do not appear to pose a cause for concern. None of the other parameters analyzed were reportedly detected in the River Gut sediment samples collected on February 19, 1986.

ICMI also reported results of a leachate generated from a composite of samples from locations G-6 and G-7. Barium and lead were reported in this sample at concentrations of 1.2 milligrams per liter (mg/L) and 0.24 mg/L, respectively.

On March 13, 1986, USEPA collected three sediment samples from the River Gut. ESI obtained split samples for independent analysis by ICMI. Sample locations are shown on Figure 3 of the USEPA report (1986). A copy of the figure is included in Appendix N.

USEPA analyzed the three sediment samples for VOCs, semivolatile organic compounds (SVO), pesticides, polychlorinated biphenyls (PCB), metals and dioxins. ICMI analyzed the samples for VOCs, SVOs and PCBs. Results reported by USEPA and ICMI were not consistent. In the background sample, 085251 USEPA reported butyl benzyl phthalate, di-n-octyl phthalate, and several metals at relatively low concentrations. ICMI reported all of the parameters analyzed as not detected. In Sample 085252, collected near the discharge point of the lab pit, USEPA reported di-n-octyl phthalate and several metals at relatively low concentration. The only substance reported by ICMI in this sample was methylene chloride (flagged as a possible laboratory-induced contaminant). In Sample 085253, collected near the discharge point of the Process Pit drain, USEPA reported xylene, several SVOs and several metals at relatively low concentrations. ICMI reported chloroform, ethylbenzene and toluene only. The reason for the discrepancies between the data reported by USEPA and ICMI are unknown.

On February 28, 1991, NUS collected three sediment samples from the River Gut, two sediment samples from the storm drains and one background soil sample near the Virgin Islands Port Authority (VIPA) well field located west of the site. Sample SED1 was located in the gut approximately 500 feet downstream from the site. Sample SED2 (and duplicate sample SED4) was located in the gut near the discharge point of the loading dock surface and lab pit drains. Sample SED3 was collected in the gut near the upstream property boundary. Samples SED4 and SED5 were collected from the central and southern storm drains, respectively. Sample locations are shown on Figure 3 from the NUS report (1991). A copy of the figure is included in Appendix N.

The samples collected by NUS were analyzed for VOCs, SVOs, pesticides, PCBs and metals. No VOCs or SVOs were detected in the three samples collected from the gut. The VOC 2-butanone (methyl ethyl ketone) was detected in the two sediment samples from the storm drains and in the background sample. The only other VOCs reported were xylenes in the two drain samples and trichloroethene in the background sample, all of which were reported at estimated concentrations below the method detection limits (MDL). Several SVOs and pesticides were detected in the two samples from the storm drain sediments, all at estimated concentrations below the MDLs. Metals were detected in all of the samples collected by NUS. Chromium, copper, lead and zinc were generally detected at concentrations similar to those reported by ESI for the samples collected from the River Gut on February 19, 1986. The metals antimony, arsenic and nickel were reported at relatively low concentrations by USEPA. These metals were not reported by ESI. Several other metals, apparently not previously analyzed, were also detected. These included aluminum, barium, calcium, iron, magnesium, manganese, potassium, sodium and vanadium. The concentrations reported for these metals do not appear to pose a cause for environmental concern.

3.7.2 Sump

During the inspection in July 1993, HLA observed a sump located to the west of the Maintenance Building. This sump is located near the edge of the concrete paved surface and receives runoff from the paved portion of the site. During the site visit in July 1993, HLA observed several pipes entering the sump. HLA has been unable to find data regarding the conditions in the vicinity of this feature.

3.7.3 Septic Tanks

According to ESI, there were three septic tanks on the site (ESI, 1987d), two of which were identified. The location of the septic tank that serviced the office lavatories was unknown.

3.7.4 Dryer Building

The dryer building is located in the southern portion of the site (Figure 3-1). Affected soils and water were placed in this building by ESI as part of their remediation program.

3.7.5 4,000-Gallon AST Area

Two vertical, 4,000-gallon ASTs are located adjacent to the Production Area. At the time of the USEPA removal action, these ASTs contained approximately one inch of liquid. USEPA contractors cleaned these tanks as part of the removal action.

3.7.6 Former Location of Paint Cans and Drums

During the removal action conducted by the USEPA, paint cans and drums were identified on the concrete paved area near the southern corner of the Laboratory and Warehouse building. A sketch map showing the approximate location of these materials was included in the USEPA Pollution Report dated October 25, 1991. Copies of available USEPA Pollution Reports are included in Appendix L.

The USEPA did not report evidence (presence or absence) of staining or affected soil associated with the paint cans and drums. This area was heavily vegetated at the time of HLA's site visit.

3.7.7 Groundwater

In October 1990, USEPA prepared the "Compendium of Well Water Data Collected at the Virgin Island Chemical Co. by the USEPA (1986-1990)." The compendium summarizes chloroform concentrations detected in selected wells during five sampling events between March 13, 1986 and June 25, 1990. These data are summarized with other available data on Table 3-8.

In all but the first sample from the onsite monitoring well, chloroform concentrations were below the federal Maximum Contaminant Level (MCL) of 0.1 mg/L for trihalomethanes.

3.8 Results of Previous Removal Actions

This section discusses the removal actions performed by USEPA. Previous removal actions performed by ICC are discussed in Section 2.5.3.3.

3.8.1 Remedial Preliminary Assessment

On January 31, 1989, the USEPA Response and Prevention Branch conducted a Preliminary Assessment and Removal Evaluation at the site. This work was in response to a request from Mr. George Pavlou, the Associate Director of Enforcement Programs. The results of the inspection and subsequent removal activities undertaken by the USEPA are documented in 30 Pollution Reports. Copies of the USEPA Pollution Reports are included in Appendix L.

At the time of the Preliminary Assessment and Removal Evaluation, the USEPA identified the following three areas of concern:

- Laboratory (main building);
- Drum Storage Warehouse (Main Building); and
- Grounds outside the building including the reactor and centrifuge.

3.8.1.1 Laboratory

Items noted during the USEPA evaluation included the following:

- Two boxes of sodium;
- Six cans of ethyl ether;
- Two bottles of potassium cyanide;
- Phosphorous pentoxide;
- Sodium hydride;
- Two flammable storage cabinets containing various materials; and
- Two office cabinets with spilled chemicals.

Many other chemicals were noted but not inventoried.

3.8.1.2 Drum Storage Warehouse

Approximately 400 drums in various condition, some severely deteriorated, were identified in the warehouse. The contents of the drums included: ethyl alcohol, an unidentified sludge, methanol, glacial acetic acid, benzyl acetate, toluene, antifreeze/glycol, salicylic acid, methyl isobutyl carbinol, sodium hydroxide, paint and unidentified substances.

3.8.2 USEPA Phase I Removal Activities

Phase I removal activities are documented in USEPA Pollution Reports 2 through 13 (Appendix L). Activities performed included relocation of drums to the warehouse, opening and sampling containers and sampling the fire water tank.

3.8.3 First Fuming Drum Emergency Response Action

On May 9, 1990 the USEPA performed an emergency response action following a report of a fuming drum. The drum was identified as No. 29, then located in the rear of the warehouse. The response action was completed by May 12. Activities associated with the emergency response action are summarized in USEPA Pollution Report 14 (Appendix L).

3.8.4 Phase II Removal Activities

Phase II removal activities performed by the USEPA between June 15 and July 10, 1990 are documented in Pollution Reports 15 through 19. Activities included obtaining bids for waste classification analyses, lab packing and drum segregation, drum crushing and remote detonation of several containers. As part of this action, the USEPA sampled groundwater from wells identified as VIPA and WAPA on June 25.

3.8.5 Second Fuming Drum Emergency Response Action

On July 25, 1990, the USEPA performed an emergency response action following a report of a fuming drum. The drum was identified as No. 22. This drum had been found to contain benzyl chloride, a severe skin irritant. The response action was completed on July 27 when this drum and two other drums containing benzyl chloride were stabilized using lime and the bungs were replaced. Activities associated with the emergency response action are summarized in USEPA Pollution Report 20 (Appendix L).

3.8.6 Phase III Removal Activities

Between August 6 and November 8, 1990, USEPA performed Phase III activities as documented in Pollution Reports 21 and 22 (Appendix L). Work performed included additional sampling and preparation of disposal arrangements.

3.8.7 Response to Vandalism

Between July 27 and November 9, 1990, the site was vandalized and various materials and equipment to be used for the final removal activities were stolen. The local police were notified and the USEPA returned to the site on November 11 to upright overturned drums, repair damage, and inventory equipment. These activities are summarized in Pollution Report 23 (Appendix L).

3.8.8 Final Phase Removal

Final disposition of the waste generated is summarized in Pollution Report 30 (Appendix L). According to USEPA, cleanup activities were completed by April 1991 and all waste was removed from the site by October 24, 1991. HLA has not been able to obtain copies of Pollution Reports 24 through 29.

3.9 National Priorities List

On January 18, 1994, The USEPA issued National Priorities List for Uncontrolled Hazardous Waste Sites (NPL) Proposed Rule No. 16. This document proposes the site for the NPL. However, as of the time this document was prepared, the site had not been listed.

The NPL includes two sections. The first, or General Superfund Section, consists of sites being addressed by the USEPA. The second section, or Federal Facilities Section, consists of sites being addressed by other federal agencies. Currently, the General Superfund Section includes 1,069 sites and 67 proposed sites. The Federal Facilities Section includes 123 sites and 30 proposed sites.

The site has been proposed for the NPL General Superfund Section based on its score under the Hazard Ranking System (HRS), which is Appendix A of 40 Code of Federal Regulations (CFR) Part 300. The HRS evaluates four pathways: groundwater, surface water, soil exposure and air. Based on discussions with USEPA during the meeting on February 7, 1994, the site received an HRS score of 50 and the site was ranked based solely on groundwater pathways. Sites that score a 28.50 or greater on the HRS are eligible for the NPL.

4.0 WORK PLAN RATIONALE

4.1 Data Needs

In preparing this RIWP, HLA reviewed existing documents provided by USEPA and ICC. Based on this review and the remedial investigation objectives outlined in Section 1.1, the following data needs have been identified for the ICC site:

- More detailed understanding of site geology and hydrogeology;
- Groundwater flow direction(s);
- Effect of seasonal changes in groundwater flow direction, if any;
- Magnitude, nature and extent of potential impacts to soil and/or groundwater;
- Information on sewage treatment plant operations and discharges near well fields;
- Whether areas of potential concern exist other than those identified during previous investigations;
- Existence of third septic tank reported by ESI;
- Possible source of chloroform detected in the onsite and nearby wells;
- Effect of high chloride and TDS concentrations on groundwater chemistry;
- Other potential sources of groundwater contamination which may have an impact on the Study Area;
- Location of the contaminated container burning area; and
- Updated information on use of groundwater in the vicinity of the ICC site.

4.2 Work Plan Approach

The tasks outlined in Section 5.0 of this RIWP were developed to satisfy the data needs listed in Section 4.1. Comments received from USEPA have included the following, and have been considered in developing this RIWP:

- Discussions during the pre-scoping meetings on August 13 and November 18, 1993;
- Comments from the Technical Document Review by Camp, Dresser & McKee (1987); and
- Comments from USEPA on the Remedial Investigation Work Plan prepared by ESI (USEPA, 1990e).

The tasks to be accomplished are as follows:

- Project Planning
- Obtaining access to site
- Clearing site of heavy vegetation
- Performing reconnaissance of site and surrounding area
  - Onsite areas of potential concern not previously identified
  - Areas discussed in Section 3.7 of this RIWP
  - Identification of other possible sources of contamination both onsite and offsite.
- Reviewing records for other offsite potential sources of groundwater contamination
- Identifying wells within three miles of the site
  - Records search, if available
  - Field reconnaissance
- Investigating hydrogeology and groundwater quality
  - Complete 10 exploratory soil borings
    - Collect approximately 75 soil samples to investigate site stratigraphy
    - Collect 30 soil samples for laboratory analysis
  - Complete five soil borings as groundwater monitoring wells
    - Collect five groundwater samples for laboratory analysis
  - Repair or modify existing Wells
  - Survey relative monitoring well elevations
    - Measure water levels in seven monitoring wells
    - Construct water table contour maps to assess groundwater flow direction
  - Quarterly groundwater sampling for one year
    - Water level monitoring for one year
    - Water level recording at selected wells
    - Evaluate subsurface stratigraphy, hydraulics and groundwater chemistry
- Meetings and Progress Reports
  - Meeting with USEPA to discuss preliminary results
  - Address and document changes in scope of work, which may include installation and sampling of additional soil borings and/or monitoring wells, if necessary and appropriate, which may be determined to be warranted based on the results of the Remedial Investigation activities outlined in Section 5.0 of this Work Plan
- Validating laboratory data

- Identifying applicable or relevant and appropriate requirements (ARAR)
- Preparing Remedial Investigation Report
- Managing and disposing of investigation-derived wastes
- Baseline Risk Assessment

Tasks associated with a Feasibility Study will be completed if necessary and appropriate (see Section 6.5) in accordance with applicable guidelines. To the extent that a Feasibility Study is contemplated, an addendum to this Work Plan delineating the anticipated tasks will be submitted to USEPA for approval prior to task implementation.

Based on the anticipated low concentrations of residual waste, quantitative air sampling is not proposed as part of this investigation. Air quality monitoring for health and safety purposes will be performed during intrusive activities. Air quality monitoring procedures are discussed in the project HASP (Appendix B).

4.3 Data Quality Objectives

Data quality objectives for the project are discussed in the *Quality Assurance Project Plan* (Appendix C) and are not repeated herein.

4.4 Preliminary Identification of ARARs

This describes the procedures used to identify and evaluate ARARs for the ICC site. This discussion is not intended to serve as the final determination of all ARARs for the site. Instead it is an identification of a number of ARARs that may pertain to the site based on currently available data. The identification of ARARs is an iterative process carried on throughout the Remedial Investigation. The final determination of ARARs will be made as part of the selection of a remedy, if any. HLA is unaware of any identification of ARARs for the site by the GOVI pursuant to Section 121(d)(2)(A) of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) 42 U.S.C. §9621(d)(2)(A).

The ARARs evaluation was performed in a manner consistent with USEPA guidance, including the NCP found in 40 CFR 300, the NCP preamble found in 55 Federal Register (Fed. Reg.) 8666 (March 8, 1990), and the "CERCLA Compliance With Other Laws Manual: Parts I and II" (Office of Solid Waste Emergency Response [OSWER] Directives 9234.1-01 and 9234.1-02) (Compliance Manual).

This discussion describes the procedures used in the identification and evaluation of ARARs. Specifically, this discussion: summarizes the definitions and procedures used to evaluate the applicability or relevance and appropriateness of potential ARARs; describes ARARs categories; and identifies potential ARARs associated with state authorized programs.

4.4.1 Definition of ARARs

Remedial actions selected under CERCLA must attain a degree of cleanup that, at a minimum, assures protection of human health and the environment (42 U.S.C. § 9621[d][1]). When a hazardous substance remains onsite, CERCLA requires that remedial actions meet a level or standard of control that at least attains standards, requirements or limitations under any federal or stricter state environmental law, if such requirements are legally applicable or relevant and appropriate under the circumstances (42 USC § 9621[d][2]). Guidance and health advisories may also be used as matters "to be considered." To-Be-Considered (TBC) requirements are not identified in this preliminary identification of ARARs.

- Applicable Requirements. Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances found at a CERCLA site (NCP, 40 CFR § 300.5)

- Relevant and Appropriate Requirements. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site (NCP, 40 CFR § 300.5).

- To-Be-Considered Requirements. TBCs are non-promulgated advisories or guidance issued by federal or state government that are not legally binding and do not have the status of potential ARARs. In many circumstances, however, TBCs will be considered along with ARARs as part of the site risk assessment, if performed, and may be used in determining the necessary level of cleanup for protection of health or the environment (NCP, 40 CFR § 300.400[g][3]).

The terms "applicable" and "relevant and appropriate" are mutually exclusive. Therefore, a requirement under environmental laws may be either "applicable" or "relevant and appropriate," but not both (Compliance Manual, Vol. 1, p. xiii). For a requirement to be "applicable," the remedial action or the circumstances at the site must satisfy all the jurisdictional prerequisites for the requirement. If a requirement is not applicable, it nonetheless may still be relevant and appropriate.

In deciding whether a requirement is relevant and appropriate the following factors, found in 40 CFR § 300.400(g)(2), are evaluated: (1) the purpose of the requirement; (2) the medium regulated or affected by the requirement; (3) the substances regulated by the requirement; (4) the actions or activities regulated by the requirement; (5) the variances, waivers, or exemptions to the requirement; (6) the type of place regulated or affected by the requirement; (7) the type and size of structure or facility regulated or affected by the release;

and (8) any consideration of use or potential use of affected resources associated with the requirement.

The evaluation of relevance considers the above factors with respect to whether a requirement addresses problems or situations sufficiently similar to the circumstances of the contemplated remediation. If the requirement is relevant, the evaluation of appropriateness will consider the above factors with respect to whether the requirement is well suited to the particular site (55 Fed. Reg. 8743).

CERCLA response actions are subject only to substantive, not administrative, requirements (55 Fed. Reg. 8758). Substantive requirements are those that pertain directly to actions or conditions in the environment, such as concentration-based standards, technology-based standards, and restrictions upon activities in certain special locations. Administrative requirements, on the other hand, are those mechanisms that facilitate the implementation of the substantive requirement and include the approval of, or consultation with, administrative bodies, issuance of permits, documentation and reporting and record keeping (55 Fed. Reg. 8758 and Compliance Manual, Vol. 1, p. 1-11).

The concept of ARARs pertains to those portions of actions conducted wholly onsite. However, both substantive and administrative requirements are applicable offsite. For example, if the discharge point to surface waters is located onsite, a discharge permit is not required. However, if the discharge point is considered to be offsite, a permit would be required. Also, certain requirements are not considered to be ARARs because the relevant activities do not occur onsite. For example, pretreatment requirements are not ARARs because, even if CERCLA waste water is discharged to a sewer located onsite, treatment by a publicly owned treatment works (POTW) located offsite is considered an offsite activity (Compliance Manual, Vol. 1, p. 3-21).

CERCLA expressly provides for state standards to be ARARs at a site. However, only those standards that are more stringent than federal requirements may be considered. In addition, the state standards must be promulgated (i.e., the requirement must be of general applicability and legally enforceable). Finally, the requirements must be identified in a timely manner by the particular state (40 CFR § 300.400[g][4]).

Only requirements that could possibly pertain to the site were listed and evaluated. For example, mining laws were not listed because no mines are present onsite.

4.4.2 ARAR Categories

ARARs are divided into three groups: chemical-, action-, and location-specific ARARs. These categories are described as follows:

- Chemical-Specific ARARs. These ARARs are usually health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numeric values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to the ambient environment (Compliance Manual, Vol. 1, p. 1-13).

- Action-Specific ARARs. Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous substances (Compliance Manual, Vol. 1, p. 1-29).

- Location-Specific ARARs. Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they occur in special locations. Location- specific ARARs relate to the geographical or physical position of the site (e.g., presence of wetlands, endangered species, flood plains, etc.) (Compliance Manual, Vol. 1, p. 1-25).

4.4.3 ARARs Associated With State-Authorized Programs

For those state programs which have received federal authorization pursuant to federal law, generally both the federal and state requirements are provided. Most environmental statutes authorizing delegation to states of a federal program do not address how quickly states must incorporate federal changes into the state's delegated program. Thus, state programs may lag behind federal programs. Also, the federal statutes require that state requirements be at least as stringent as the federal requirements. Therefore, a listing of both the state and federal requirements is provided.

States may be authorized by the USEPA to implement the hazardous waste management program in lieu of the USEPA in accordance with 42 USC § 6926. The extent of authorization and the portion of the Solid Waste Disposal Act (SWDA) pursuant to which USEPA has promulgated regulations is relevant to whether the state or federal requirement is considered the ARAR.

The SWDA was amended by the Resource Conservation and Recovery Act (RCRA) and later by the Hazardous and Solid Waste Amendments of 1984 (HSWA). When new federal regulations are promulgated under HSWA, the regulations remain under federal jurisdiction until the state receives authorization from the USEPA. Thus, the federal HSWA regulations are applicable or relevant and appropriate. When federal regulations are promulgated pursuant to RCRA, however, the regulations are not applicable until the state program (if the state has been authorized to implement RCRA) adopts those regulations. (Compliance Manual, Vol. 2, App. B).

The U.S. Virgin Islands do not have RCRA authorization nor clean up standards for groundwater or soil, besides soil standards for total petroleum hydrocarbons (100 mg/kg), total benzene, toluene, ethylbenzene and xylenes (50 mg/kg) and lead (5 mg/kg). The USEPA Region II has authorization over the Virgin Islands through their New York Caribbean Program. Through this program, federal clean up standards would apply. There are no final standards for soil remediation. Groundwater remediation levels are site specific and are based on the National Revised Primary Drinking Water Standards.

4.4.4 Preliminary Lists of ARARs

Chemical-specific, action-specific, and location-specific ARARs are preliminarily identified in Tables 4-1, 4-2 and 4-3, respectively. The tables identify the requirements and their legal

citations, describe the requirements, and comment on the applicability or relevance and appropriateness of each requirement.

5.0 REMEDIAL INVESTIGATION TASKS

The tasks to be completed as part of the Remedial Investigation are outlined below. As discussed in Section 4.2, specifics of well locations, wells to be sampled, analytical parameters and other activities may need to be modified based on the findings of various tasks. USEPA will be notified of any substantive changes, and any changes in approach will be discussed with, and approved by, USEPA prior to implementation. Field activities will be conducted following procedures outlined in the SAP. Health and Safety precautions for field activities will be as presented in the HASP. Quality assurance measures for Remedial Investigation activities are outlined in the QAPP.

5.1 Project Planning and Management

5.1.1 Meetings with USEPA

Two meetings with USEPA are currently planned for this project. A project kick-off meeting will be requested immediately following USEPA approval of the work plans. The kick-off meeting will include a brief review of the scope of work to ensure the parties involved are in agreement with the planned scope of work.

A second meeting will be requested following receipt, interpretation and validation of data and prior to preparation of the Remedial Investigation report (see Section 5.9). At that time, the findings will be discussed along with the format for the Remedial Investigation report.

5.1.2 Monthly Progress Reports

Monthly progress reports will be prepared and submitted every month beginning 30 days after the date remedial investigation work plan approval is received from USEPA. The monthly progress reports will include the following:

- Description of actions taken toward compliance with the consent order and remedial investigation work plan tasks implemented;
- Copies of data obtained including laboratory results (whether or not reviewed, validated and interpreted);
- Description of data anticipated to be received and activities scheduled for next 30 day period; and
- Description of problems encountered and actions taken or to be taken to mitigate/remedy problems and a schedule for those actions.

5.2 Background Investigation

5.2.1 Obtain and Review Well Records

HLA will contact the St. Croix Department of Planning and Natural Resources (DPNR) regarding well records within three miles of the site.

5.2.2 Obtain and Review Historic Aerial Photographs

HLA will obtain available aerial photographs of the site and surrounding area. Based on discussions with private and government resources the following photographs are available for St. Croix:

- 1963 photograph from Interra (Available at a scale of 1 inch to 1,500 feet)

- 13 photographs from the U.S. Department of the Interior at scales ranging from 1:23,600 to 1:124,755 including:
  - One 1954 photograph
  - Two 1974 photographs
  - 10 Photographs taken between 1990 and 1991.

It is uncertain at this time whether the photographs listed can be expanded to show useful details or if the site is in fact covered. National Ocean Services will also be contacted to determine whether any additional photographs are available.

5.2.3 Obtain and Evaluate Additional Existing Data

HLA will obtain any additional data and data packages available for the site. ICC files will be inspected for any additional data. Additional data, if any, available from the USEPA will be requested under the Freedom of Information Act (FOIA). The additional data, if any, will be validated, if practicable, and preliminarily evaluated with respect to existing data.

HLA will also research possible effects of elevated chloride and TDS on groundwater chemistry.

5.2.4 Obtain Information on Potential Offsite Source Areas

Other potential sources of groundwater contamination may be present in the vicinity of the site. A records review to identify other sites that may be potential contaminant sources will be conducted.

The review will initially focus on the area within one-quarter mile of the site. When the lateral direction of groundwater flow is better defined and more information is available on the extent of contamination, if any, the focus of the review may be expanded or reduced. Types of sites to be identified include the following:

- RCRA facilities

- Leaking underground storage tank facilities
- CERCLA Information System sites
- National Pollution Discharge Elimination System dischargers
- Virgin Islands listed hazardous waste sites
- Emergency Response Notification System and Hazardous Materials Incident Report System spill sites
- Solid waste disposal facilities

Commercial databases categorize sites in the U.S. Virgin Islands as unmappable. Sites identified using a commercial database will be indicated by zip code or locality only. All sites that have a zip code in the area will be considered for inclusion. After receipt of database information, HLA will perform a field reconnaissance to determine the actual location of the facilities identified. A map will be prepared showing the location of the facilities identified within the search radius. Information on facilities found to be outside the radius searched will be excluded.

Sites identified by the commercial database will be evaluated based on type, location and proximity to the site. Further information on selected sites will be obtained through the federal Freedom of Information Act or equivalent local laws from the USEPA, GOVI, DPNR, local health department, local building inspector, fire department or other local agencies maintaining such information. The information obtained will be evaluated for relative potential for contribution to groundwater conditions at the site.

Available information on the nearby sewage treatment plant will be obtained. If sufficient information cannot be obtained, HLA will request permission from the St. Croix Department of Public Works (DPW) to inspect the sewage treatment plant and interview plant personnel regarding sewage treatment, waste disposal and treated water discharge practices.

5.3 Acquire Access and Permits

5.3.1 Access Agreements

Prior to initiation of field activities, access agreements must be obtained from the owner of the properties on which field work will be performed or which must be crossed to access field work areas. At this time, all field work will be performed on property believed to be owned by CHS.

Access agreements will be negotiated with the property owners by the Respondents's legal counsel. Efforts to obtain access agreements will include, but not be limited to, use of letters sent by certified mail to the property owners requesting access for field personnel and subcontractors, USEPA, and their authorized representatives.

Diligent efforts will be made to finalize access agreements in a timely manner so as to avoid delays in RIWP implementation. To this end, efforts to acquire access agreements will be initiated prior to receipt of RIWP approval.

5.3.2 Well Drilling Permits

Based on discussions with representatives of the DPNR, the following procedures will be necessary to obtain permits to install the monitoring wells:

1. Drilling permits will be obtained from the DPNR for each of the wells to be installed.

2. Plot map will be obtained from the DPW.

3. The site location and wells will be indicated on the plot map and returned to DPNR with the appropriate permit fees.

4. DPNR official will examine the site and then issue the permit.

According to DPNR and local drillers, this process is expected to take three to four weeks. At this time it is expected that the drilling contractor will obtain the permits.

5.3.3 Customs Permits for Samples

Permits required to bring the environmental samples into the U.S. will be obtained by the laboratory contractor prior to beginning work on this project. Contractors currently anticipated for use on the project already have the necessary permits in-place.

5.3.4 USEPA Disposal Permission

Waste classification samples will be analyzed to classify waste soil and water generated during this investigation. Based on results of the waste classification samples, potential disposal sites will be identified. Results of waste classification samples and names of proposed disposal sites will be forwarded to USEPA with a request for permission to dispose of the waste generated. Proposed analyses and procedures for management of investigation derived wastes are discussed in Section 5.10.

5.4 Site Clearing and Reconnaissance

The site is overgrown and will have to be cleared for access. Site clearing will not include vegetation within 25 feet of the River Gut as required under the Virgin Islands Statute pertaining to trees and water courses (see Table 4-3). Once the site is cleared of heavy vegetation, a general site inspection will be performed. The areas described in Section 3.7 (with the exception of groundwater) will be inspected visually for evidence of contamination.

5.5 Field Sampling Program

The field sampling program is described in detail in the SAP (Appendix A).

5.5.1 Soil Sampling Program

5.5.1.1 Soil Boring Locations and Rationale

The proposed locations for the soil borings are shown in Figure 3-1. The general objectives of soil boring placement applicable to all 10 proposed borings are as follows:

- Identify areas of soil contamination
- Assess concentrations of contamination identified
- Investigate site stratigraphy
- Evaluate existence and extent of low permeability layer previously reported by ESI

The location and rationale for each boring are discussed below:

SBB1 This boring will be located in to the east of tank No. 8 in the area of the reported toluene release. Samples will be collected to evaluate whether historical releases in this area have affected soil conditions and, if so, the vertical extent of impact. Boring SBB1 will be completed as Monitoring Well MW-1.

SBC1 This boring well be located to the east of the Former Process Pit. This direction is believed to be hydraulically downgradient from the pit. Samples will be collected to evaluate whether soil has been affected through historical use of the pit. This boring will be completed as Monitoring Well MW-2.

SBC2 This boring will be located near the end of central storm drain that crosses the site. Overflow from the Former Process Pit is believed to have discharged via this sewer. Samples will be collected to evaluate whether this discharge has affected soil quality near the property boundary. Boring SBC2 will be completed as Monitoring Well MW-3.

SBD1 This boring will be completed through the loading dock area, through the reported location of the Former Lab Pit. Samples will be collected to evaluate whether soil has been affected through historical use of the pit. Boring SBD1 will be completed as Monitoring Well MW-4.

SBD2 This boring will be completed through the Former Lab Drain where it exited beneath the paved area near the loading dock. Samples will be collected to evaluate whether soil in this area has been affected by discharge from the drain as well as runoff from the loading dock and paved area. This boring will be abandoned upon completion.

SBD3 This boring will be completed near the end of the Loading Dock Surface Drain. Samples will be collected to evaluate whether soil near the property boundary have been affected by discharge from this drain. Unless evidence of affected soil is detected in the field, this boring will be abandoned upon completion. If evidence of

affected soil is detected in the field at this location, boring SBD3 may be completed as a monitoring well.

SBD4 This boring will be completed near the southeastern corner of the site. Soil samples from this location will be collected for field screening purposes only. This boring will be completed as Monitoring Well MW-5.

SBE1 This boring will be located adjacent to the Concrete Pad Near the AST Farm in the location of a previously reported release. Samples will be collected to evaluate whether historical releases in this area have affected soil conditions and, if so, the vertical extent of impact. Boring SBE1 will be abandoned upon completion.

SBF1, SBF2 and SBF3
These borings will be located on the north, east and west sides of the Concrete Storage Pad. Samples will be collected to evaluate whether runoff from this structure has affected soil quality in this area. These three borings will be abandoned upon completion.

5.5.1.2 Drilling and Soil Sampling Procedures

The soil borings will be advanced using hollow-stem auger drilling techniques. This method has been selected based on procedures previously used at the site as documented in the geotechnical reports (CDS, 1979 and 1980) and through discussions with local drillers.

The soil borings will be sampled continuously using a split-spoon sampling device to 10 feet below grade and at 5-foot intervals to completion depth at the water table. Samples will be collected more frequently at suspected changes in lithology and at the anticipated water table depth (20 feet below grade). As discussed in Section 2.2.4.4, groundwater is expected to be encountered at approximately 20 feet below grade.

A portion of material from each split spoon sample will be placed in a plastic bag and screened in the field for relative VOC concentrations using an FID or photo-ionization detector (PID). Sample material collected for laboratory analysis of VOCs will not be subjected to field screening.

Samples for laboratory analysis will be collected from the 0- to 1-foot interval below grade; above the water table; and at an intermediate depth interval. The intermediate depth interval will be selected based on relative VOC concentrations and/or visible evidence of contamination. If none of the samples from a given boring exhibit VOCs or visible evidence of contamination, the intermediate depth sample will be collected immediately above the first layer of relatively low permeability encountered.

All soil samples from each boring will be analyzed for Target Compound List Volatile Organic Compounds plus a library search of up to 15 tentatively identified compounds (TCL

VOCs+15) by Contract Laboratory Program (CLP) Statement of Work (SOW) OLMO1.9. The shallow sample from each boring will also be analyzed for the following parameters:

- TCL SVOs plus a library search of up to 15 tentatively identified compounds (TCL SVOs+15) and pyridine by CLP SOW OLMO1.9;
- TCL Pesticides and PCBs by CLP SOW OLMO1.9; and
- Target Analyte List (TAL) Inorganics CLP SOW ILMO3.0.

If any analytes are detected at concentrations exceeding the proposed Examples of Concentrations Meeting Criteria for Action Levels (July 27, 1990 federal register), the samples from the deeper intervals will be analyzed for those parameters as well. The shallow samples will be analyzed using a one-week laboratory TAT to allow the remaining samples to be analyzed, if necessary, within the 14-day technical holding time (see SAP, Appendix AB). The additional samples, if any, will be analyzed using a standard 3- to 4-week laboratory TAT.

5.5.2 Groundwater Monitoring Well Installation

5.5.2.1 Monitoring Well Locations

Monitoring well locations are shown on Figure 3-1. General objectives of well placement applicable to all five proposed well locations are as follows:

- Obtain water level data onsite.
- Evaluate the distribution of chemicals, if any, present in the groundwater near potential source areas.

The location and specific rationale for each well location are discussed below.

MW-1 This monitoring well will be installed near the reported release in the Above-ground Storage Tank Farm. This well will be used to evaluate groundwater conditions in the area of the reported historical release. If free from contamination, this well may serve as an upgradient monitoring location for water levels and water quality.

MW-2 This monitoring well will be installed on the anticipated hydraulically downgradient side of the Former Process Pit. The well will be used to evaluate groundwater conditions near the center of the site. The well will provide water level and water quality data in the immediate vicinity of the former process pit.

MW-3 This monitoring well will be installed near the eastern property boundary along the central storm drain. This well will be used to evaluate groundwater conditions near the anticipated downgradient property boundary.

MW-4 This well will be installed in the location of the Former Lab Pit beneath the loading dock. Samples from this well will be used to evaluate whether historical operation of Former Lab Pit affected groundwater quality.

MW-5 This well will be installed near the southeastern corner of the site. This well will be used to evaluate groundwater quality in the direction anticipated to be hydraulically downgradient from the Former Lab Pit, Loading Dock and associated drains.

5.2.2.2 Drilling and Completion of Monitoring Wells

Well construction procedures and details are described in the SAP (Appendix A). Well screens will be placed across the water table. This will be done to allow detection of any light and separate-phase floating contaminants, should they be present. The total thickness of the saturated zone at the site is unknown. However, based on available information, the River Gut alluvial deposits in this area may be greater than 100 feet thick in this area. There are currently no plans to install monitoring wells deeper into the aquifer.

The wells will be developed as described in the SAP. Development water will be placed in 55-gallon drums and staged onsite pending disposal.

5.5.3 Rehabilitate Existing Wells

Assuming the well labelled P-1 (Figure 3-1) can be located, both existing wells will be modified to facilitate access. This will include removal of the pumps and well heads. Locking protective steel casings will be installed to protect the tops of the wells and water-tight plugs will be placed at the top of the inner casings.

Immediately after removal of the well cap, the air above and within the well casing will be screened for VOCs using an FID or PID. The bottoms of the wells will be sounded and a caliper will be lowered into the wells in an attempt to determine the screened intervals, if any. A grab sample will be collected from the sediment, if any, at the bottom of each well and inspected in the field.

Well development procedures described in SAP will be used to redevelop the wells. Because information regarding the construction and integrity of the wells is not currently available, the two existing wells are not currently anticipated to be used for groundwater sampling.

Assuming it can be determined that the wells are screened in the shallow portion of the aquifer, water levels will be taken for use in constructing water table contour maps for the site.

5.5.4 Survey

The latitude, longitude and elevations of the two existing production wells and the new monitoring wells will be surveyed by a licensed surveyor. Elevations surveyed will include

the inner, outer and ground elevations with respect to MSL. The locations of the inner casing elevation measurements will be marked for future water level measurements.

5.5.5 Groundwater Monitoring and Sampling

5.5.5.1 First Round of Groundwater Sampling

Approximately two weeks after installation and development, groundwater samples will be collected from the five new monitoring wells. Groundwater sampling procedures are described in the SAP.

Prior to collecting samples, water levels will be measured in all of the wells onsite. Groundwater elevations will be calculated by subtracting the measured depth to water from the surveyed referenced elevation described in Section 5.5.4. Groundwater contour maps will be prepared using the water table elevations. These will be used to evaluate lateral groundwater flow directions.

The groundwater samples will be analyzed by a Superfund Contract Laboratory Program (CLP) laboratory for TCL VOCs+15, SVOs+15, Pesticides and PCBs, TAL inorganics and pyridine. HLA currently plans to contract this service to ETC Laboratory of Edison, New Jersey. Much of the analytical work will be performed by ETC/Gulf South Laboratory in New Orleans, Louisiana. Library searches of up to 15 TICs will be performed on both the VOC and SVO fractions. Both field-filtered and unfiltered samples will be analyzed for TAL metals in accordance with the USEPA Region III QA Directive *Field Filtration Policy for Monitoring Well Groundwater Samples Requiring Metals Analysis*, Bulletin No. QAD009 (April 23, 1990). Specific conductance, temperature and pH will be measured in the field. The parameters were selected based on substances previously reported at the site.

5.5.5.2 Water Level Monitoring

Water level measurements and survey data will be used to construct groundwater contour maps to determine the direction of horizontal groundwater flow at the site. Groundwater at the site may be influenced by seasonal effects from the nearby River Gut.

To evaluate potential seasonal fluctuations in water levels and direction of flow, quarterly water level measurements will be recorded at each monitoring well for a period of one year. One or more continuous water level recorders will be installed in selected wells to supplement the quarterly measurement data and to evaluate diurnal or other short term water level fluctuations. The wells to be monitored and the wells in which continuous water level recorders will be placed will be selected based on evaluation of water level data for the initial three month period of water level measurements.

The water level data will be compared to previously collected data and water level elevation contour maps will be prepared periodically. Data from the continuous recorders is also anticipated to be used in conjunction with the quarterly water level measurements and precipitation records to evaluate the potential recharge effects at the site.

5.5.5.3 Quarterly Groundwater Sampling

Three additional rounds of groundwater samples will be collected from selected wells on a quarterly basis. The quarterly sampling data will be used to evaluate seasonal trends in contaminant concentrations and will provide a more statistically representative groundwater quality database.

The wells to be sampled and the parameters to be analyzed will be determined based on interpretation of the water level data and results of initial sampling discussed above. The wells to be sampled and analytical parameter list will be discussed with and approved by EPA prior to sample collection. Based on available data, HLA anticipates sampling three of the monitoring wells on a quarterly basis for TCL VOCs+15 and pyridine.

5.6 Data Validation

All laboratory data will be validated as discussed in the QAPP (Appendix C).

5.7 Data Evaluation

Following completion of data validation, the laboratory data will be compiled and summarized along with the field data. Laboratory and pertinent field data will be input into a computerized database for subsequent tabulation and analysis. The data will be plotted and evaluated for patterns of distribution, degradation, migration and other such relationships.

Data generated during this project will be used to:

- Determine hydraulic gradient;
- Identify constituents in soil and groundwater; and
- Evaluate site conditions with respect to ARARs.

5.8 Development of ARARs

The preliminary listing of ARARs provided in Section 4.4 will be refined, developed and revised, as needed, throughout completion of the Remedial Investigation activities to take into consideration new chemical data, site conditions and potential remedial actions. Further, state and federal registers will be reviewed periodically to identify changes to the ARARs that have already been identified.

5.9 Remedial Investigation Report

Following completion of all Remedial Investigation activities, a draft Remedial Investigation report will be prepared and submitted to USEPA. The Remedial Investigation report will include the following:

- Executive Summary
- Discussion of the history of the site;
- Summary of previous investigations and remedial actions;
- Description of the site including the physical setting, climate, surface water hydrology, geology and soils;
- Summary of sampling locations and procedures;
- Discussion of deviations, if any, from the RIWP;
- Tabulated summaries of soil and groundwater quality data;
- Data on groundwater flow direction;
- Nature and extent of contamination, if any;
- Contaminant fate and transport, if applicable;
- Summary of Baseline Risk Assessment activities;
- Listing of ARARs;
- Summary and conclusions; and
- Recommendations regarding identification of other potential sources of contamination in the vicinity of the site.

Appendices to the Remedial Investigation Report will include the following:

- Technical memorandum on field activities;
- Analytical data;
- QA/QC evaluation results; and
- Risk Assessment methods used.

After consideration of USEPA's comments, the report will be finalized.

5.10 Management of Investigation Derived Wastes

Investigation-derived wastes generated during the Remedial Investigation activities will generally be managed in accordance with USEPA's *Guide to Management of Investigation-Derived Wastes* quick reference fact sheet (USEPA, 1992c).

The types of wastes anticipated to be generated include the following:

- Decontamination fluids
- Drilling fluids and cuttings
- Well development and purge water
- Used personal protective equipment

Decontamination fluids, drilling fluids and cuttings will be containerized (e.g., in drums or portable above-ground storage tanks for liquids, in drums or roll-offs for solids) and stored in the warehouse building. This storage area was used by USEPA contractors during previous removal activities. The containers will be labelled with regard to contents, date of generation and boring of origin.

Representative composite samples will be collected from the containers and laboratory tested for RCRA characteristics. Based on the results of the analyses, the waste materials may be disposed offsite in accordance with CERCLA 121(d)(3) and the *CERCLA Off-Site Policy* directive (USEPA, 1987d). For all shipments of 10 cubic yards or more, written notification will be provided to environmental officials of the receiving state and the USEPA project coordinator.

Well development and purge water will also be containerized in drums or portable tanks, labelled with regard to contents, date of generation and well of origin, and stored in the warehouse. If the results of analyses of groundwater samples indicate that no chemicals of concern are present, the water may be discharged at a local facility, if approved by the St. Croix DPW. If not approved, these wastes will be stored in the warehouse for eventual characterization and disposal. Solids that may accumulate at the bottom of the containers, particularly those of development water, will be treated in the same manner as the drilling fluids and cuttings.

Personal protective equipment and disposable field equipment will be decontaminated, if applicable, collected in drums or an industrial dumpster, and disposed at a RCRA Subtitle D facility.

Containment systems that can contain at least 110 percent of the volume of the containers stored will be provided for liquid wastes stored in the warehouse.

6.0 BASELINE RISK ASSESSMENT AND FEASIBILITY TASKS

6.1 Baseline Risk Assessment

If evidence of onsite soil and/or groundwater contamination is identified during the Remedial Investigation, a Baseline Risk Assessment will be undertaken to assess the potential risk posed by the site. The scope of the Baseline Risk Assessment will be developed based on the findings of the Remedial Investigation. The Baseline Risk Assessment will include a Baseline Ecological Assessment and a Baseline Human Health Assessment, as and if necessary. Some tasks discussed under the Baseline Risk Assessment may be unnecessary. At several points throughout the Risk Assessment the data will be evaluated to determine if further action is necessary. For example, if no exposure pathways or receptors can be identified or an exposure pathway is found to be incomplete, further action may not be needed. Additionally, if the concentrations of detected chemicals are below those concentrations shown to pose a risk, further action may not be necessary.

6.1.1 Baseline Ecological Assessment

A baseline ecological risk assessment of onsite conditions would follow USEPA guidance for performing ecological investigations and ecological risk assessments. This guidance is contained in:

- *Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference,* EPA/600/3-89/013, (1989);
- *Risk Assessment Guidance for Superfund (RAGS) Volume II, Environmental Evaluation manual,* EPA 540 1-89 001, Interim Final (1989), and
- *Framework For Ecological Risk Assessment,* EPA/630/R-92/001 (1992).

In addition to EPA guidance, appropriate Virgin Islands Government guidance or regulations related to ecological impacts, will be identified.
The Baseline Ecological Assessment has been divided into the following phases:

- Phase I - Problem Formulation;
- Phase II - Analysis; and
- Phase III - Risk Characterization.

Phase I - Problem Formulation, will include a review and evaluation of available literature and a limited field reconnaissance designed to identify potential stressors, exposure pathways, and ecological receptors. Subsequent phases will not be performed if results of Phase I indicate the site is not affected or there are no exposure pathways and/or receptors.

If warranted by the findings of Phase I, Phase II - Analysis (Section 6.1.1.2) would include sampling and analysis of appropriate environmental media such as water and/or soils. The sampling results would be utilized to characterize the potential problem. Sample types and locations would be consistent with the findings and recommendations of Phase I and the hydrogeological investigation outlined in the other sections of this Work Plan. If warranted

by the findings of Phase II of this investigation, Phase III, would include development and implementation of an assessment of potential ecological risk (Section 6.1.1.3).

6.1.1.1 Phase I-Problem Formulation

6.1.1.1.1 Identification Potential Stressors

Data generated during the investigation tasks described in Section 5.0 of this Work Plan will be evaluated to identify potential stressor chemicals. If sampling of environmental media does not identify any potential stressor chemicals the ecological risk assessment will summarize these findings and recommend no further action.

6.1.1.1.2 Identification of Potential Exposure Pathways

If potential stressor chemicals are identified by onsite soil and groundwater investigations, an investigation to identify potential exposure pathways will be implemented. This investigation will use available literature to identify potential pathways. If no pathways for chemicals into the surrounding environment can be established, or the pathways are found to be incomplete the ecological risk assessment will be limited to the source area.

A limited visual field inspection will be conducted to verify the status of potential pathways identified by the literature review.

6.1.1.1.3 Ecological Assessment Area

If potential stressor chemicals are identified at the onsite, a Phase I Ecological Assessment Area (Phase I EAA) will be established based on the findings of the Remedial Investigation activities outlined in Section 5.0.

6.1.1.1.4 Environmental Resources Inventory

Once the Phase I EAA has been established, an Environmental Resources Inventory (ERI) of the area will be implemented to provide baseline data for other parts of the Ecological Assessment. Literature sources will be reviewed to identify environmental resources within the EAA. Limited field work will be implemented to confirm conditions or boundaries identified by the literature review (Section 6.1.1.1.6). The inventory is intended to identify the following environmental resources:

- Surface Water Resources.
  - Wetlands
  - Floodplains
  - Streams
  - Watershed

ıce Water Drainage

ın Water Pathways

Concern.

ɔgy.

ıy.

entification and Characterization of Potential Stressors and Exposure thways

ı the ERI will be analyzed to provide a characterization of the potential ys identified earlier. If this characterization shows the pathway(s) to be these conditions will be documented and no further work on the ecological will be done.

entification of Potential Ecological Receptors

ntial ecological receptors within the EAA will be accomplished through of the potential exposure pathways (Section 6.1.1.1.2) and the results of the esources inventory (Section 6.1.1.1.4). The results of the Phase I ll focus primarily on receptor areas and habitats. Species of concern that within these areas or habitats will be listed. If no potential receptors can be is task the conditions will be documented and no further action will be

ield Verification

ıase I, a limited field reconnaissance will be conducted to verify conditions ıe literature review. The Phase I field activities will consist of visually ıresence and extent of the major features within the EAA identified by the l Resources Inventory literature review (Section 6.1.1.1.4) and the presence or ential ecological receptors as identified in Section 6.1.1.1.2. Field personnel nvironmental scientists with experience in biology, ecology, risk assessment, l planning and hazardous waste investigations.

Ecological Assessment Technical Memorandum

An ecological assessment technical memorandum detailing the findings of the Phase I Ecological Assessment when work is concluded will be prepared and distributed to the appropriate reviewing regulatory agencies. The memorandum will describe work completed to that time and provide recommendations.

6.1.1.2 Phase II-Analysis

Additional ecological assessment work may be proposed, if found to be necessary based upon the findings and recommendations of the investigations carried out in Phase I of the Baseline Ecological Assessment and the hydrogeological investigations outlined in the other sections of this Work Plan. Assessment of potential ecological receptors and possible field and laboratory sampling and analysis would be carried out as discussed below.

6.1.1.2.1 Potentially Impacted Environmental Media

Potentially impacted environmental media identified within the Study Area in Phase I of the Ecological Assessment will be sampled and analyzed. Sampling locations within the Study Area will be those proposed in the ecological assessment technical memorandum described in Section 6.1.1.1, following USEPA approval. Water and sediment samples may be collected in the vicinity of the Study Area.

6.1.1.2.2 Identification and Assessment of Potential Contaminants of Concern

If warranted by the analytical results of the sampling program noted in Section 6.1.1.2.1, Potential Contaminants of Concern (PCOC) and their concentrations will be identified and a toxicological profile for the PCOCs will be developed as appropriate. In conjunction with the identification and assessment of the contaminants of concern and potential receptors, potential ARARs will be identified. If warranted, a technical memorandum identifying PCOCs and including associated toxicological profiles will be submitted to USEPA.

6.1.1.3 Phase III Risk Characterization

If a potential risk to ecological resources is indicated by Phase II sampling activities, a work plan which details the activities of a quantitative ecological risk assessment will be submitted to the USEPA for approval. Phase III would consist of the following activities:

- Assessment of potential ecological receptors
- Benthic macroinvertebrate populations evaluation
- Risk analysis
- Habitat and wetland delineations and function/value assessments
- Species of concern survey

6.1.2 Baseline Human Health Risk Assessment

If evidence of onsite soil and/or groundwater contamination is identified during the remedial investigation, the guidance EPA has provided to evaluate potential human health risks will be followed. The EPA Superfund guidance is the only regulatory guidance that has been provided to evaluate potential human health and environmental impacts of chemical contaminants. The EPA risk assessment guidance is acceptable to local and state agencies. Specific EPA guidance followed for human health risk assessments include: Superfund Exposure Assessment Manual (SEAM), 1988, EPA/540/1-88/001, Exposure Factors Handbook, 1989, EPT/600/8-89/043, Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (1989), OSWER 9285.7-019 (RAGS), and RAGS Volume I: Part B, Development of Risk-based Preliminary Remediation Goals) OSWER Directive 9284.7-01B,1991, and RAGS Volume I: Part C, (Risk Evaluation of Remedial Alternatives), OSWER Directive 9285.7-01C, 1991. These documents are the most recent EPA guidance and they are appropriate to evaluate the potential impacts of chemicals released to the environment. The overall steps in a risk assessment are given below:

1. Preliminary data evaluation
2. Prepare a risk assessment plan
3. Select indicator chemicals
4. Identify exposure pathways
5. Identify human receptor populations
6. Locate exposure points and identify chemical exposure concentrations
7. Estimate chemical intake for receptors
8. Assess toxicology of indicator chemicals
9. Characterize potential human health risks
10. Determine site-specific chemical concentrations that have acceptable levels of risk (clean up levels)

If results of the preliminary data evaluation indicate that there are no chemicals onsite or exposure pathways that would result in a risk to human receptors, the remaining steps (2 through 10) noted above would not be performed.

6.2 Development, Screening and Analysis of Remedial Alternatives

If necessary, based on the results of the Risk Assessment, remedial alternatives to be evaluated for the site will be selected during the Feasibility Study portion of the project. A

preliminary review of remedial alternatives will be conducted following completion of the Risk Assessment activities.

6.3 Feasibility study.

If necessary, a separate plan will be prepared for the complete Feasibility Study in the future. The Feasibility Study report will be discussed in an addendum to this Work Plan to be prepared for the Feasibility Study following completion of any risk assessment which may be conducted.

7.0 PROJECT ORGANIZATION

HLA, as a contractor to ICC, has responsibility for designing the sampling and analysis programs necessary to achieve the project objectives. HLA's project management structure is illustrated in Figure 7-1.

HLA will provide project management, perform and/or observe field investigations, and prepare and submit project deliverables to USEPA. To achieve these goals, HLA will retain experienced subcontractors in the specific disciplines necessary.

The ICC project will include several subcontractors. Selection of qualified subcontractors will include assessment of technical and professional qualifications, experience, proposed methodologies and cost. Where appropriate, HLA will address a request for proposal to several qualified subcontractors to obtain the most experienced and cost-competitive subcontractor.

Subcontractors will be required to review and sign the HASP (Appendix B) and will be advised by HLA personnel in possible hazards associated with their particular tasks.

8.0 ANTICIPATED SCHEDULE

The anticipated implementation schedule is presented as Figure 8-1. It has been prepared based on the number of weeks from receipt of USEPA approval of the remedial investigation work plan. The proposed schedule is based on the following assumptions:

- Access agreements for locations of all field activities will be obtained at least one week prior to the intended start date for field activities
- Inclement weather conditions will not delay any segment of field activities by more than one week
- Access to work areas will be available for a minimum of ten consecutive hours per day

The schedule also assumes that site conditions encountered in the field will not vary greatly from those anticipated. If site conditions do differ greatly, additional time may be needed to amend the remedial investigation work plan. If this is the case, the remedial investigation work plan schedule will have to be modified accordingly.

9.0 ACRONYMS AND ABBREVIATIONS

ARARs	Applicable or Relevant and Appropriate Requirements
AST	Above-ground Storage Tank
BTEX	Benzene, toluene, ethylbenzene and xylenes
CDS	Caribbean Drilling Services
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CWM	Chem-Waste Management, Inc.
DPNR	St. Croix Department of Planning and Natural Resources
DPW	St. Croix Department of Public Works
EAA	Ecological Assessment Area
ERI	Environmental Resources Inventory
ESI	Enviro-Science, Inc.
FEMA	Federal Emergency Management Agency
FID	Flame-Ionization Detector
FOIA	Freedom of Information Act
FWS	US Fish and Wildlife Service
gpm	Gallons per minute
gpm/ft	Gallons per minute per foot (Specific Capacity)
GOVI	Government of the Virgin Islands
HASP	Health and Safety Plan
HLA	Harding Lawson Associates
HRS	Hazard Ranking System
HSWA	Hazardous and Solid Waste Amendments of 1984
ICC	Island Chemical Company
ICMI	Industrial Corrosion Management Inc.
MCL	Maximum Contaminant Levels
MDL	Method detection limit
mg/L	Milligrams per liter
MSL	Mean Sea Level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NUS	Halliburton NUS Corporation
NWI	National Wetlands Inventory
OSWER	Office of Solid Waste Emergency Response
PCB	Polychlorinated biphenyls
PCOC	Potential Contaminants of Concern
PID	Photo-ionization detector
POTW	Publicly owned treatment works
ppm	Parts per million
QAPjP	Quality Assurance Project Plan
QG	Quinidine gluconate
QS	Quinine sulfate
RCRA	Resource Conservation and Recovery Act
RIWP	Remedial Investigation Work Plan

SAP	Sampling and Analysis Plan
SCS	Soil Conservation Survey
SVO	Semi-volatile organic compound
SWDA	Solid Waste Disposal Act
TAL	Target Analyte List
TBC	To-Be-Considered
TCL	Target Compound List
TDS	Total dissolved solids
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VICHEM	Virgin Islands Chemical Company
VIPA	Virgin Islands Port Authority
VOC	Volatile organic compound

10.0 REFERENCES

Caribbean Drilling Services Incorporated. 1979. *Subsurface Investigation - Proposed Cooper Laboratories Plant Expansion, Estate Bethlehem, St. Croix,* May 12.

Caribbean Drilling Services Incorporated. 1980. *Subsurface Investigation, Proposed Firewater Tank, Cooper Laboratories Plant, Frederiksted, St. Croix,* August 19.

Cederstrom, D.J. 1941. Notes on the Physiography of St. Croix, Virgin Islands. *American Journal of Science, V. 239, No. 8,* August.

Cederstrom, D.J. 1950. Geology and Ground-Water Resources of St. Croix, Virgin Islands. U.S. Geological Survey Water Supply Paper 1067.

CDM Federal Programs. 1987. *Island Chemical Company, Technical Document Review,* August 5.

Colon-Ramos, H.M. 1983. *Ground-Water records for St. Croix, U.S. Virgin Islands,* American Journal of Science, v. 239, p. 533-576

Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA): Public Law 96-510, 42 USC 9601 et.seq.

Diax, P.L., Aquino, Z., Figueroa-Alamo, C., Vachier, R.J., and A.V. Sanchez. 1993. *Water resources data, Puerto Rico and the U.S. Virgin Islands, water year 1992.* U.S.G.S. Water Data Report PR-92-1.

Enviro-Science, Inc. 1984a. *Progress Report for Island Chemical Company/Chemical Contamination,* October 1.

Enviro-Science, Inc. 1984b. *Progress Report, Island Chemical Company, Inc. (Berlex), St. Croix, Virgin Islands,* December.

Enviro-Science, Inc. 1985a. *Addendum to Progress Report, Island Chemical Company, Inc. (Berlex), St. Croix, Virgin Islands,* April 4.

Enviro-Science, Inc. 1985b. *Report Concerning Small Quantity Generator Status of Island Chemical,* May 7.

Enviro-Science, Inc. 1986. *Project Summary for Island Chemical Company, Inc. (Berlex), St. Croix, Virgin Islands,* April 17.

Enviro-Science, Inc. 1987a. *Attachment, Site Description for Island Chemical Company, St. Croix, U.S. Virgin Islands,* April 8.

Enviro-Science, Inc. 1987b. *Remedial Investigation Work Plan for Island Chemical Company, St. Croix, USVI,* April 9.

Enviro-Science, Inc. 1987c. *Remedial Investigation Work Plan for Island Chemical Company, St. Croix, USVI,* April 16.

Enviro-Science, Inc. 1987d. *Attachment, Site Description for Island Chemical Company, St. Croix, U.S. Virgin Islands,* April 16.

Forman, R.T.T., 1974. An Introduction to the Ecosystems and Plants on St. Croix, U.S. Virgin Islands. In *Guidebook to the Geology and Ecology of Some Marine and Terrestrial Environments, St. Croix, U.S. Virgin Islands.* Special Publication No. 5. West Indies Laboratory, Farleigh Dickinson University.

Garcia, R. and M. Canoy, 1984. Reconnaissance of Ground-water Quality in the U.S. Virgin Islands, July 1984, U.S.G.S. Water-resources Division, Open-file Data Report 84-807.

Geraghty & Miller, Inc. 1983. *Report on Current Groundwater Conditions in the U.S. Virgin Islands,* April 29.

Gill, I.P., 1989. The Evolution of Tertiary St Croix. Ph.D. dissertation, Louisiana State University and Agricultural and Mechanical College.

Gill, I.P. and D.K. Hubbard, 1986. Subsurface geology of the St. Croix carbonate rock system. Water Resources Research Center, College of the Virgin Islands, Capsule Report No. 8.

Haire, W.J. and K.G. Johnson, 1978. Floods of November 11-13, 1974, in St. Croix, U.S. Virgin Islands. U.S.G.S. Water Resources Investigations 77-136 Open-file Report.

Johnson, K.G., R.A. Carrasquillo, and R. Gonzalez, 1982. Flood of October 8, 1977 in St. Croix, U.S. Virgin Islands. U.S.G.S. Water-Resources Investigations 82-262 Open-file Report.

Lidz, B.H. 1988. Upper Cretaceous (Campanian) and Cenozoic Stratigraphic Sequence, northeast Caribbean (St. Croix, U.S. Virgin Islands). *Geological Society of America Bulletin,* v. 100, p. 282-298. February.

Multer, H.G. and L.C. Gerhard ed. 1974. *Guidebook to the Geology and Ecology of Some Marine and Terrestrial Environments, St. Croix, U.S. Virgin Islands.* Special Publication No. 5. West Indies Laboratory, Farleigh Dickinson University.

NUS Corporation, a Halliburton Company. 1991. *Final Draft Site Inspection Report, Island Chemical Company/VI Chemical, St. Croix, U.S. Virgin Islands,* September 11.

Ogden, J.C. 1974. The Major Marine Environments of St. Croix, U.S. Virgin Islands. In *Guidebook to the Geology and Ecology of Some Marine and Terrestrial Environments, St. Croix, U.S. Virgin Islands.* Special Publication No. 5. West Indies Laboratory, Farleigh Dickinson University.

Rivera, L.H., Frederick, W.D., Farris, C., Jensen, E.H., Davis, L., Palmer, C.D., Jackson, L.F., and W.E. McKinzie, 1970. Soil Survey of the Virgin Islands of the United States. U.S.D.A. Soil Conservation Service, 1970.

Robinson, T.M., 1972. Ground-water in central St. Croix, U.S. Virgin Islands. U.S.G.S. Open-File Report, Caribbean District.

Speed, R.C., L.C. Gerhard, and E.H. McKee. 1979. Ages of Deposition, Deformation, and Intrusion of Cretaceous Rocks, Eastern St. Croix, Virgin Islands. *Geological Society of America Bulletin, Part I, v. 90, p. 629-632,* July.

Superfund Amendments and Reauthorization Act of 1986: Public Law 99-499.

Torris-Gonzalez, S. and F. Rodriguez del Rio, 1990. Potentiometric surface of the Kinshill aquifer and hydrologic conditions, St. Croix, U.S. Virgin Islands, U.S.G.S. Water-resources Investigations Report 89-4085. July.

Torres-Gonzalez, S., 1987. Steady-State Simulation of Ground-Water Flow Conditions in the Kingshill Aquifer, St. Croix, U.S. Virgin Islands, July 1987. *American Water Resources Association, Monograph Series No. 15.*

Torres-Sierra, H., 1987. Estimated water use in St. Croix, U.S. Virgin Islands, October 1983-September 1985. U.S.G.S. Open-File Data Report 86-537.

U.S. Department of Agriculture, Soil Conservation Service, 1970. *Soil Survey, Virgin Islands of the United States,* August.

U.S. Environmental Protection Agency, 1983, *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans: QAMS-005/80; Office of Monitoring Systems and Quality Assurance, ORD, Washington, D.C.*, February.

U.S. Environmental Protection Agency, 1984, *Guidelines Establishing Test Procedures for the Analysis - Final Rule and Proposed Rule, 40 CFR Part 136*, October.

U.S. Environmental Protection Agency. 1985. *RCRA Enforcement, Berlex Laboratories, (a subsidiary of Island Chemical Co., Inc.), St. Croix, Virgin Islands, VID980651095,* September 9. [sic - ICC was a subsidiary of Berlex].

U.S. Environmental Protection Agency, 1986a *Draft Supplement to Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans: QAMS-005/80, Office of Monitoring Systems and Quality Assurance, ORD, Washington, D.C.*, December.

U.S. Environmental Protection Agency, 1986b, *User's Guide to the Contract Laboratory Program: Office of Emergency and Remedial Response, Sample Management Office,* December.

U.S. Environmental Protection Agency, 1986c, *National Enforcement Investigations Center Policies and Procedures Manual, EPA -330-9-78-001-R.*

U.S. Environmental Protection Agency, 1986d, *Test Methods for Evaluating Solid Waste: Office of Solid Waste and Emergency Response (OSWER) Directive SW-846, Vol. 1B.*

U.S. Environmental Protection Agency. 1987a. *Draft Administrative Order On Consent, Island Chemical Company, Inc., Berlex Laboratories, Inc., Respondents,* March.

U.S. Environmental Protection Agency, 1987b, *A Compendium of Superfund Field Operations Methods, OSWER Directive 9355-0-14,* December.

U.S. Environmental Protection Agency, 1987c, *Data Quality Objectives for Remedial Response Activities (development process): USEPA/540/G-87/003, Office of Emergency and Remedial Response, Washington, D.C.,* March.

U.S. Environmental Protection Agency, 1987d, *CERCLA Off-Site Policy,*

U.S. Environmental Protection Agency, 1988a, *Laboratory Data Validation - Functional Guidelines for Evaluating Organics Analyses: TDD Doc. No. HQ-8401-01, Hazardous Site Evaluation Division,* February.

U.S. Environmental Protection Agency, 1988b, *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Atmospheric Research and Exposure Assessment Laboratory,* June.

U.S. Environmental Protection Agency, 1988c, *Laboratory Data Validation - Functional Guidelines for Evaluating Inorganics Analyses, Hazardous Site Evaluation Division,* July.

U.S. Environmental Protection Agency, 1988d, *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final, EPA/540/6-89/004,* October.

U.S. Environmental Protection Agency, 1989a, *Preliminary Assessment, Removal Evaluation and Funding Authorization Request for a CERCLA Removal Action at the Virgin Island Chemical Company, Inc., Site, St. Croix, U.S. Virgin Islands - ACTION MEMORANDUM,* August 8.

U.S. Environmental Protection Agency, 1989b, *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A, Interim Final, Office of Emergency and Remedial Response,* December.

U.S. Environmental Protection Agency, 1989c, *Region II CERCLA Quality Assurance Manual, Revision I.*

U.S. Environmental Protection Agency, 1990a, *Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule, 40 CFR Part 261*, Thursday, March 29.

U.S. Environmental Protection Agency, Region III, 1990d, *Field Filtration Policy for Monitoring Well Groundwater Samples Requiring Metals Analysis*, Bulletin No. QAD009, April 23.

U.S. Environmental Protection Agency. 1990e. *Comments on Work Plan*, October 19.

U.S. Environmental Protection Agency. 1991a. Final Pollution Report, USEPA Region II Response and Prevention Branch, October 25.

U.S. Environmental Protection Agency, 1991b, *Model Quality Assurance Project Plan: Office of Superfund, Region V*, May.

U.S. Environmental Protection Agency, 1991c, *Contract Laboratory Program Statement of Work for Low Concentration Organic Analysis*, June.

U.S. Environmental Protection Agency, 1992a, *Region II SOP HW-6, CLP Organic Data Review and Preliminary Review, Revision 8*, January.

U.S. Environmental Protection Agency, 1992b, *Region II SOP #W-2 Evaluation of Metals Data for the CLP* Revision II, January.

U.S. Environmental Protection Agency, 1992c, *Guide to Management of Investigation-Derived Wastes, Quick Reference Fact Sheet*, 1992c.

U.S. Environmental Protection Agency, 1993, *Administration Order on Consent for Remedial Investigation/Feasibility Study*, Docket No. III-93-21-DC, July.

Whetten, J.T., 1966. *Geology of St. Croix, U.S. Virgin Islands:* Geological Society of America Memoir 98.

Tables

Table 2-1. Wells Within One Mile of Site

Island Chemical Company
St. Croix, U.S. Virgin Islands

Well Identification	Reported Use	Distance from Site (feet)	Direction from Site	Reported Depth (feet)	Reported Static Water depth (feet)[1]	Reported Water Elevation (feet above MSL)[2]	Reported Yield (gpm)	Year Installed
Virgin Islands Port Authority No. 1	Not Available	NA	W	NA	NA	NA	NA	NA
Virgin Islands Port Authority No. 2	Not Available	NA	W	NA	NA	NA	NA	NA
Fairplain 9	Public Water Supply	500	SSE	62	62	NA	21	NA
Fairplain 8	Public Water Supply	1,000	SE	56	56	NA	37.9	NA
Fairplain 7	Public Water Supply	1,200	SE	57	57	NA	15.7	NA
Fairplain 6	Public Water Supply	1,300	SSE	105	18.1	NA	30	NA
Fairplain 2	Public Water Supply	1,300	SSE	79	23.3	NA	NA	NA
Old Golden Grove	Public Water Supply	1,300	W	NA	NA	6	NA	NA
Fairplain 4	Public Water Supply	1,400	SSE	100	19.7	NA	21	NA
Fairplain 3	Public Water Supply	1,500	SE	97	13.5	3	NA	NA
Fairplain 5	Public Water Supply	1,600	SE	96	18.6	3	10.4	NA
Fairplain 1	Public Water Supply	1,800	SE	100	20.9	6	NA	NA
Golden Grove PW8	Public Water Supply	2,500	W	NA	NA	NA	< 2	1972/1973
Boring near Anguila	Test Hole	2,900	E	NA	NA	-4	NA	NA
Riggers and Erectors	Commercial?	3,000	SE	NA	NA	NA	NA	NA
Golden Grove PW6	Public Water Supply	3,200	WNW	NA	NA	NA	< 2	1972/1973
Negro Bay 9	Public Water Supply	3,300	WSW	140	NA	NA	54-62	1979
Golden Grove PW9	Public Water Supply	3,300	W	NA	NA	NA	< 2	1972/1973

See last page for notes

Table 2-1. Wells Within One Mile of Site

Island Chemical Company
St. Croix, U.S. Virgin Islands

Well Identification	Reported Use	Distance from Site (feet)	Direction from Site	Reported Depth (feet)	Reported Static Water depth (feet)[1]	Reported Water Elevation (feet above MSL)[2]	Reported Yield (gpm)	Year Installed
Negro Bay 5	Public Water Supply	3,400	WSW	95	NA	NA	NA	1973
Golden Grove PW7	Public Water Supply	3,400	W	NA	NA	NA	< 2	1972/1973
Negro Bay 8	Public Water Supply	3,500	WSW	120	NA	NA	54-62	1978
Golden Grove PW5	Public Water Supply	3,600	W	NA	NA	41	< 2	1972/1973
Golden Grove PW1	Public Water Supply	3,600	WNW	NA	NA	NA	NA	1972/1973
Negro Bay 7	Public Water Supply	3,700	WSW	120	NA	NA	54-62	1978
Golden Grove PW4	Public Water Supply	3,700	WNW	110	NA	NA	NA	1972/1973
Negro Bay 4	Public Water Supply	3,700	WSW	95	NA	NA	NA	1973
Negro Bay 3	Public Water Supply	4,000	WSW	95	NA	2	NA	1973
Negro Bay 6	Public Water Supply	4,000	WSW	120	NA	NA	54-62	1978
Golden Grove PW2	Unused	4,100	W	NA	NA	25	60	1972/1973
Golden Grove PW3	Public Water Supply	4,400	W	NA	NA	NA	2	1972/1973
College of Virgin Islands	Domestic	4,600	NNE	95?	NA	55	NA	NA
Near Profit	Unused Well	4,900	NE	NA	NA	24	NA	NA
Airport	Unused Well	5,000	SE	NA	NA	5	NA	NA

1 Reported depth, construction or sounding 1982
2 Static water depth (Geraghty & Miller)
3 Static water level elevation (Torres-Gonzales)
NA Not available
Source: Adapted from Geraghty & Miller, 1983; Torres-Gonzales, 1990.

Table 2-2. Summary of Events
Island Chemical Company
St. Croix, U.S. Virgin Islands

Date	Events
May 1, 1969	Steffey leased site to Houston Chemicals
March 20, 1972	Houston assigned the lease to Caribe Chemicals, subsequently known as Pierrel
June 30, 1978	Pierrel assigned the lease to Cooper Laboratories. ICC was incorporated July 21, 1978 and the lease was assigned to ICC by Cooper in 1979
November 1, 1979	Cooper sold its stock in ICC to Berlex
1980 through 1982	Berlex uses the facility in attempt to perfect a quinidine process. By the end of 1982 the plant was permanently closed.
November 27, 1892 through February 1, 1983	ICC removes 26,748 gallons of toluene and 6,946 gallons of xylenes for disposal at Inland Chemical, Puerto Rico. Approximately 15,000 gallons of a water solution was removed from the cistern and disposed locally.
May 17, 1983	GOVI inspection indicated no hazardous waste on site
September 14, 1984	ICC sold its assets to Virgin Island Chemical Co. (VICHEM)
09/17/84 through 10/28/84	ESI investigates soil conditions in the Loading Dock Area and AST Farm
June 5, through August 7, 1985	ESI investigates soil conditions in Drain Lines and Lab Pit area. Toluene affected soils are excavated and placed on trays in the dryer building for thermal treatment. Results of treatment are documented through periodic sampling.
June 14, through July 19, 1985	ESI collects sludge and liquid samples from Lab Pit and Process Pit. Samples submitted to ICMI for various analyses
September 9, 1985	USEPA collects samples from Dryer and Lab Pit for PPL analysis
December 5, 1985	ICC disposes of 192 drums of waste at Chemical Waste Management in Emelle, Alabama
February 19, 1986	ESI collects samples from River Gut. Analyzed for metals, cyanide, phenols and VOCs. A few metals were detected
March 12, 1986	ESI collects liquid samples from nine ASTs for characterization by ICMI
March 13, 1986	USEPA collects three additional samples from Gut, two from lab pit and one from northern onsite well. ESI obtains splits.
June 2, 1986 through March 10, 1987	ESI prepares waste profiles for 67 drums. Final disposition of these drums is unclear.
January 31, 1989	USEPA performs a Preliminary Assessment. At this time, the site was occupied by St. Croix Security Kennels and VIAG fuels, Inc.
March 30, 1989 through April 30, 1991	USEPA plans and performs waste removal activities. Final disposal of hazardous materials reportedly completed by 10/24/91
September 17, through 19, 1989	Hurricane Hugo strikes
February 28, 1991	NUS collects groundwater, soil and sediment samples as part of the Preliminary Assessment/Site Investigation
December 11, 1991	Draft PA/SI report issued by NUS

Table 2-3. Summary of ICC Disposal Activities
Island Chemical Company
St. Croix, U.S. Virgin Islands

Date	Manifest	Waste Description (from manifests)	Source	Method	Disposal Site
11/27/82	IC01	3,175 gal. Toluene	ASTs	Bulk tanker	Inland Chemical, Puerto Rico
11/30/82	IC02	5,205 gal. Toluene	ASTs	Bulk tanker	Inland Chemical, Puerto Rico
12/14/82	IC03, IC04	9,913 gal. Toluene	ASTs	Bulk tanker	Inland Chemical, Puerto Rico
01/07/83	IC05, IC06	8,455 gal Toluene	ASTs	Bulk tanker	Inland Chemical, Puerto Rico
02/01/83	IC07, IC08	6,946 gal Xylenes	ASTs	Bulk tanker	Inland Chemical, Puerto Rico
1982/1983	NA	15,000 gal aqueous/basic solution	Cistern	Bulk tanker	Disposed locally by Cruzan Environmental Services[1]
	NA	Metal, plastic drums and ashes from burning of fiber drums, pallets and soil	ICC Cleanup	Unknown	East Anguila Sanitary Landfill[1]
12/02/85	243031, 243032, 243033	94 drums toluene/benzene 35 drums toluene/chlorobenzene 34 drums toluene/chloroform 15 drums toluene/acetone 14 drums containing drum pieces	Process pit water and sludge; soil and drums from waste water drain line removal; toluene containing water and soil	Drums	Chemical Waste Management, Inc., Emelle, Alabama
10/24/91	USEPA Pollution Report	Various waste streams	USEPA Removal Action	Various[2]	Various[2]

Notes:
1 Information based on ICC in-house memorandum dated February 7, 1983.
2 By October 24, 1991, USEPA reported that all waste had been shipped offsite. See USEPA Pollution Report No. 30 (Appendix M).

Table 2-4. Summary of Substances Reported

Island Chemical Company
St. Croix, U.S. Virgin Islands

Substance Reported	ICC Contractors		OHM Inventory	USEPA Contractors		
	Laboratory Analyses	Inventory		Lab Reagent List	Drum Inventory	Laboratory Analyses
Acetic Acid		X	X	X	X	
Acetic anhydride		X				
Acetone	X	X	X	X	X	
Acetonitrile		X		X		
Acetylene					X	
Activated carbon					X	
Aldrin						X
Alkalinity C,D,E,G				X		
All-weather patch material					X	
Aluminum						X
Aluminum chloride				X		
Amersite 2 Corrosive Inhibitor			X		X	
Ammonia liquid		X				
Ammonium acetate				X		
Ammonium Hydroxide				X		
Ammonium hydroxide				X		
Ammonium persulfate				X		
Ammonium thiocyanate				X		
Amyl alcohol				X		
Antifreeze			X			
Antimony						X
Aromatic Solvents			X			
Arsenic	X					X
Arsenic trioxide				X		
Ashland MeOH					X	
Barium						X
Barium chloride				X		
Barium hydroxide				X		

See last page for notes

Table 2-4. Summary of Substances Reported
Island Chemical Company
St. Croix, U.S. Virgin Islands

Substance Reported	ICC Contractors		OHM Inventory	USEPA Contractors		
	Laboratory Analyses	Inventory		Lab Reagent List	Drum Inventory	Laboratory Analyses
Benzaldehyde	X			X		
Benzene	X			X		
Benzene methanol	X					
Benzhydrol				X		
Benzoic acid	X			X		
Benzoin				X		
Benzophenone	X			X		X
Benzoquinone	X					
Benzoyl chloride				X		
Benzyl acetate	X		X	X	X	
Benzyl alcohol				X		
Benzyl benzoate				X		
Benzyl chloride			X	X	X	
Benzyl cinnamate				X		
Benzyl ether				X		
Benzyl phenone		X				
Benzyltriethylammoniumchloride				X		
γ BHC						X
Δ BHC						X
Bis(2-ethyl hexyl)phthate						X
Bismuth subnitrate				X		
Boiler Treatment			X			
Bromine				X		
Bromophenol blue				X		
Brucine sulfate				X		
Buffer solution pH 4.00				X		
Buffer solution pH 7.00				X		
Buffer solution pH 10.00				X		

See last page for notes

Table 2-4. Summary of Substances Reported

Island Chemical Company
St. Croix, U.S. Virgin Islands

Substance Reported	ICC Contractors		OHM Inventory	USEPA Contractors		
	Laboratory Analyses	Inventory		Lab Reagent List	Drum Inventory	Laboratory Analyses
Butanol		X				
1-Butanol				X		
2-Butanone (see methyl ethyl ketone)						
2-Butoxy ethanol			X			
Butyl benzyl phthate						X
Butyl chloride		X				
Butylated hydroxy toluene		X				
Cadmium	X					
Calcium						X
Calcium Hypochloride		X				
Calcium sulfate				X		
CAO-3 BHT				X		
Carbon Black		X				
Carbon tetrachloride	X					X
Castor Wax		X				
Caustic Acid			X			
Cello-Seal				X		
Charcoal		X				X
α Chlordane						X
γ Chlordane						X
Chloride-F				X		
Chlorine					X	
Chlorobenzene	X					
1-Chlorobutane				X		
Chlorodiphenyl methane				X		
Chloroform	X	X	X	X	X	
Chloromethylbenzene	X					
1-Chloro-2-methyl benzene	X					

See last page for notes

Table 2-4. Summary of Substances Reported

Island Chemical Company
St. Croix, U.S. Virgin Islands

Substance Reported	ICC Contractors		OHM Inventory	USEPA Contractors		
	Laboratory Analyses	Inventory		Lab Reagent List	Drum Inventory	Laboratory Analyses
4-Chlorobenzene sulfonamide				X		
Chromium	X					X
Chromotropic acid NA salt				X		
Cinchona Bark		X				
Cleen and Shine Multi Surface Cleaner			X			
Cobalt						X
Cobalt chloride				X		
Color Standard 4				X		
Congo Red				X		
Contaminated Clothing			X			
Contaminated trash and wood			X			
Copper	X			X		X
Crofox					X	
Crystal Clear floor finish					X	
Cupric sulfate				X		
Cyanides	X					
2-Cyclopyridine						
DDE						X
4,4-DDT						X
Degreaser					X	
20% Dibah in toluene		X				
Dibenzoyl tartaric acid				X		
Dibenzo-18-Crown-6				X		
1,1-Dichloroethane	X			X		
1,2-Dichloroethane	X					
trans-1,2-Dichloroethene	X			X		
Dichlorophenyl methane				X		
Dichlorotoluene				X		

See last page for notes

Table 2-4. Summary of Substances Reported
Island Chemical Company
St. Croix, U.S. Virgin Islands

Substance Reported	ICC Contractors		OHM Inventory	USEPA Contractors		
	Laboratory Analyses	Inventory		Lab Reagent List	Drum Inventory	Laboratory Analyses
Dieldrin						X
Diethylamine		X				
Diethylene glycol				X		
Diethylene Glycol Monomethyl Ether Floor finish (Sunnyside)			X			
Diisobutyl aluminum hydride				X		
2,6-Dimethoxybenzoic acid				X		
1,3-Dinitrobenzene				X		
Di-n-butyl phthalate						X
Di-n-octyl phthalate						X
Diphenyl methanone (see benzophenone)						
Diphenylmethane				X		
Diphenylthiocarbazone				X		
2,6-Ditertiarybutyl, p-cresol				X		
DPD #1,2,3 Reagents				X		
Drewtrol 8500 Boiler water sludge and scale preventative			X		X	
Endosulfan I						X
Endosulfan II						X
Endosulfan Sulfate						X
Endrin Ketone						X
Eosin Y				X		
Ethanediol, 1,2-			X			
Ether anhydrous				X		
Ethoxyguin				X		
Ethyl Acetate			X	X		
Ethyl Alcohol		X	X		X	
Ethyl ether				X		
Ethylbenzene	X	X		X		
Ethylene glycol		X	X			

See last page for notes

Table 2-4. Summary of Substances Reported

Island Chemical Company
St. Croix, U.S. Virgin Islands

Substance Reported	ICC Contractors		OHM Inventory	USEPA Contractors		
	Laboratory Analyses	Inventory		Lab Reagent List	Drum Inventory	Laboratory Analyses
Ethylene Glycol Base Antifreeze			X			
Ferric ammonium sulfate				X		
Ferric chloride				X		
Ferrous ammonium sulfate				X		
Filteraid					X	
Fluoranthene						X
Fluorene						X
9H-Fluorene-9-one	X					
Fluorenone	X	X				
Formic acid				X		
Glacial Acetic Acid			X			
Gluconofin		X				
Glucono-delta-Lactone		X				
Glycol			X		X	
Heptachlor						X
Heptachlor epoxide						X
Heropa 320 Texaco			X			
Humisorb					X	
Hydrazine sulfate				X		
Hydrochloric Acid			X	X	X	
Hydrogen aminosulfate						
Hydrogen aminosulfonate			X			
Hydrogen chloride					X	
4-Hydroxybenzoic acid				X		
2-Hydroxybenzyl alcohol				X		
9-Hydroxyfluorene				X		
Hydroxyfurancoumarin	X	X				
Hydroxylamine hydrochloride				X		

See last page for notes

Table 2-4. Summary of Substances Reported

Island Chemical Company
St. Croix, U.S. Virgin Islands

Substance Reported	ICC Contractors		OHM Inventory	USEPA Contractors		
	Laboratory Analyses	Inventory		Lab Reagent List	Drum Inventory	Laboratory Analyses
Hydroxy-4-methyl-2-pentanone, 4-				X		
Insulation, (asbestos?)					X	
Insulation (fiberglass)					X	
Iodine				X		
Iron						X
Iron chloride				X		
Isoamyl alcohol				X		
Isobutyl alcohol				X		
Isopropanol		X				
Karl Fisher Reagent (pyridine)		X				
Kenite 700		X				
Laporte Molecular Sieve			X			
Lead	X					X
Lead acetate				X		
Lead nitrate				X		
Lithium perchlorate				X		
Lubricating oil					X	
Magnesium						X
Magnesium sulfate		X	X	X		
Magnesium sulfate trihydrate					X	
Manganese						X
Medical oxygen				X		
Mercuric chloride				X		
Mercuric oxide				X		
Mercury	X					
Mesityl oxide				X		
Methanol		X	X	X	X	
Methoxychlor						X

See last page for notes

Table 2-4. Summary of Substances Reported
Island Chemical Company
St. Croix, U.S. Virgin Islands

Substance Reported	ICC Contractors		OHM Inventory	USEPA Contractors		
	Laboratory Analyses	Inventory		Lab Reagent List	Drum Inventory	Laboratory Analyses
Methyl alcohol				X		
n-Methylaniline					X	
Methyl ethyl ketone (2-butanone)						X
Methyl isobutyl carbinol			X		X	
Methyl isobutyl ketone			X		X	
Methyl orange				X		
Methyl red				X		
Methyl tertiary butyl ether	X					
4-Methylbenzophenone				X		
1,1-oxybis(Methylene) bis-benzene	X					
Methylene chloride	X	X				
2-methyl propanol	X					
2-Methyl-1-heptene	X					
Mogul Water Treatment			X			
Molecular Sieve			X			
Monochlorobenzene				X		
Monoethanolamine			X			
Muriatic Acid		X				
Naphthalene						X
Na salt of ME salicylate				X		
Niacin N.F.				X		
Nickel	X					X
Nitric acid				X		
Nitrobenzene				X		
Non aqueous buffer solution				X		
Nutrizyme				X		
Oil #3				X		
2,2-Oxydiethanol				X		

See last page for notes

Table 2-4. Summary of Substances Reported

Island Chemical Company
St. Croix, U.S. Virgin Islands

Substance Reported	ICC Contractors		OHM Inventory	USEPA Contractors		
	Laboratory Analyses	Inventory		Lab Reagent List	Drum Inventory	Laboratory Analyses
Oxygen					X	
Paint			X		X	
p-Chlorobenzene sulfonamide				X		
p-Naptholbenzein				X		
p-Phenetidine			X		X	
p-Toluenesulfonicmonohydrate				X		
Paraffin oil				X		
Parformaldehyde				X		
Parformaldehyde prills				X		
Pentachlorophenol						X
Pentosin					X	
Perchloric acid				X		
pH indicator A				X		
Phenanthrene						X
Phenol red				X		
Phenols	X					
Phenopthalein				X		
Phenyl acetate	X					
Phenylhydrazine				X		
Phenylhydrazinehydrochloride				X		
Phosporous pentoxide				X		
Piperazine				X		
Potassium				X		X
Potassium Acetate			X		X	
Potassium bromide				X		
Potassium butoxide		X		X		
Potassium chloride				X		
Potassium cyanate				X		

See last page for notes

Table 2-4. Summary of Substances Reported
Island Chemical Company
St. Croix, U.S. Virgin Islands

Substance Reported	ICC Contractors		OHM Inventory	USEPA Contractors		
	Laboratory Analyses	Inventory		Lab Reagent List	Drum Inventory	Laboratory Analyses
Potassium dichromate				X		
Potassium ferrocyanide				X		
Potassium hydroxide				X		
Potassium iodide				X		
Potassium iodo platinate		X				
Potassium periodate				X		
Potassium platinate				X		
Potassium sulfate			X	X	X	
Potassium thiocyanate				X		
Powdered filter media					X	
Propane					X	
1-Propanol				X		
Purafil II					X	
Pyrene						X
Pyridine	X	X	X			
Quinact		X				
Quinidine			X			
Quinidine Base		X				
Quinidine Gluconate		X				
Quinidinone		X				
Quinine Bisulfate		X				
Quinine Sulfate		X			X	
Resourcinol				X		
Results Crystal Clear Finish for Floors			X			
Rinse Line Injector Fluid			X		X	
Rout non foaming ceramic tile and grout conditioner			X		X	
Salicylaldehyde				X		
Salicylic acid			X	X	X	

See last page for notes

Table 2-4. Summary of Substances Reported
Island Chemical Company
St. Croix, U.S. Virgin Islands

Substance Reported	ICC Contractors		OHM Inventory	USEPA Contractors		
	Laboratory Analyses	Inventory		Lab Reagent List	Drum Inventory	Laboratory Analyses
Salt			X		X	
Selenium						X
SI 320 Total Water Treatment			X			
Sicapent				X		
Silica gel dessicant				X		
Silver	X					
Silver nitrate				X		
Soap?			X			
Soda Ash		X	X		X	
Sodium				X		X
Sodium acetate			X	X	X	
Sodium amide				X		
Sodium benzoate			X	X		
Sodium bicarbonate		X	X		X	
Sodium borohydride				X		
Sodium carbonate				X		
Sodium chlorate				X		
Sodium chloride		X		X		
Sodium dichromate				X		
Sodium formate			X	X		
Sodium hexa meta phosphate			X		X	
Sodium hydride				X		
Sodium hydroxide		X	X	X	X	
Sodium hypochlorite		X				
Sodium nitrite				X		
Sodium nitroferricyanide				X		
Sodium sulfate				X		
Sodium tartrate				X		

See last page for notes

Table 2-4. Summary of Substances Reported

Island Chemical Company
St. Croix, U.S. Virgin Islands

Substance Reported	ICC Contractors		OHM Inventory	USEPA Contractors		
	Laboratory Analyses	Inventory		Lab Reagent List	Drum Inventory	Laboratory Analyses
Sodium thiosulfate				X		
Sta-full repair matrix			X			
Sterling salt crystals					X	
Succinic anhydride				X		
Sulfamic acid				X	X	
Sulfanilic acid				X		
Sulfate Acid		X				
Sulfite O,P,Q				X		
Sulfuric acid				X		
Tartaric Acid			X		X	
Tetaric Acid		X				
Tetrachloroethene	X					
Tetrachlorophenol			X			
Tetrahydrofuran		X	X			
Tetraphenolboron sudium				X		
Tetrasodium EDTA			X			
Thallium	X					
Thinner					X	
Thiopene				X		
Toluene	X	X	X		X	X
Total alkylinity indicator				X		
Tributyl borate				X		
1,1,1-Trichloroethane	X					
Trichloroethene	X			X		
Triethanolamine			X			
Triethylamine		X	X		X	
Triethylenediamene				X		
Uranyl acetate				X		

See last page for notes

Table 2-4. Summary of Substances Reported
Island Chemical Company
St. Croix, U.S. Virgin Islands

Substance Reported	ICC Contractors		OHM Inventory	USEPA Contractors		
	Laboratory Analyses	Inventory		Lab Reagent List	Drum Inventory	Laboratory Analyses
Vanadium						X
Variquat		X				
Waste oil					X	
Water/Carbon Mix from floor cleaning			X			
Weedox C/R 250 herbicide				X		
Xylenes	X	X		X		X
Zinc	X					X
Zinc chloride				X		

ESI Inventory,
OHM inventory, January 1990
USEPA Inventory

Table 3-1. Areas of Potential Environmental Concern
Island Chemical Company
St. Croix, U.S. Virgin Islands

Area	Identification	Location	USEPA Identification	Description
A	Laboratory and Warehouse Building	Center of site	1	Location of drum storage during USEPA removal action.
B	Above-Ground Storage Tank Farm	Northwest side of Site	2	Former location of 20 ASTs, 10 tanks remain onsite. ESI identified and excavated area of soil between ASTs 8 and 9 affected by historical releases
C	Former Process Pit	East of Maintenance Building	3	Former location of underground concrete storage tank used to collect process waste water. Tank was reportedly emptied, cleaned and filled with concrete by ESI in 1986?. Conflicting information is available regarding the size of the tank (8,000 or 17,000 gallons)
D	Loading Dock and Former Lab Pit Area	North of Laboratory	4	Cobble-filled pit located beneath loading dock formerly received waste liquids from laboratory drains. Pit was connected to a second pit located near the property boundary by a 4-inch PVC pipe.
E	Soil Beneath Concrete Pad Near ASTs	Northwest of ASTs	5	ESI identified and excavated one area of soil affected by historical releases.
F	Concrete Storage Pad	North of Laboratory	6	Used for storage of various materials.

Table 3-2. Summary of Environmental Sampling

Area B - Above-Ground Storage Tank Farm
Island Chemical Company
St. Croix, U.S. Virgin Islands

Sample Name	Sample Date	Matrix	Collect by/ Analyzed by	Laboratory Sample No.	Parameters Analyzed	Substances Detected[1]
T8-1	ca. 09/17/84	Soil	ESI/Berlex	-	Toluene; pyridine; QG; QS	Toluene(694); QG(274); QS(101)
T8-2	ca. 09/17/84	Soil	ESI/Berlex	-	Toluene; pyridine; QG; QS	QG(47)
Tank-8	ca. 09/17/84	Soil	ESI/Berlex	-	Toluene; pyridine; QG; QS	toluene(13,880); QG(4,050); QS(1,521)
Tank-4	ca. 09/17/84	Soil	ESI/Berlex	-	QG; QS	QG(8,227); QS(2,594)
Tank-9	ca. 09/17/84	Soil	ESI/Berlex	-	QG; QS	QS(354)
Tank-7	ca. 09/17/84	Soil	ESI/Berlex	-	QG; QS	None detected
#4 Sample	ca. 09/17/84	Soil	ESI/Berlex	-	QG; QS	None detected
#4 High Conc.	ca. 09/17/84	Soil	ESI/Berlex	-	QG; QS	None detected
S4-1	ca. 10/15/84	Soil	ESI/Berlex	-	Toluene; pyridine	None detected
Tank 4	03/12/86	Liquid	ESI/ICMI	53581	QS; QC; Benzoquinone; fluorenone	Benzoquinone(30%); fluorenone(70%)
Tank 7	03/12/86	Liquid	ESI/ICMI	53582	Benzophenone; fluroenone	Benzophenone(39.6%); fluorenone(43.8%); unknown alkane(16.6%).
Tank 8	03/12/86	Liquid	ESI/ICMI	53583	VOCs; benzophenone; fluorenone	Benzophenone(85.7%); fluorenone(14.3%); toluene(8)
Tank 9	03/12/86	Liquid	ESI/ICMI	53584	VOCs; p-Phenetidine	Acetone(4.2); ethylbenzene(0.15); p-Phenetidine(89.1%); toluene(0.05); xylenes(14.1); unknown aromatic(10.9%)
Tank 10	03/12/86	Liquid	ESI/ICMI	58535	Hydroxyfurano-coumarin	Hydroxyfuranocoumarin(87.6%)
Tank 11	03/12/86	Liquid	ESI/ICMI	53586	Hydroxyfurano-coumarin	Hydroxyfuranocoumarin(82.4%)
Tank 12	03/12/86	Liquid	ESI/ICMI	53587	Hydroxyfurano-coumarin; p-phenetidine	Hydroxyfuranocoumarin(50.7%); p-phenetidine(46.3%)
Tank 13	03/12/86	Liquid	ESI/ICMI	53588	p-Phenetidine	p-Phenetidine(100%)
Tank 14	03/12/86	Liquid	ESI/ICMI	53589	VOCs; benzophenone; fluroenone	Chloroform(0.008[B]); methylene chloride(0.011[B]); benzophenone(64.8%); fluorenone(35.2%); toluene(0.0067[B])

Table 3-2. Summary of Environmental Sampling

Area B - Above-Ground Storage Tank Farm
Island Chemical Company
St. Croix, U.S. Virgin Islands

Sample Name	Sample Date	Matrix	Collect by/ Analyzed by	Laboratory Sample No.	Parameters Analyzed	Substances Detected[1]
VI25-S2	02/28/91	Soil	EPA/Compu-Chem	BGL	VOCs; AECs; B/Ns; Pest; PCBs; metals	Heptachlor epoxide(J); Dieldrin(J); γ-Chlordane(J); Al(21,700); As(7.65); Ba(136); Ca(23,300); Cr(27.9J); Co(21.1); Cu(99.8); Fe(44,100); Pb(35.3); Mg(7,800); Mn(1,050); Ni(18.8J); K(2,990); Na(J); V(97.2); Zn(387J)
VI25-S3	02/28/91	Soil	EPA/Compu-Chem	BGL	VOCs; AECs; B/Ns; Pest; PCBs; metals	Aldrin(30J); Heptachlor epoxide(10J); Dieldrin(J); 4-4'-DDE(5.8J); Endrin(J); Endosulfan sulfate(J); 4-4'-DDT(J); Endrin Ketone(J); gamna-Chlordane(7.5J); Al(21,000); SB(J); As(9.1J); Ba(196); Ca(43,100); Cr(49J); Co(22.3); Cu(73.7); Fe(81,700); Pb(322); Mg(7,420); Mn(987); Ni(33.5J); K(2,920); Na(J); V(63.5); Zn(362J)

Notes:

1 Reported concentrations in parentheses, presented in parts per million (ppm). See Table 3-9 for list of chemical abbreviations
2 Laboratory reported fluorethyne "possibly from plastic bag"
B Compound detected in blank sample
J Estimated concentration
T Tentatively identified compound
B/N Base/neutral extractable compounds
AECs Acid extractable compounds
PCBs Polychlorinated biphenyls
Pest. Pesticides
VOCs Volatile organic compounds

Table 3-3. Summary of Environmental Sampling

Soils in Dryer
Island Chemical Company
St. Croix, U.S. Virgin Islands

Sample Name	Sample Date	Collect by/ Analyzed by	Laboratory Sample No.	Parameters Analyzed	Substances Detected[1]
Dryer #1	06/14/85	ESI/York	-	Toluene	Toluene(1,500)
Dryer #2	06/14/85	ESI/York	-	Toluene	Toluene(150)
Dryer	06/14/85	ESI/ICMI	42889	VOCs	Benzene(6.6); chloroform(340); 1,2-DCA(4.2); t-1,2-DCE(4.0); ethylbenzene(16.1); toluene(4,000); xylenes(32.8)
Dryer	07/01/85	ESI/ICMI	43747	VOCs	Acetone(7); toluene(0.41)
Dryer	07/01/85	ESI/ICMI	43752	VOCs	Acetone(2.0); toluene(1.5)
5434-Dryer	07/01/85	ESI/York	-	Toluene	Toluene(7.7)
5435-Dryer	07/01/85	ESI/York	-	Toluene	Toluene(0.92)
Dryer	07/17/85	ESI/ICMI	44629	VOCs	Acetone(1.2); PCE(0.07); toluene(0.36)
Lab Pit #5967[2]	08/07/85	ESI/ICMI	45364	VOCs;	Acetone(0.23); benzene(0.01); chloroform(0.11); t-1,2-DCE(0.03); ethylbenzene(0.04); toluene(0.05); xylenes(0.02)
(Dryer) ICC 1:00	08/07/85	ESI/York	-	Toluene	Toluene(0.36)
5753-Dryer	08/07/85?	ESI/York	-	Toluene	Toluene(0.6)
5754-Dryer	08/07/85?	ESI/York	-	Toluene	Toluene(0.66)
Drying Oven (Left side composite)	09/09/85	EPA/EPA	087001	"Purgeable and Non-volatile organic Priority Pollutants"	Benzophenone(15,000); B2EHP(13); fluorene(9.2); toluene(0.46)
Drying Oven (Right side composite)	09/09/85	EPA/EPA	087002	"Purgeable and Non-volatile organic Priority Pollutants"	Benzophenone(2,600); B2EHP(4.7); DNOP(0.5[J]); fluorene(1.3); toluene(0.56)

Notes:

[1] Reported concentrations in parentheses, presented in parts per million (ppm). See Table 3-9 for list of chemical abbreviations.

[2] Chain of custody form indicates "Dryer"

J Estimated concentration

VOC Volatile organic compound

Table 3-4. Summary of Environmental Sampling

Area C - Former Process Pit
Island Chemical Company
St. Croix, U.S. Virgin Islands

Sample Name	Sample Date	Matrix	Collect by/ Analyzed by	Laboratory Sample No.	Parameters Analyzed	Substances Detected[1]
Pit-Duplicate	06/14/85	Liquid	ESI/ICMI	42885	Not analyzed	Insufficient sample volume to analyze
Pit Sludge	06/14/85	Sludge	ESI/ICMI	42886 & 42887-Composite	VOCs; Pest; PCBs; AECs; B/Ns; metals; CN; phenol	As(40); Cd(22.8); chloroform(220); Cr(592); Cu(327); CN(1.44); Pb(688); Hg(2.73); methylene chloride(125); Ni(134); phenol(0.01); toluene(1,560); Zn(3,594); benzene methanol^{T}(15,000^{J}); benzyl acetate^{T}(170,000^{J}); chloromethylbenzene^{T}(4,400^{J}); 1-chloro-2-methylbenzene^{T}(40^{J}); diphenyl methanone^{T}(30,000^{J}); 9H-fluorene-9-one^{T}(3,000^{J}); 1,1'-(oxybis (methylene)bis) benzene^{T}(4,000^{J})
Pit Sludge	06/14/85	"White Lump"	ESI/ICMI	42888	Unknown	No laboratory report provided
St. Croix	07/19/85	Water	ESI/ICMI	44418	VOCs; Pest; PCBs; B/Ns; AECs; metals; CN; phenol	Benzene(0.04); Cd(0.003); Cr(0.027); Cu(0.153); CN(0.053); Pb(0.011); Hg(0.001); Ni(0.08); phenol(0.161); Ag(0.008); Th(0.029); toluene(0.38); Zn(4.85); benzaldehyde^{T}(3.0^{J}); chloromethyl benzene^{T}(0.3^{J}); benzene methanol^{T}(24^{J}); phenyl acetate^{T}(26^{J}); diphenyl methane^{T}(0.4^{J}); 1-1'-(oxybis (methylene)bis benzene^{T}(0.4^{J});
VI25-SED5	02/26/91	Soil	NUS/Compu -Chem	BGL	VOCs; AECs; B/Ns; Pest; PCBs; metals	2-Butanone(0.005^{J}); xylenes(0.006^{J}); 2-methylnaphthalene(0.63^{J}); acenapthene(^{J}); fluorene(^{J}); phenanthrene(^{J}); DNBP(^{J}); fluoranthene(^{J}); pyrene(^{J}); BBP(^{J}); B2EHP(2.2^{J}); γ-BHC(^{J}); aldrin(0.012^{J}); heptachlor epoxide(0.0048^{J}); endosulfan I(0.004^{J}); dieldrin(0.0041^{J}); 4,4'-DDT(^{J}); methoxychlor(^{J}); α-chlordane(0.0035^{J}); γ-chlordane(0.0001^{J}); Al(9,400); Sb(26.6^{J}); As(8^{J}); Ba(48.6); Ca(51,200); Cr(57.6^{J}); Co(13.8); Cu(307); Fe(183,000); Pb(466); Mg(4,740); Mn(925); Ni(47.8^{J}); K(^{J}); Na(^{J}); V(^{J}); Zn(1,500^{J})

Notes:

1	Reported concentrations in parentheses, presented in parts per million (ppm). See Table 3-9 for list of chemical abbreviations.
J	Estimated concentration
T	Tentatively identified compound
B/N	Base/neutral extractable compound
AEC	Acid extractable compound
BTEX:	Benzene, toluene, ethylbenzene and xylenes
PCB	Polychlorinated biphenyls
Pest	Pesticides
VOC	Volatile organic compound

Table 3-5. Summary of ICC Environmental Sampling

Area D - Loading Dock and Lab Pit Area
Island Chemical Company
St. Croix, U.S. Virgin Islands

Sample Name	Sample Date	Matrix	Collect by/ Analyzed by	Laboratory Sample No.	Parameters Analyzed	Substances Detected[1]
D-1	ca. 09/17/84	Soil	ESI/Berlex	NA	Toluene; pyridine; QC; QS	Pyridine(920); QC(452); QS(82)
D-2	ca. 09/17/84	Soil	ESI/Berlex	NA	Toluene; pyridine; QC; QS	Pyridine(507); QC(96)
D-3	ca. 09/17/84	Soil	ESI/Berlex	NA	Toluene; pyridine; QC; QS	None detected
D-4	ca. 09/17/84	Soil	ESI/Berlex	NA	Toluene; pyridine; QC; QS	None detected
D-5	ca. 09/17/84	Soil	ESI/Berlex	NA	Toluene; pyridine; QC; QS	Pyridine(3,014); QC(170)
Loc.4-4'B	09/18-19/84	Soil	ESI/ICMI	34625	VOCs	Fluorethyne^{2T}(0.38); 2-methylpropanol^{T}(0.16)
Loc.13-3'B	09/18-19/84	Soil	ESI/ICMI	34626	VOCs	Fluorethyne^{2T}(0.31); 2-methylpropanol^{T}(0.16)
Loc.20-1'B	09/18-19/84	Soil	ESI/ICMI	34624	VOCs	Toluene(0.16); fluorethyne^{2T}(0.45); 2-methylpropanol^{T}(0.20); pentane^{T}(0.01)
Loc.21-4'B	09/18-19/84	Soil	ESI/ICMI	34627	VOCs	Fluorethyne^{2T}(0.06); 2-methyl-1-heptene^{T}(0.21); 2-methylpropanol^{T}(0.47); pyridine^{T}(0.02)
H22 1'A	ca. 10/15/84	Soil	ESI/Berlex	-	Toluene; pyridine	None detected
H-21 3'B	ca. 10/15/84	Soil	ESI/Berlex	-	Toluene; pyridine	Pyridine(1.2)
20 Septic	10/23-28/84	Soil	ESI/York	-	Toluene; pyridine; VOCs; O&G	Toluene(0.54); benzene(0.0005^{J}); chloroform(0.012); diphenyl methanone(64); 1,1-methylene bis-Benzene(8.4); methylene chloride(0.0015^{J}); O&G(241)
20 A-2'	10/23-28/84	Soil	ESI/York	-	Toluene; pyridine; VOCs; O&G	Toluene(0.69); benzene(0.0009^{J}); chloroform(0.005); ethylbenzene(0.068); methylene chloride(0.0023^{J}); xylenes(0.6); O&G(566)
21 A-2'	10/23-28/84	Soil	ESI/York	-	Toluene; pyridine; VOCs; O&G	Toluene(0.015); benzene(0.0006^{J}); chloroform(0.0038^{J}); ethylbenzene(0.007); methylene chloride(0.0024^{J}); PCE(0.0009^{J}); TCE(0.0008^{J}); O&G(1,500)
21 A-4'	10/23-28/84	Soil	ESI/York	-	Toluene; pyridine; VOCs; O&G	Toluene(0.043); benzene(0.0004^{J}); chloroform(0.0026^{J}); methylene chloride(0.0022^{J}); O&G(27.9)

See last page for notes

Table 3-5. Summary of ICC Environmental Sampling

Area D - Loading Dock and Lab Pit Area
Island Chemical Company
St. Croix, U.S. Virgin Islands

Sample Name	Sample Date	Matrix	Collect by/ Analyzed by	Laboratory Sample No.	Parameters Analyzed	Substances Detected[1]
25 - 2'	10/23-28/84	Soil	ESI/York	-	Toluene; pyridine; VOCs; O&G	Toluene(0.21); pyridine(13); benzene(0.0004[J]); chloroform(0.005); methylene chloride(0.0017[J]); O&G(89.6)
27 - 2'	10/23-28/84	Soil	ESI/York	-	Toluene; pyridine; VOCs; O&G	Toluene(0.016); pyridine(26); benzene(0.0006[J]); chloroform(0.019); methylene chloride(0.0022[J]); O&G(187)
32 - 2'	10/23-28/84	Soil	ESI/York	-	Toluene; pyridine; VOCs; O&G	Toluene(0.015); pyridine(43); benzene(0.0008[J]); chloroform(0.0042[J]); methylene chloride(0.0044[J]); 1,1,1-TCA(0.0008[J]); O&G(50.6)
35 - 4'	10/23-28/84	Soil	ESI/York	-	Toluene; pyridine; VOCs; O&G	Toluene(0.008); benzene(0.0004[J]); chloroform(0.013); methylene chloride(0.0024[J]); 1,1,1-TCA(0.011); O&G(39.5)
36 - 2'	10/23-28/84	Soil	ESI/York	-	Toluene; pyridine; VOCs; O&G	Toluene(0.007); benzene(0.0002[J]); chloroform(0.0014[J]); methylene chloride(0.0016[J]); O&G(965)
Lab Pit	06/14/85	?	ESI/ICMI	42883	Unknown	No report provided
Lab Pit Duplicate	06/14/85	?	ESI/ICMI	42884	Unknown	No report provided
Lab Pit #1	06/14/85	Soil	ESI/York	-	Pyridine	Pyridine(3.9)
Lab Pit #2	06/14/85	Soil	ESI/York	-	Pyridine	None detected
Lab Pit #3	06/14/85	Soil	ESI/York	-	Pyridine	Pyridine(0.51)
Lab Pit #4	06/14/85	Soil	ESI/York	-	Pyridine	Pyridine(0.18)
Lab Pit #1	07/01/85	Soil	ESI/ICMI	43748	Unknown	No report provided
Lab Pit #2	07/01/85	Soil	ESI/ICMI	43749	Unknown	No report provided
Lab Pit #3	07/01/85	Soil	ESI/ICMI	43750	Unknown	No report provided
Lab Pit #4	07/01/85	Soil	ESI/ICMI	43751	Unknown	No report provided

See last page for notes
Revised August 5, 1994
\\WORK\24231\02\PREVSMPD.TAB

Table 3-5. Summary of ICC Environmental Sampling

Area D - Loading Dock and Lab Pit Area
Island Chemical Company
St. Croix, U.S. Virgin Islands

Sample Name	Sample Date	Matrix	Collect by/ Analyzed by	Laboratory Sample No.	Parameters Analyzed	Substances Detected[1]
5436-Lab Pit #1	07/01/85	Soil	ESI/York	-	Pyridine	Pyridine(1.1)
5437-Lab Pit #2	07/01/85	Soil	ESI/York	-	Pyridine	Pyridine(3.4)
5438-Lab Pit #3	07/01/85	Soil	ESI/York	-	Pyridine	None detected
5439-Lab Pit #4	07/01/85	Soil	ESI/York	-	Pyridine	None detected
Lab Pit Sample 1	07/17/85	Soil	ESI/ICMI	44630	Unknown	No report provided
Lab Pit Sample 2	07/17/85	Soil	ESI/ICMI	44631	Unknown	No report provided
Lab Pit #5967 COC indicates "Dryer"	08/07/85	Soil	ESI/ICMI	45364	VOCs;	Acetone(0.23); benzene(0.01); chloroform(0.11); t-1,2-DCE(0.03); ethylbenzene(0.04); toluene(0.05); xylenes(0.02))
Lab Pit #5965	08/07/85	Soil	ESI/ICMI	45362	VOCs;	Acetone(0.32); benzene(0.34); 1,1-DCA(0.02); t-1,2-DCE(0.02); ethylbenzene(0.01); toluene(0.08); xylenes(0.06))
Lab Pit # 5966	08/07/85	Soil	ESI/ICMI	45363	VOCs;	Acetone(0.27); benzene(1.37); 1,1-DCA(0.02); t-1,2-DCE(0.01)
Lab Pit	08/07/85	Soil	ESI/ICMI	45360 & 45361	Unknown	No report provided
Lab Pit 12:00	08/07/85	Soil	ESI/York	-	Pyridine	Pyridine(2.7)
Lab Pit 12:00	08/07/85	Soil	ESI/York	-	Pyridine	None detected
Lab Pit 3:00	08/07/85	Leachate?	ESI/York	-	VOCs	Toluene(0.022)
Lab Pit 3:00	08/07/85	Leachate?	ESI/York	-	VOCs	Toluene(0.021)
Lab Pit 3:00	08/07/85	Leachate?	ESI/York	-	VOCs	Toluene(0.36)
5751-Lab Pit #2	08/07/85?	Soil	ESI/York	-	Pyridine	None detected

See last page for notes
Revised August 5, 1994
\WORK\24231\02\PREVSMPD.TAB

Table 3-5. Summary of ICC Environmental Sampling

Area D - Loading Dock and Lab Pit Area
Island Chemical Company
St. Croix, U.S. Virgin Islands

Sample Name	Sample Date	Matrix	Collect by/ Analyzed by	Laboratory Sample No.	Parameters Analyzed	Substances Detected[1]
5752-Lab Pit #1	08/07/85?	Soil	ESI/York	-	Pyridine	None detected
Lab Waste Drainage Area (North side surface)	09/09/85	Soil	EPA/EPA	087003	"Purgeable and Non-volatile organic Priority Pollutants"	B2EHP(16); toluene(0.42)
Lab Waste Drainage Area (North side subsurface)	09/09/85	Soil	EPA/EPA	087004	"Purgeable and Non-volatile organic Priority Pollutants"	B2EHP(1.9); DNOP(4.2); toluene(0.44) chloroform (0.2), benzene (0.2) AG 3/14/98
Lab Waste Drainage Area (South side surface)	09/09/85	Soil	EPA/EPA	087005	"Purgeable and Non-volatile organic Priority Pollutants"	B2EHP(51); DNOP(0.6[J]); toluene(0.36)
Lab Waste Drainage Area (South side subsurface)	09/09/85	Soil	EPA/EPA	087006	"Purgeable and Non-volatile organic Priority Pollutants"	B2EHP(36); DNBP(75); DNOP(2); toluene(0.4)
085252-ESI	03/13/86	Soil	ESI/ICMI	53363	VOCs; AECs; B/Ns; PCBs	Methylene chloride(0.015[B])
085254-ESI	03/13/86	Soil	ESI/ICMI	53365	VOCs; AECs; B/Ns; PCBs	Chloroform(0.0092[B]); methylene chloride(0.0087[B])
085255-ESI	03/13/86	Soil	ESI/ICMI	53366	VOCs; AECs; B/Ns; PCBs	Chloroform(0.0054[B]); methylene chloride(0.015[B])
085252 Lab waste pit seep	03/13/86	Soil	EPA/EPA	NA	VOCs; AECs; B/Ns; Pest; PCBs; metals; dioxins	DNOP(9); As(1[J]); Be(7[J]); Cr(22); Cu(45); Ni(20[J]); Sb(10); Zn(63)
085254 Lab waste pit #1	03/13/86	Soil	EPA/EPA	NA	VOCs; AECs; B/Ns; Pest; PCBs; metals; dioxins	DNOP(4.9); As(0.8[J]); Be(7[J]); Cr(27); Cu(55); Ni(25); Sb(8.4); Se(0.8[J]); Zn(80)
085255 Lab waste pit #2	03/13/86	Soil	EPA/EPA	NA	VOCs; AECs; B/Ns; Pest; PCBs; metals; dioxins	DNOP(3.2); As(2[J]); Be(7[J]); Cr(26); Cu(58); Ni(27); Se(0.8[J]); Zn(79)

Table 3-5. Summary of ICC Environmental Sampling

Area D - Loading Dock and Lab Pit Area
Island Chemical Company
St. Croix, U.S. Virgin Islands

Sample Name	Sample Date	Matrix	Collect by/ Analyzed by	Laboratory Sample No.	Parameters Analyzed	Substances Detected[1]
VI25-S1	02/20/91	Soil	NUS/Compu -Chem	BGL	VOCs; AECs; B/Ns; Pest; PCBs; metals	-Chlordane(4J); γ-Chlordane(4.9J); Al(13,600); Ba(108); Ca(69,300); Cr(19.8J); Co(13.4); Cu(58.7); Fe(21,500); Pb(9); Mg(3,630); Mn(735); Ni(10.7J); K(2,170); V(74.7); Zn(142J)
VI25-SED2[3]	02/20/91	Soil	NUS/Compu -Chem	BGL	VOCs; AECs; B/Ns; Pest; PCBs; metals	Al(32,400); Sb(J); As(3.2J); Ba(115); Ca(74,900); Cr(16.3J); Co(23.7); Cu(60.5); Fe(35,800); Pb(7.5); Mg(10,900); Mn(1,320); Ni(13.8J); K(1,400); Na(1,040J); V(62.1); Zn(73.5J)
VI25-SED4[3]	02/20/91	Soil	NUS/Compu -Chem	BGL	VOCs; AECs; B/Ns; Pest; PCBs; metals	Al(33,600); As(3.6J); Ba(122); Ca(82,100); Cr(16.8J); Co(25.4); Cu(64.8); Fe(38,840); Pb(7.8); Mg(11,800); Mn(1,430); Ni(15.2J); K(1,600); Na(1,750J); V(64.8); Zn(79.9J)

Notes:

1 Reported concentrations in parentheses, presented in parts per million (ppm). See Table 3-9 for list of chemical abbreviations.
2 Laboratory reported fluorethyne "possibly from plastic bag"
3 Duplicate samples
B Substance present in blank
J Estimated concentration
T Tentatively identified compound
B/Ns Base/neutral extractable compounds
AECs Acid extractable compounds
PCBs Polychlorinated biphenyls
Pest Pesticides
VOCs Volatile organic compounds

301857

Table 3-6. Summary of Environmental Sampling
Area E - Soil Beneath Concrete Pad Near ASTs
Island Chemical Company
St. Croix, U.S. Virgin Islands

Sample Name	Sample Date	Matrix	Collect by/ Analyzed by	Parameters Analyzed	Substances Detected[1]
S4-1	ca. 09/17/84	Soil	ESI/Berlex	Toluene; pyridine; QG; QS	None detected
S4-2	ca. 09/17/84	Soil	ESI/Berlex	Toluene; pyridine; QG; QS	None detected
S4-3	ca. 09/17/84	Soil	ESI/Berlex	Toluene; pyridine; QG; QS	None detected
S4-4	ca. 09/17/84	Soil	ESI/Berlex	Toluene; pyridine; QG; QS	None detected
S4-Surface	ca. 09/17/84	Soil	ESI/Berlex	Toluene; pyridine; QG; QS	None detected

Notes:

1 Reported concentrations in parentheses, presented in parts per million (ppm). See Table 3-0 for list of chemical abbreviations

Table 3-7. Summary of ICC Environmental Sampling

Background, River Gut and Drains
Island Chemical Company
St. Croix, U.S. Virgin Islands

Area	Sample Name	Sample Date	Matrix	Collect by/ Analyzed by	Laboratory Sample No.	Parameters Analyzed	Substances Detected[1]
Unknown	Drain Line #1	06/07/85	Soil	ESI/ICMI	42882	BTEX	Benzene(0.1); toluene(235); ethylbenzene(0.25); xylenes(0.6)
Unknown	Drain Line #2	06/07/85	Soil	ESI/ICMI	42881	VOCs	Carbon tetrachloride(10); chloroform(68); ethylbenzene(9); methylene chloride(1,240); toluene(5,800); xylenes(18[T])
Unknown	Drain Line #1	06/07/85	Soil	ESI/York	-	Toluene	Toluene(140)
Unknown	Drain Line #2	06/07/85	Soil	ESI/York	-	Toluene	Toluene(310)
Gut	G-1	02/19/86[3]	Soil	ESI/ICMI	52463	Metals; CN; phenols; VOCs	Cr(14.5); Cu(37.3); Pb(21); Zn(83.1)
Gut	G-1 Dup	02/19/86[3]	Soil	ESI/ICMI	52463	Metals; CN; phenols; VOCs	Cr(17.9); Cu(43.5); Pb(25.7); Zn(87.8)
Gut	G-2	02/19/86[3]	Soil	ESI/ICMI	52464	Metals; CN; phenols; VOCs	Cr(16.4); Cu(38.3); Pb(22); Zn(57.8)
Gut	G-3	02/19/86[3]	Soil	ESI/ICMI	52465	Metals; CN; phenols; VOCs	Cr(16.7); Cu(33.8); Pb(14.5); Zn(129)
Gut	G-4	02/19/86[3]	Soil	ESI/ICMI	52466	Metals; CN; phenols; VOCs	Cr(12); Cu(25.3); Pb(13.2); Zn(37.1)
Gut	G-5	02/19/86[3]	Soil	ESI/ICMI	52467	Metals; CN; phenols; VOCs	Cr(17.1); Cu(36.1); Pb(20.2); Zn(57.2)
Gut	G-6	02/19/86[3]	Soil	ESI/ICMI	52468	Metals; CN; phenols; VOCs	Cd(1.0); Cr(46.6); Cu(40); Pb(32.9); Zn(349)
Gut	G-7	02/19/86[3]	Soil	ESI/ICMI	52469	Metals; CN; phenols; VOCs	Cd(2.4); Cr(71.1); Cu(51.4); Pb(40.4); Zn(881)

See last page for notes

Table 3-7. Summary of ICC Environmental Sampling

Background, River Gut and Drains
Island Chemical Company
St. Croix, U.S. Virgin Islands

Area	Sample Name	Sample Date	Matrix	Collect by/ Analyzed by	Laboratory Sample No.	Parameters Analyzed	Substances Detected[1]
Gut	G-8	02/19/86[3]	Soil	ESI/ICMI	52470	Metals; CN; phenols; VOCs	Cr(20.4); Cu(32.8); Pb(19.4); Zn(76.2)
Gut	G-9	02/19/86[3]	Soil	ESI/ICMI	52471	Metals; CN; phenols; VOCs	Cr(19.8); Cu(34.9); Pb(21.4); Zn(75.7)
Gut	G-10	02/19/86[3]	Soil	ESI/ICMI	52472	Metals; CN; phenols; VOCs	Cr(30.6); Cu(62.7); Pb(16.5); Zn(86.5)
Gut	G-11	02/19/86[3]	Soil	ESI/ICMI	52473	Metals; CN; phenols; VOCs	Cr(41.1); Cu(69.7); Pb(12.8); Zn(871)
Gut	G-6G-7 Comp.	02/19/86[3]	Leachate	ESI/ICMI	54501	RCRA Metals	Ba(1.2); Pb(0.24)
Gut G-1	085251-ESI	03/13/86	Soil	ESI/ICMI	53362	VOCs; SVOs; PCBs	None detected
Gut G-2	085252-ESI	03/13/86	Soil	ESI/ICMI	53363	VOCs; SVOs: PCBs	Methylene chloride(0.015[B])
Gut G-3	085253-ESI	03/13/86	Soil	ESI/ICMI	53364	VOCs; SVOs; PCBs	Chloroform(0.0082[B]); ethylbenzene(0.0028[J]); toluene(0.0044[B])
Gut	085251 Gut Background	03/13/86	Soil	USEPA/USEPA	NA	Pest/PCBs; VOCs; SVOs; metals; dioxins	BBP(1); DNOP(17); As(2[J]); Cr(10); Cu(40); Ni(19); Se(1[J]); Zn(100)
Gut	085252 Lab waste pit seep	03/13/86	Soil	USEPA/USEPA	NA	Pest/PCBs; VOCs; SVOs; metals; dioxins	DNOP(9); As(1[J]); Be(7[J]); Cr(22); Cu(45); Ni(20[J]); Sb(10); Zn(63)
Gut	085253 Drainage pit disch.	03/13/86	Soil	USEPA/USEPA	NA	Pest/PCBs; VOCs; SVOs; metals; dioxins	Xylene(0.47); DNOP(7.7); 1,4-DCB(0.87); 1,2-DCB(2.9); naphthalene(3.1); fluorene(2.0); phenanthrene(2.4); As(0.8[J]); Be(8[J]); Cr(52); Cu(52); Pb(30[J]); Ni(32); Se(1[J]); Zn(300)

See last page for notes

Table 3-7. Summary of ICC Environmental Sampling
Background, River Gut and Drains
Island Chemical Company
St. Croix, U.S. Virgin Islands

Area	Sample Name	Sample Date	Matrix	Collect by/ Analyzed by	Laboratory Sample No.	Parameters Analyzed	Substances Detected[1]
Gut 500' Downstream	VI25-SED1	02/28/91	Sediment	USEPA/ Compu-Chem	BGL	VOCs; SVOs; Pest; PCBs; metals	Dieldrin(J); endrin(J); 4,4'-DDT(J); Al(15,700); As(J); Ba(90.3); Ca(45,600); Cr(18.7J); Co(14.7); Cu(46.4); Fe(25,700); Pb(15.1); Mg(7,600); Mn(954); Ni(10.8J); K(J); Na(J); V(82.4); Zn(53.9J)
Gut Lab Drain	VI25-SED2[4]	02/28/91	Sediment	USEPA/ Compu-Chem	BGL	VOCs; SVOs; Pest; PCBs; metals	Al(32,400); Sb(J); As(3.2J); Ba(115); Ca(74,900); Cr(16.3J); Co(23.7); Cu(60.5); Fe(35,800); Pb(7.5); Mg(10,900); Mn(1,320); Ni(13.8J); K(1,400); Na(1,640J); V(82.1); Zn(73.5J)
Gut Upstream	VI25-SED3	02/28/91	Sediment	USEPA/ Compu-Chem	BGL	VOCs; SVOs; Pest; PCBs; metals	Al(30,400); Sb(J); As(4.1J); Ba(111); Be(J); Ca(79,900); Cr(17.6J); Co(24.8); Cu(62); Fe(39,200); Pb(7.5); Mg(11,800); Mn(1,400); Ni(14.8J); K(J); Na(J); V(83.2); Zn(82.3J)
Gut Lab Drain Dup	VI25-SED4[4]	02/28/91	Sediment	USEPA/ Compu-Chem	BGL	VOCs; SVOs; Pest; PCBs; metals	Al(33,600); As(3.8J); Ba(122); Ca(82,100); Cr(16.8J); Co(25.4); Cu(64.8); Fe(38,400); Pb(7.8); Mg(11,800); Mn(1,430); Ni(15.2J); K(1,600); Na(1,750J); V(64.8); Zn(79.9J)
Central Storm Drain at Process Pit	VI25-SED5	02/28/91	Sediment	USEPA/ Compu-Chem	BGL	VOCs; SVOs; Pest; PCBs; metals	2-Butanone(0.085J); xylenes(0.086J); naphthalene(J); 2-methylnaphthalene(0.63J); acenaphthylene(J); fluorene(J); phenanthrene(J); di-n-butyl phthalate(J); fluoranthene(J); pyrene(J); butylbenzylphthalate(J); bis(2-ethyl hexyl)phthalate(2.2J); γ-BHC(J); aldrin(0.012J); heptachlor epoxide(0.0048J); endosulfan I (0.004J); dieldrin(0.0041J); 4,4'-DDT(J); methoxychlor(J); α-chlordane(0.0035J); γ-chlordane(0.0061J); Al(9,400); Sb(26.6J); As(8J); Ba(48.6); Ca(51,200); Cr(57.6J); Co(13.8); Cu(367); Fe(183,000); Pb(466); Mg(4,740); Mn(925); Ni(47.8J); K(J); Na(J); V(J); Zn(1,500J)

See last page for notes

Table 3-7. Summary of ICC Environmental Sampling

Background, River Gut and Drains
Island Chemical Company
St. Croix, U.S. Virgin Islands

Area	Sample Name	Sample Date	Matrix	Collect by/ Analyzed by	Laboratory Sample No.	Parameters Analyzed	Substances Detected[1]
Southern Storm Drain	VI25-SED6	02/28/91	Sediment	USEPA/ Compu-Chem	BGL	VOCs; SVOs; Pest; PCBs; metals	2-Butanone(0.15); xylenes(J); pyrene(J); Δ-BHC(0.0077J); aldrin(0.02J); dieldrin(0.01J); 4,4'-DDE(0.024J); endosulfan II(0.0095J); methoxychlor(J); γ-chlordane(0.016J); Al(10,600); Sb(J); As(5.5J); Ba(95.8); Cd(4.5); Ca(42,100); Cr(110J); Co(17.3); Cu(109); Fe(121,000); Pb(187); Mg(5,000); Mn(1,420); Ni(40.6J); K(J); Na(J); V(J); Zn(1,710J)
Offsite VIPA well field	VI25-S6	02/20/91	Soil	USEPA/ Compu-Chem	BGL	VOCs; SVOs; Pest; PCBs; metals	2-Butanone(0.016J); trichloroethene(0.21J); pentachlorophenol(J); Al(19,200); As(J); Ba(113); Ca(18,000); Cr(20J); Co(19.5); Cu(43.7); Fe(25,300); Pb(9.9); Mg(5,150); Mn(1,070); Ni(10.3J); K(2,500); Na(J); V(84.9); Zn(44.3J)

Notes:

1 Reported concentrations in parentheses, presented in parts per million (ppm). See Table 3-9 for list of chemical abbreviations.
2 Laboratory reported fluorethyne "possibly from plastic bag"
3 ESI report indicates these samples were collected on January 30 and 31, 1986 (ESI, 1987, p.11)
4 Samples VI25-SED2 and VI25-SED4 were duplicate samples.
B Substance reported in blank
J Estimated concentration
T Tentatively identified compound
SVO Semivolatile organic compound
BTEX: Benzene, toluene, ethylbenzene and xylenes
GW Groundwater
PCB Polychlorinated biphenyls
Pest Pesticides
VOC Volatile organic compound

Table 3-8. Summary of ICC Environmental Sampling

Water Samples
Island Chemical Company
St. Croix, U.S. Virgin Islands

Area	Sample Name	Sample Date	Collect by/ Analyzed by	Laboratory Sample No.	Parameters Analyzed	Substances Detected[1]
Well P-2	085256-ESI	03/13/86	ESI/ICMI	53367	Pest/PCBs; VOCs; AECs; B/Ns; metals; CN; phenol	As(0.007); Cr(0.002); Cu(0.007); Pb(0.005); Hg(0.0005); Se(0.019); Ag(0.004); Zn(0.022); CN(0.007); DNOP(0.0024[J])
Well P-2	On-site well	03/13/86	USEPA/ USEPA	085256	Pest/PCBs; VOCs; metals;	Chloroform(0.13); DNOP(0.0039); B2EHP(0.28); As(0.002[J]); Be(0.005[J]); Cd(0.003[J]); Cr(0.007[J]); Cu(0.008[J]); Sb(0.003[J]); Zn(0.02[J]); Hg(0.0006J)
Fairplain 6	NA	03/07/88-03/10/88	USEPA/NA	NA	NA	Chloroform(0.024)
Fairplain 9	NA	03/07/88-03/10/88	USEPA/NA	NA	NA	Chloroform(0.075 and 0.070)
VIPA 1	NA	03/07/88-03/10/88	USEPA/NA	NA	NA	Chloroform(0.0115)
VIPA 2	NA	03/07/88-03/10/88	USEPA/NA	NA	NA	Chloroform(0.0113)
Fairplain 6	NA	10/31/88-11/02/88	USEPA/NA	NA	NA	Chloroform(0.0359)
Fairplain 9	NA	10/31/88-11/02/88	USEPA/NA	NA	NA	Chloroform(0.0104 and 0.0097
Fairplain 8	NA	10/31/88-11/02/88	USEPA/NA	NA	NA	Chloroform(0.0124)
VIPA 2	NA	10/31/88-11/02/88	USEPA/NA	NA	NA	Chloroform(<0.0016)
Fairplain 6	NA	01/17/90	USEPA/NA	NA	NA	Chloroform(0.039)
Fairplain 9	NA	01/17/90	USEPA/NA	NA	NA	Chloroform(0.025)

See last page for notes

Table 3-8. Summary of ICC Environmental Sampling

Water Samples
Island Chemical Company
St. Croix, U.S. Virgin Islands

Area	Sample Name	Sample Date	Collect by/ Analyzed by	Laboratory Sample No.	Parameters Analyzed	Substances Detected[1]
Fairplain 8	NA	01/17/90	USEPA/NA	NA	NA	Chloroform(0.005)
Water Tank	NA	01/17/90	USEPA/NA	NA	NA	Chloroform(0.0239[2])
Fairplain 6	NA	06/25/90	USEPA/NA	NA	NA	Chloroform(0.011)
Fairplain 9	NA	06/25/90	USEPA/NA	NA	NA	Chloroform(0.030)
VIPA 1	NA	06/25/90	USEPA/NA	NA	NA	Chloroform(0.002[J])
VIPA 2	NA	06/25/90	USEPA/NA	NA	NA	Chloroform(<0.005)
PW-1 (south well)	VI25-GW1	02/28/91	USEPA/ Compu-Chem	BGL	VOCs; AECs; B/Ns; Pest; PCBs; metals	Chloroform(0.031); BBP([J]); Al([J]); As([J]); Ba([J]); Ca(68.8); Cu([J]); Fe(0.121); Pb(0.0031); Mg(43.5); Mn([J]); Hg(0.002); K([J]); So([J]); Na(548); V([J]); Zn([J])
Fairplain 6	VI25-GW2	02/28/91	USEPA/ Compu-Chem	BGL	VOCs; AECs; B/Ns; Pest; PCBs; metals	Chloroform(0.012); phenol([J]); B2EHP([J]); Al([J]); Ba([J]); Ca(69.9); Cu([J]); Fe([J]); Pb(0.004); Mg(46.6); Mn(0.383); K([J]); Na(363); V([J]); Zn([J])
Fairplain 6	VI25-GW3	02/28/91	USEPA/ Compu-Chem	BGL	VOCs; AECs; B/Ns; Pest; PCBs; metals	Chloroform(0.012); Al([J]); Ba([J]); Ca(74.1); Cu([J]); Fe([J]); Pb(0.0042); Mg(50.5); Mn(0.4); Hg(0.0033); K([J]); Na(374); V([J]); Zn(0.0218)
Fairplain 8	VI25-GW4	02/28/91	USEPA/ Compu-Chem	BGL	VOCs; AECs; B/Ns; Pest; PCBs; metals	Chloroform(0.012); BBP([J]); heptachlor([J]); heptachlor epoxide([J]); DDE([J]); endosulfan II([J]); endosulfan sulfate([J]); endrin ketone([J]); γchlordane([J]); Al([J]); Ba([J]); Ca(127); Cu([J]); Fe([J]); Pb(0.0039); Mg(71.6); Mn(0.0177); K([J]); Na(590); V([J]); Zn([J])
VIPA 1	VI25-GW5	02/28/91	USEPA/ Compu-Chem	BGL	VOCs; AECs; B/Ns; Pest; PCBs; metals	Chloroform([J]); 1,1,1-TCA([J]); As([J]); Ba([J]); Ca(61.3); Cu([J]); Fe([J]); Pb(0.0037); Mg(40.1); Hg(0.0012[J]); K([J]); Na(572); V(0.0503[J]); Zn([J])

See last page for notes

Table 3-8. Summary of ICC Environmental Sampling

Water Samples
Island Chemical Company
St. Croix, U.S. Virgin Islands

Area	Sample Name	Sample Date	Collect by/ Analyzed by	Laboratory Sample No.	Parameters Analyzed	Substances Detected[1]
VIPA 2	VI25-GW6	02/26/91	USEPA/ Compu-Chem	BGL	VOCs; AECs; B/Ns; Pest; PCBs; metals	Fluoranthene(0.01[J]); B2EHP([J]); Al([J]); Ba([J]); Ca(75.8); Cu([J]); Fe([J]); Pb(0.0059); Mg(58); Mn([J]); Hg(0.00072[J]); K([J]); Na(237); V([J]); Zn(0.369)

Notes:

1 Reported concentrations in parentheses, presented in parts per million (ppm). See Table 3-9 for list of chemical abbreviations.
2 Average concentration from three samples collected.
J Estimated concentration
T Tentatively identified compound
NA Not available
B/Ns Base/neutral extractable compound
AECs Acid extractable compound
PCBs Polychlorinated biphenyls
Pest Pesticides
VOCs Volatile organic compound

Table 3-9. Summary of Environmental Sampling
Chemical Abbreviations
Island Chemical Company
St. Croix, U.S. Virgin Islands

Abbreviation	Substance	Abbreviation	Substance
Ag	Silver	Hg	Mercury
As	Arsenic	K	Potassium
B2EHP	Bis(2-ethylhexyl)phthalate	Mg	Magnesium
Ba	Barium	Mn	Maganese
BBP	Butylbenzyl phthalate	Na	Sodium
Be	Beryllium	Ni	Nickel
Ca	Calcium	O&G	Oil and grease
Cd	Cadmium	Pb	Lead
CN	Cyanide	PCE	Tetrachloroethene
Cr	Chromium	QG	Quinidine gluconate
Cu	Copper	QS	Quinine sulfate
DCB	Dichlorobenzene	Sb	Antimony
DDE	4,4'-DDE	Se	Selenium
1,2-DCA	1,2-Dichloroethane	1,1,1-TCA	1,1,1-Trichloroethane
t-1,2-DCE	trans-1,2-Dichloroethene	TCE	Trichloroethene
DNBP	Di-n-butyl phthalate	Th	Thallium
DNOP	Di-n-octyl phthalate	Zn	Zinc
Fe	Iron		

Table 4-1. Potential Chemical Specific ARARs and TBCs

Island Chemical Company Site
St. Croix, U.S. Virgin Islands

Standard, Requirements Criteria or Limitation	Citation	Description	Comment
FEDERAL ARARs AND TBCs			
Safe Drinking Water Act	42 USC §§ 300h - 300h-7		
- National Primary Drinking Water Standards (Primary MCLs)	40 CFR Part 141	Establishes primary MCLs for public water systems measured at the tap based on protection of health and consideration of technical and economic feasibility.	Potentially applicable if groundwater in the vicinity of the site is used or may be used as a source of water for a public water supply system and private water supply wells.
- National Secondary Drinking Water Standards (Secondary MCLs)	40 CFR Part 143	Establishes non-enforceable secondary MCLs for public water supply systems measured at the tap relating to aesthetic qualities.	Potentially applicable if groundwater in the vicinity of the site is being used or may be used as a source of water for a public water supply system and private water supply wells.
- Maximum Contaminant Level Goals (MCLGs)	40 CFR §§ 141.50 and 141.51	Establishes non-enforceable MCLGs for public water supply systems which are entirely health-based.	CERCLA §121(d) provides that MCLGs shall be attained if relevant and appropriate. The NCP states that non-zero MCLGs should be used for remedial actions. If groundwater in the vicinity of the site is used or may be used as a source of water for a public water supply system and private water supply wells then non-zero MCLGs may be relevant and appropriate.
Federal Water Pollution Control Act as amended by the Clean Water Act	33 USC §§1251 - 1387		
- Criteria and Standards for NPDES	40 CFR Parts 122 - 125	Establishes a program for issuing, monitoring, and enforcing permits for direct discharge	Substantive requirements are potential ARARs.
- Toxic Pollutant Effluent Standards	40 CFR Part 129	Establishes pollutant effluent standards for 6 groups of toxic pollutants ...	Potentially relevant and appropriate if the remedy requires discharge of treated water to surface water.
- Water Quality Standards	40 CFR Part 50	Requires NPDES permits to include effluent limitations and requires states to promulgate water quality standards	These requirements are implemented through Virgin Islands' regulations.

Table 4-1. Potential Chemical Specific ARARs and TBCs

Island Chemical Company Site
St. Croix, U.S. Virgin Islands

Standard, Requirements Criteria or Limitation	Citation	Description	Comment
- Clean Water Act Water Quality Criteria (WQC)	Quality Criteria for Water (1986) ("Gold Book")	Non-enforceable guidelines to be used in conjunction with designated uses of stream segments to establish water quality standards	CERCLA §121 requires attainment of WQC where relevant and appropriate. However, according to EPA Guidance, the WQC are not relevant and appropriate with respect to groundwater used for drinking water supply.
Clean Air Act	42 USC §§ 7401 - 7626		
- National Ambient Air Quality Standards (NAAQS)	40 CFR Part 50	Establishes ambient air quality standards for six "criteria pollutants". (CO, Pb, NO_2, PM_{10}, O_3, SO_x)	Applicable through the State or Federal Implementation Plan.
- National Emissions Standards for Hazardous Air Pollutants (NESHAPs)	40 CFR Part 61	Establishes emissions standards for designated hazardous air pollutants from specific sources	Potential ARAR if pollutant emitted is covered by NESHAP or MACT standard
- New Source Performance Standards (NSPS)	40 CFR Part 60	Establishes performance standards for emissions from new or modified sources	Potential ARAR if the pollutant emitted and alternative developed are the same as or sufficiently similar to the pollutants and source category covered by an NSPS.
Solid Waste Disposal Act (SWDA) as amended by the Resource Conservation and Recovery Act (RCRA) and the Hazardous and Solid Waste Amendments (HSWA).	42 USC §§ 6901 - 6987		
- RCRA MCLs	40 CFR § 264.94	Establishes concentration limits for hazardous constituents in groundwater beneath regulated units (landfills, surface impoundments, waste piles, and land treatment units) that received hazardous waste after July 26, 1982.	Potentially applicable if the jurisdictional criteria are fulfilled; potentially relevant and appropriate, otherwise.
- RCRA Air Emissions Standards	40 CFR Part 264, Subparts AA and BB	Establishes air emissions standards for process vents on equipment that treat hazardous wastes that have a total organics concentration of 10 ppm (subpart AA) and for equipment leaks from equipment that treat hazardous wastes containing 10 percent or more of total organics (Subpart BB)	Potentially applicable if the jurisdictional criteria are fulfilled; potentially relevant and appropriate, otherwise.

Table 4-1. Potential Chemical Specific ARARs and TBCs

Island Chemical Company Site
St. Croix, U.S. Virgin Islands

Standard, Requirements Criteria or Limitation	Citation	Description	Comment
- Proposed RCRA Air Emission Standards	56 Fed.Reg. 33490 (July 22, 1991)	Proposes organic air emission standards for tanks, surface impoundments, and containers	Proposed RCRA air emission standards will be considered.
- Proposed RCRA Action Levels (ALs)	55 Fed.Reg. 30798 (July 27, 1990)	Proposes health-based screening levels for air, water, and soil, used to determine whether corrective action is necessary for solid waste management units	RCRA ALs will be considered.
- Proposed RCRA Performance Standards (PSs)	55 Fed. Reg. 30798 (July 27, 1993)	Proposed PSs are concentrations for establishing media protection standards for carcinogens	RCRA PSs will be considered.
U.S. VIRGIN ISLANDS ARARs*			
Virgin Islands Safe Drinking Water Act (VI SDWA)	Virgin Island Code Annotated Title 19, Sections 1301--1310 (V.I. Code Ann. tit. 19, §§ 1301--1310)	Provides for the establishment of interim primary drinking water standards.	Interim primary drinking water standards promulgated under the V.I. SDWA are potential ARARs if more stringent than the federal primary MCLs.
Virgin Islands Water Pollution Control Act	V.I. Code Ann. tit. 12, §§ 181-198	Provides for the establishment of water quality standards for surface and groundwaters.	V.I. Water Quality Standards are potential ARARs as cleanup standards or if the alternative developed involves discharges to surface or groundwaters.
Virgin Islands Air Pollution Control Act	V.I. Code Ann. tit. 12, §§ 201--217	Provides for the establishment of limitations of the levels, concentrations or quantities of emissions of various air contaminants. Prohibits the emission of obnoxious, pungent, odorous, or ill-smelling gases, fumes, or other air pollutants	V.I. emission limitations and odor prohibitions are potential ARARs if the alternative developed involves air emissions.

* Potential ARARs are based upon Virgin Islands Code Annotated (1993). Current regulations are not readily available.

Table 4-2. Potential Action-Specific ARARs

Island Chemical Company Site
St. Croix, U.S. Virgin Islands

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
FEDERAL ARARs			
Safe Drinking Water Act	42 USC §§ 300h-300h-7		
- Underground Injection Control Regulations	40 CFR Parts 144 to 147	Establishes procedural and permitting standards for construction and operation of injection wells in order to protect underground sources of drinking water	Substantive requirements are potentially applicable if reinjection wells are used for discharge of treated water.
Federal Water Pollution Control Act as amended by the Clean Water Act (CWA)	33 U.S.C. §§ 1251-1387		
- National Pollutant Discharge Elimination System (NPDES) Criteria Standards	40 C.F.R. Parts 122-125	Requires permits for the discharge of pollutants from any point source into waters of the United States, including territorial seas.	Substantive requirements are potentially applicable if remedial activities involve onsite discharges to surface and marine waters.
- Toxic Pollutant Effluent Standards	40 C.F.R. Part 129	Establishes effluent limitations, standards and prohibitions for certain toxic pollutants: aldrin/dieldrin, endrin, toxaphene, benzidine, PCBs, and DDT.	Potentially applicable if remedial activities involve discharges of toxic pollutants to onsite surface waters.
- Best Management Practices (BMPs) for Toxic Pollutants	40 C.F.R. Part 125, Subpart K	Establishes BMPs for ancillary industrial activities such as, loading and unloading operations, plant site runoff, and sludge and waste disposal areas.	Remedial actions are not industrial activities and so the BMPs are not applicable. BMPs are potentially relevant and appropriate if toxic pollutants will be discharged to onsite surface waters.
- Stormwater Requirements	40 C.F.R. § 122.26	Establishes permitting requirements for point source discharges of stormwater associated with industrial activities to waters of the United States. Includes requirements for a BMP plan. General permits may contain additional requirements.	CERCLA remedial activities would not be considered a discharge associated with industrial activity so the substantive stormwater requirements would not be considered applicable. However, they are potentially relevant and appropriate if there is an onsite point source discharge of stormwater.
- Monitoring	40 C.F.R. § 122.41, and §§ 136.1-136.4	Establishes discharge monitoring parameters, analytical procedures, and quality control requirements.	Potential ARAR if there are point source discharges to onsite waters.

Table 4-2. Potential Action-Specific ARARs

Island Chemical Company Site
St. Croix, U.S. Virgin Islands

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Clean Water Act § 404 Rivers and Harbors Act of 1899	33 U.S.C § 1344 33 U.S.C. § 403		
- Dredge and Fill Permits	40 CFR Parts 230 and 231 33 CFR Parts 320 - 330	Establishes conditions for discharge of dredge and fill materials to waters of the U.S. or ocean waters.	Substantive requirements are potential ARARs if the alternative developed involves discharge of dredge and fill material into waters of the U.S. (including wetlands and ocean waters).
- Guidelines for the Land Disposal of Solid Wastes	40 C.F.R. Part 241	Establishes requirements and procedures for land disposal of all solid wastes except hazardous, agricultural, and mining wastes.	The guidelines are potential ARARs if solid wastes will be land disposed.
- Identification and Listing of Hazardous Wastes	40 C.F.R. Part 261	Defines solid wastes which are subject to regulation as hazardous wastes.	
- Standards Applicable to Generation of Hazardous Waste	40 C.F.R. Part 262	Establishes standards for generators of hazardous waste.	Substantive requirements are potential ARARs if hazardous wastes or substantially similar wastes are generated as a result of investigative and remedial activities.
- Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 C.F.R. Part 264	Establishes minimum standards which define the acceptable management of hazardous waste for owners and operators of facilities which treat, store, or dispose of hazardous waste.	
• General Facility Standards	Subpart B	Establishes general operating standards, including security requirements, inspection standards, and personnel training.	Potential ARAR for onsite treatment, storage, or disposal of hazardous wastes or sufficiently similar wastes.
• Preparedness and Prevention	Subpart C	Establishes preparedness and prevention standards for a facility with respect to design, construction, maintenance, and operation to minimize unplanned releases.	Potential ARAR for onsite treatment, storage, or disposal of hazardous wastes or sufficiently similar wastes.
• Contingency Plan and Emergency Procedures	Subpart D	Establishes contingency and emergency response provisions to follow in the event of an unplanned release.	Potential ARAR for onsite treatment, storage, or disposal of hazardous wastes or sufficiently similar wastes.

Table 4-2. Potential Action-Specific ARARs

Island Chemical Company Site
St. Croix, U.S. Virgin Islands

	Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
•	*Manifest System*, Recordkeeping, and Reporting	Subpart E	Establishes *recordkeeping and reporting* requirements for hazardous waste manifests.	*Administrative procedures only. Creates no substantive cleanup requirement.*
•	Water Quality Monitoring and Response Programs from Solid Waste Management Units	Subpart F	Establishes provisions for monitoring and response programs for releases from solid waste management units and regulated units.	Potential ARAR if hazardous waste or substantially similar waste is treated, stored, or disposed of onsite.
•	Closure and Post-Closure	Subpart G	Establishes closure and post-closure requirements.	Potential ARAR if regulated units remain onsite.
•	Financial Requirements	Subpart H	Establishes financial assurance requirements during closure and post-closure periods.	Not applicable or relevant and appropriate because creates no substantive cleanup requirement.
•	Use and Management of Containers	Subpart I	Establishes design, operating, and procedural standards for containers.	Potential ARAR if an alternative developed would involve storage of hazardous wastes or substantially similar wastes in containers.
•	Tank Systems	Subpart J	Establishes design, operating, and procedural standards for tank systems.	Potential ARAR if an alternative developed would involve use of tanks to treat or store hazardous wastes or substantially similar wastes.
•	Surface Impoundments	Subpart K	Establishes design, operating, and procedural standards for surface impoundments.	Potential ARAR if an alternative developed involves treatment or storage of hazardous wastes or substantially similar wastes in a surface impoundment.
•	Waste Piles	Subpart L	Establishes design, operating, and procedural standards for waste piles.	Potential ARAR if an alternative developed would involve treatment or storage of hazardous wastes or substantially similar materials in piles.
•	Land Treatment	Subpart M	Establishes design, operating, and procedural standards for land treatment units.	Potential ARAR if an alternative developed would involve treatment or storage in a land treatment unit of hazardous wastes or substantially similar wastes.
•	Landfills	Subpart N	Establishes design, operating, and procedural standards for landfills.	Potential ARAR if an alternative developed would involve disposal of hazardous wastes or substantially similar wastes in a landfill.

Table 4-2. Potential Action-Specific ARARs

Island Chemical Company Site
St. Croix, U.S. Virgin Islands

	Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
•	Incinerators	Subpart O	Establishes design, operating, and procedural standards for incinerators.	Potential ARAR if an alternative developed would involve incineration of hazardous wastes or substantially similar wastes.
•	Corrective Action Management Units (CAMUs) and Temporary Units (TUs)	Subpart S	Allows use of CAMUs for disposal of hazardous wastes without triggering LDRs or MTRs. Allows alternate design operating and closure standards for temporary tank and container storage areas of hazardous wastes.	Potential ARAR if hazardous waste must be land disposed or stored temporarily in tanks or containers for greater than 90 days.
•	Miscellaneous Units	Subpart X	Establishes design, operating, and procedural standards for other types of TSD units.	Potentially applicable if hazardous waste or substantially similar waste is treated, stored, or disposed at miscellaneous units.
•	Process Vents and Equipment Leaks	Subparts AA and BB	Establishes air emission standards for process vents on equipment that treat hazardous wastes that have a total of 10 ppm (Subpart AA) and for equipment leaks from equipment that treat hazardous wastes containing 10 percent or more of total organics (Subpart BB).	Potential ARAR if air emissions result from treatment alternative.
•	Containment Buildings	Subpart DD	Establishes design, operating and procedural standards for containment buildings.	Potential ARAR if alternative developed involves use of a containment building for the storage or treatment of hazardous waste or substantially similar waste.
•	Liners and Leak Detection for Hazardous Waste Disposal Units	57 Fed.Reg. 3462 (January 29, 1992)	Establishes design criteria for liners and leak detection and action leakage rates for surface impoundments and landfills. Requires a construction quality assurance (CQA) plan for surface impoundments, landfills, and wastepiles.	Potential ARAR if treatment alternative involves a surface impoundment or landfill.

Table 4-2. Potential Action-Specific ARARs

Island Chemical Company Site
St. Croix, U.S. Virgin Islands

	Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
-	Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 C.F.R. Part 265	Establishes minimum interim status standards that define the acceptable management of hazardous waste during the period of interim status and until certification of final closure, or if the facility is subject to postclosure requirements, until postclosure responsibilities are fulfilled.	Except as noted below, the more stringent part 264 standards represent the ultimate RCRA compliance standards and are consistent with CERCLA's goal of long-term protection of public health and welfare and the environment. The federal regulations provide interim status standards for thermal treatment and chemical, physical and biological treatment, but not standards for such treatment methods for permitted facilities.
•	Thermal Treatment	40 C.F.R. Part 265, Subpart P	Establishes general operating and procedural requirements for thermal treatment other than incineration.	Potential ARAR if an alternative developed would utilize thermal treatment of hazardous wastes or substantially similar wastes.
•	Chemical, Physical, and Biological Treatment	40 C.F.R. Part 265, Subpart Q	Establishes general operating and procedural requirements for units which treat hazardous wastes by chemical, physical, or biological methods in other than tanks, surface impoundments, and land treatment facilities.	Potential ARAR if an alternative developed would utilize chemical, physical, and biological treatment of hazardous wastes or substantially similar wastes.
-	Underground Storage Tanks (UST)	40 C.F.R. Part 280	Establishes standards for design, construction, installation, operations, maintenance, release detection, free product removal, closure and corrective action.	Substantive requirements are potentially applicable if USTs are present or remedial activities involve the use of USTs.
-	Land Disposal Restrictions (LDR)	40 C.F.R. Part 268, 57 Fed. Reg. 37194 (Aug. 8, 1992).	Establishes prohibitions on land disposal unless treatment standards are met.	Potentially applicable if hazardous wastes are land disposed on-site.
Clean Air Act (CAA)		42 U.S.C. §§ 7401-7642		
-	National Ambient Air Quality Standards (NAAQS)	40 C.F.R. Part 50	Establishes ambient air quality standards for six "criteria pollutants" (CO, Pb, NO_2, PM_{10}, O_3, SO_x)	Potentially applicable through the State or Federal Implementation Plan.
-	New Source Review/Prevention of Significant Deterioration (NRS/PSD)		Establishes control technology and monitoring requirements for attainment and non-attainment areas for major new sources.	Potential ARAR if alternative developed emits a criteria pollutant and constitutes a major source.

Table 4-2. Potential Action-Specific ARARs

Island Chemical Company Site
St. Croix, U.S. Virgin Islands

	Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
-	Standards of Performance for New Stationary Sources (NSPS)	40 C.F.R. Part 60	Sets NSPS for emissions from new or modified sources.	Potential ARAR if the pollutant emitted and alternative developed are the same as or sufficiently similar to the pollutants and source category regulated by an NSPS.
-	National Emission Standards for Hazardous Air Pollutants (NESHAPs)	40 C.F.R. Part 61	Sets NESHAPs for designated hazardous pollutants from specific sources.	Potential ARAR if hazardous air pollutants will be emitted as part of the remedial activities.
U.S. VIRGIN ISLANDS ARARs*				
Virgin Islands Water Pollution Control Act		V.I. Code Ann. tit. 12, Chapter 7	Provides for the establishment of requirements for the protection of surface and groundwaters.	Potential ARAR if alternatives developed involves discharge to surface or groundwaters.
Virgin Islands Well Driller Requirements		V.I. Code Ann. tit. 12, § 157	Requires well drillers to obtain a license and for all non-private wells to be drilled by a licensed driller.	All monitoring and extraction wells will be drilled by a licensed well driller.
Virgin Islands Requirements for Sealing Wells		V.I. Code Ann. tit. 12, § 161	Requires effective sealing of well if highly mineralized water is encountered or well is abandoned.	All abandoned monitoring and extraction wells will be effectively sealed as well as any wells encountering highly mineralized water.
Virgin Islands Solid and Hazardous Waste Management Act		V.I. Code Ann. tit. 19, Part IV, Chapter 56	Provides for the establishment of regulations for the storage, collection and transportation, disposal resource recovery of solid and hazardous waste.	Regulations are potential ARARs if alternatives developed involve the treatment, storage or disposal of solid or hazardous wastes.

* Potential ARARs are based upon Virgin Islands Code Annotated (1993). Current regulations are not readily available.

301875

Table 4-3. Potential Location Specific ARARs

Island Chemical Company
St. Croix, U.S. Virgin Islands

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
FEDERAL ARARs			
Solid Waste Disposal Act (SWDA) as amended by the Resource Conservation and Recovery Act (RCRA) and the Hazardous and Solid Waste Amendments (HSWA)	42 USC §§ 6901-6992		
• Location Standards	40 CFR § 264.18	Siting is restricted in vicinity of recent faulting. Special procedures are required for facilities located within a 100-year floodplain. Placement of non-containerized liquid hazardous waste in a salt-dome, salt bed, underground mine or cave is prohibited.	Potentially applicable if in the vicinity of recent faulting or in a floodplain.
National Historic Preservation Act (NHPA)	16 U.S.C. § 470		
	40 CFR § 6.301(b) 36 CFR Part 800	For properties listed on the National Register of Historic Places, or eligible for such listing, requires that impacts on cultural resources be avoided. Where impacts are unavoidable, mitigation through design and data recovery is required.	Potentially applicable if portions of the Study Area are listed on the National Register of Historic places or are eligible for such listing.
Archaeological and Historic Preservation Act	16 U.S.C. § 469 40 CFR § 6.301(c) 48 Fed. Reg. 44716 (September 29, 1983)	Requires actions to recover and preserve artifacts if alteration of terrain threatens significant scientific, prehistorical, historical, or archeological data.	Potentially applicable if significant scientific, prehistorical, historical or archeological data are present at the Study Area.
Fish and Wildlife Coordination Act	16 U.S.C. §§ 661-666C		
	40 CFR § 6.302(g)	Requires actions to be taken to protect fish and wildlife that may be impacted by a diversion, channeling, or other activities to modify a river or stream.	

301876

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Endangered Species Act	16 U.S.C. §§ 1531 - 1544		
	40 CFR § 6.302(h) 50 CFR Part 402	Requires action to conserve endangered species and critical habitats upon which endangered species depend, includes consultation with Department of Interior.	Potentially applicable if endangered species are present at the Study Area.
Clean Water Act § 404	33 USC § 1344		
Rivers and Harbors Act of 1899	33 USC § 403		
• Dredge and Fill Permits	40 CFR Parts 230 and 231 33 CFR Parts 320-330	Prohibits discharge of dredge and fill material into navigable waters (including wetlands) of the United States without a permit.	Substantive requirements are potential ARARs if the alternative developed involves discharge of dredge and fill materials into the waters of the U.S. (including wetlands and ocean waters)
Executive Order on Protection of Wetlands	Exec. Order No. 11,000 40 CFR § 6.302(a) & Appendix A	Requires action to avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid new construction in wetlands if a practicable alternative exists.	Potentially applicable if wetlands are located within the site.
Executive Order on Floodplain Management	Exec. Order No. 11,088 40 CFR § 6.302(b) and Appendix A	Requires evaluation of the potential effect of actions taken in a floodplain and requires avoidance of the adverse impacts associated with direct and indirect development of a floodplain.	Potentially applicable if the site is in a flood plain.
National Wildlife Refuges	16 U.S.C. § 668dd		
	50 CFR Part 27	Restricts activities within a National Wildlife Refuge.	Potentially applicable if portions of the site are within a designated National Wildlife Refuge.

Table 4-3. Potential Location Specific ARARs
Island Chemical Company
St. Croix, U.S. Virgin Islands

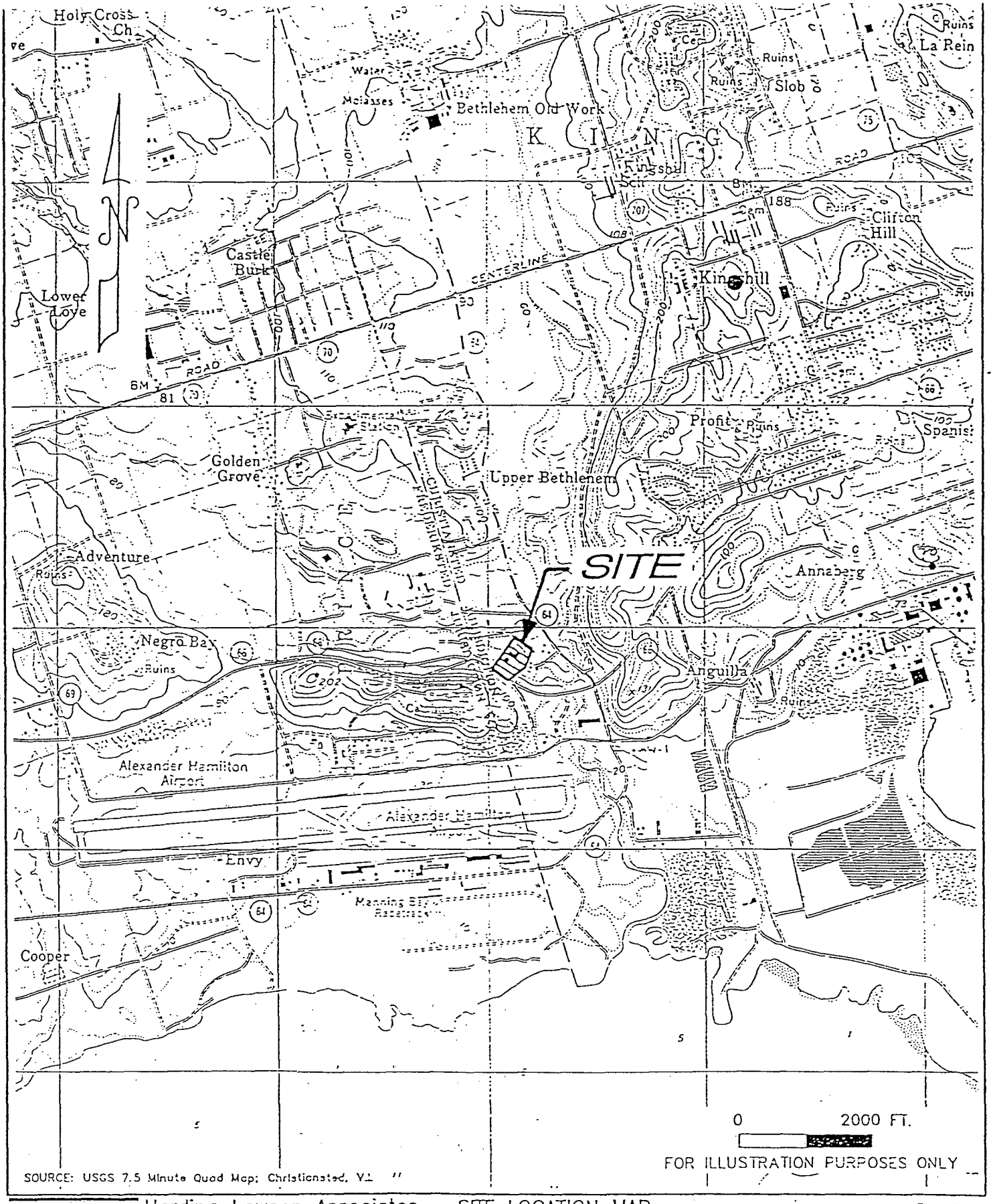
Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Wild and Scenic Rivers Act	16 U.S.C. §§ 1271 - 1287		
	40 CFR § 6.302(e) 36 CFR § 297.4	Prohibits any project that would directly or indirectly impact any river designated in U.S.C. § 127(a) without notifying DOI or the Forest Service	Potentially applicable if rivers in the site, if any, are designated as "wild and scenic or recreational."
Coastal Zone Management Act	16 U.S.C. § 1451, et.seq.	Requires conduct of activities in a manner consistent with approved state management programs for activities affecting the coastal zone and adjacent shorelands.	Potentially applicable if the site or remedial activities will affect the coastal zone.
Clean Air Act (CAA)	42 U.S.C. § 7401 - 7642		
• National Ambient Air Quality Standard (NAAQS) Attainment Area	40 CFR Part 52	Major stationary sources (i.e., those sources in the Prevention of Significant Deterioration (PSD) program with a potential to emit 250 tons per year (TPY) or more of a regulated pollutant unless the site contains sources identified in 40 C.F.R. § 52.21) in which case the threshold is 100 TPY, shall apply best available control technology (BACT) for each regulated pollutant.	Potentially applicable if remedial activities create emissions of 100/250 TPY in an attainment area.
• NAAQS Non-Attainment Area	CAA § 173	Any stationary facility emitting 100 TPY or more must obtain emissions offsets, apply lowest achievable emission rate (LAER), and all major stationary sources owned or operated by the person in the state must be in compliance or on a schedule for compliance with all applicable emission standards.	Potentially applicable if remedial activities create emissions of 100 TPY or more in a non-attainment area.
St. Croix, U.S. Virgin Islands			
Virgin Islands Conservation and Preservation of Historic and Cultural Assets Act	V.I. Code Annotated Title 12 Chapter 3, Subchapter III	Prohibits construction and demolintion within any Historic and Architectural Control District without approval by the V.I. Historic Preservation Commission.	Substantive portions of the V.I. Conservation and Preservation of Historic and Cultural Assets Act and potential ARARs if portions of the site are listed in the V.I. Registry of Historic Buildings, Sites and Places.

Table 4-3. Potential Location Specific ARARs
Island Chemical Company
St. Croix, U.S. Virgin Islands

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comment
Virgin Islands Protection of Indigenous, Endangered, and Threatened Fish, Wildlife, and Plants Act	V.I. Code Annotated Title 12, Chapter 2	Prohibits the injury, harassment, or killing of indigenous, endangered, or threatened species. Prohibits the disruption of mangrove growth and nests of any indigenous or endangered species (including all sea birds).	Potential ARAR if alternatives developed could have the prohibited impacts on indigenous, threatened or endangered species listed by the V.I. Endangered Species Preservation Commission.
Virgin Islands Statute Pertaining to Trees and Vegetation Adjacent to Watercourses	V.I. Code Annotated Title 12, Chapter 3	Prohibits the cutting or injury of any tree or vegetation within 30 feet of the center of any watercourse or 25 feet of the edge.	Potential ARAR if alternative developed involves the cutting or injury of any tree or vegetation near a watercourse.
Virgin Islands Coastal Zone Management Act.	V.I. Code Annotated Title 12, Chapter 21	Requires a coastal zone permit for any development (including dredge and fill) in the coastal zone (all territorial lands and waters specified on approved maps).	Substantive requirements are potential ARARs for any remedial activities occurring within a defined coastal zone.

* Potential ARARs are based upon Virgin Island Code Annotated (1993). Current regulations are not readily available

Figures



SOURCE: USGS 7.5 Minute Quad Map; Christiansted, V.I.

Harding Lawson Associates
Engineering and
Environmental Services
131 North Third Street
Philadelphia, PA 19106
215-627-4505

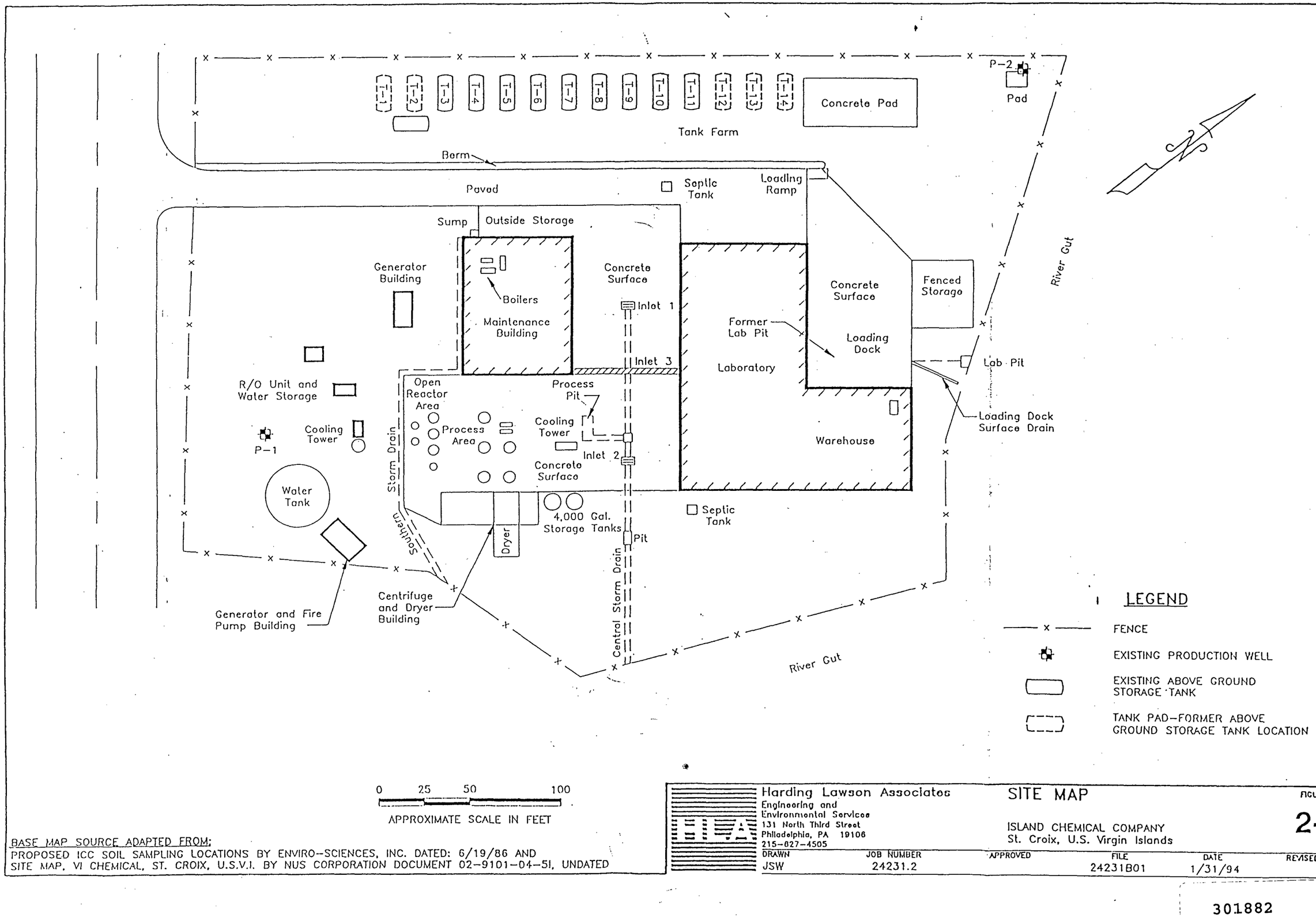
SITE LOCATION MAP

ISLAND CHEMICAL COMPANY
St. Croix, U.S. Virgin Islands

FIGURE
2-1

DRAWN	JOB NUMBER	APPROVED	FILE	DATE	REVISED DATE
JSW	24231.2		24231A01	8/25/93	

301881



BASE MAP SOURCE ADAPTED FROM:
PROPOSED ICC SOIL SAMPLING LOCATIONS BY ENVIRO-SCIENCES, INC. DATED: 6/19/86 AND SITE MAP, VI CHEMICAL, ST. CROIX, U.S.V.I. BY NUS CORPORATION DOCUMENT 02-9101-04-51, UNDATED

Harding Lawson Associates
Engineering and Environmental Services
131 North Third Street
Philadelphia, PA 19106
215-627-4505

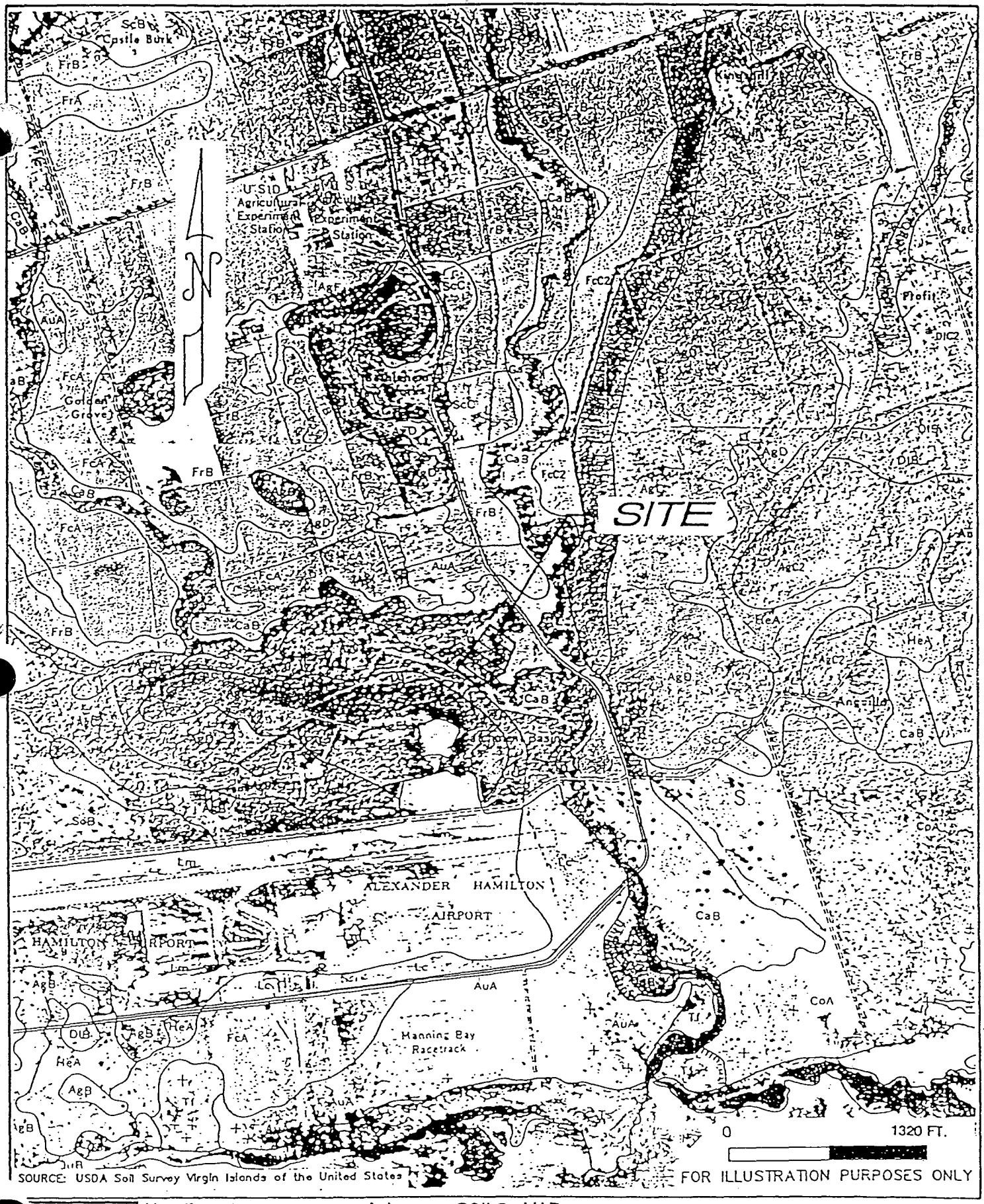
SITE MAP

ISLAND CHEMICAL COMPANY
St. Croix, U.S. Virgin Islands

FIGURE 2-2

DRAWN	JOB NUMBER	APPROVED	FILE	DATE	REVISED DATE
JSW	24231.2		24231B01	1/31/94	

301882



SOURCE: USDA Soil Survey Virgin Islands of the United States

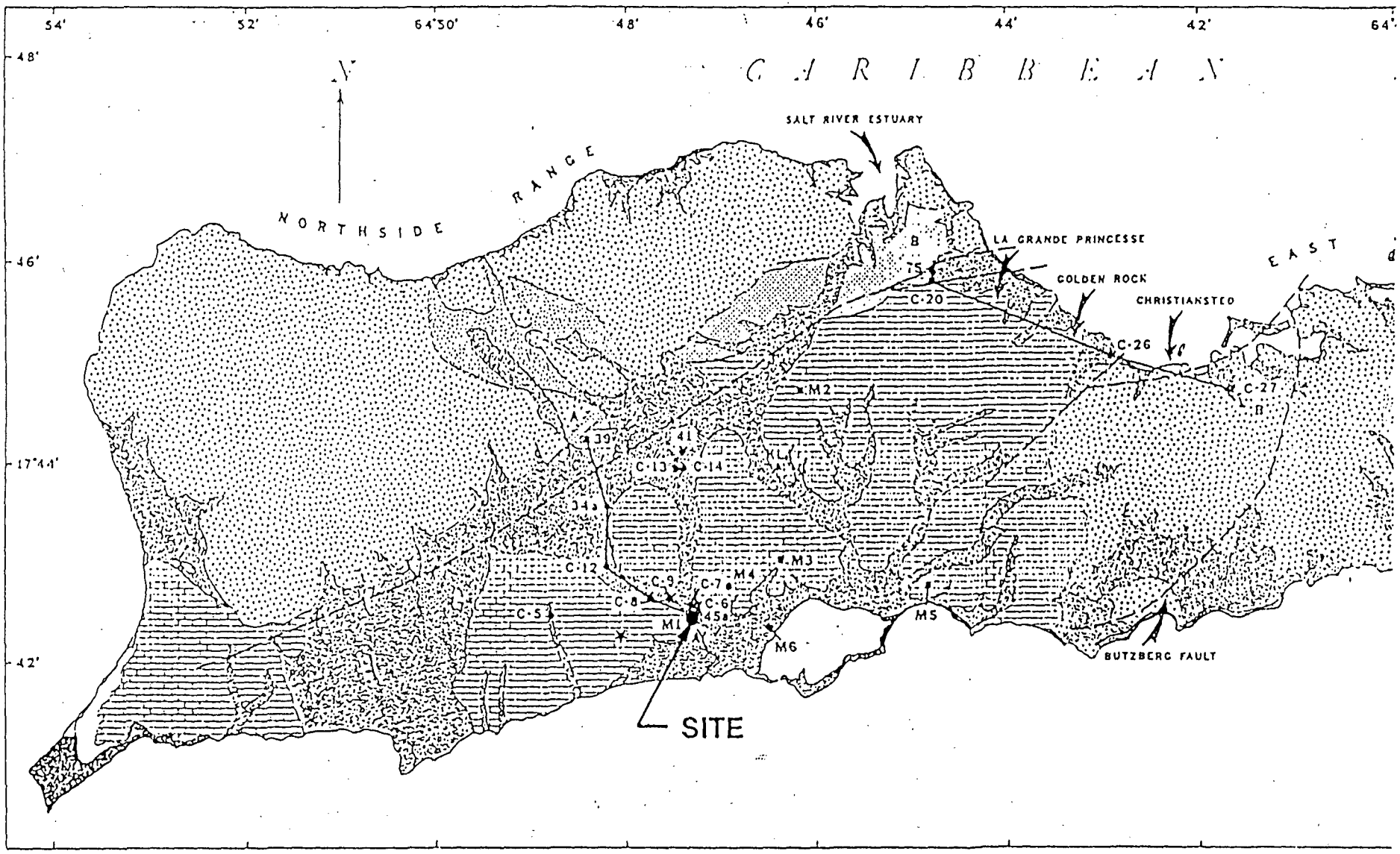
Harding Lawson Associates
Engineering and Environmental Services
131 North Third Street
Philadelphia, PA 19106
215-627-4505

SOILS MAP

ISLAND CHEMICAL COMPANY
ST. CROIX, U.S VIRGIN ISLAND

FIGURE 2-3

DRAWN	JOB NUMBER	APPROVED	FILE	DATE	REVISED DATE
JSW	24231.2		S-BASE	1/31/94	



SOURCE: LIDZ, B. H. 1988

Harding Lawson Associates
Engineering and
Environmental Services
131 North Third Street
Philadelphia, PA 19106
215-627-4505

GENERALIZED GEOLOGIC MAP
OF ST. CROIX

ISLAND CHEMICAL COMPANY
ST. CROIX, U.S. VIRGIN ISLANDS

FIGURE
2-4

DRAWN	JOB NUMBER	APPROVED	FILE	DATE	REVISED DATE
HLB	24231.2.C.1		24231A02	8/31/93	

SOURCES: USGS 7.5 Minute Quad Map: Christiansted & Frederiksted, V.I. and Geraghty & Miller, 1983 and Torres-Gonzales, 1990

Harding Lawson Associates
Engineering and
Environmental Services
131 North Third Street
Philadelphia, PA 19106
215-627-4505

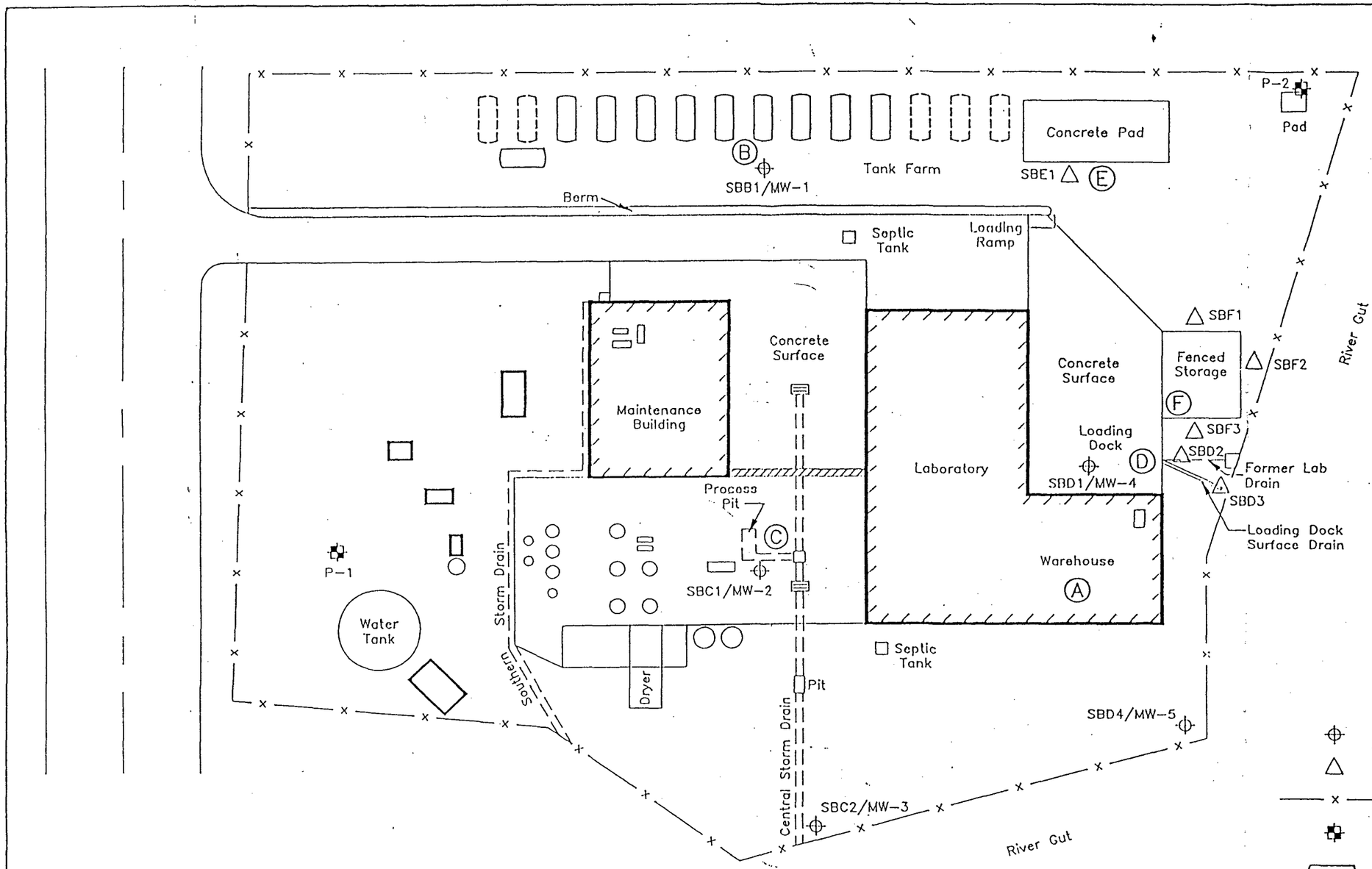
APPROXIMATE LOCATIONS OF NEARBY WELLS

ISLAND CHEMICAL COMPANY
ST. CROIX, U.S VIRGIN ISLAND

FIGURE
2-5

DRAWN	JOB NUMBER	APPROVED	FILE	DATE	REVISED DATE
JSW	24231.2		S-BASE	1/31/94	

301885



AREAS OF CONCERN

A	LABORATORY AND WAREHOUSE BUILDING
B	ABOVE-GROUND TANK FARM
C	FORMER PROCESS PIT
D	LOADING DOCK AND FORMER LAB PIT & DRAIN AREA
E	SOIL BENEATH CONCRETE PAD
F	CONCRETE STORAGE PAD

LEGEND

- PROPOSED MONITORING WELL LOCATIO
- PROPOSED SOIL BORING LOCATION
- FENCE
- EXISTING PRODUCTION WELL
- EXISTING ABOVE GROUND STORAGE TANK
- TANK PAD-FORMER ABOVE GROUND STORAGE TANK LOCATION

0 25 50 100

APPROXIMATE SCALE IN FEET

BASE MAP SOURCE ADAPTED FROM:
PROPOSED ICC SOIL SAMPLING LOCATIONS BY ENVIRO-SCIENCES, INC. DATED: 6/19/86 AND SITE MAP, VI CHEMICAL, ST. CROIX, U.S.V.I. BY NUS CORPORATION DOCUMENT 02-9101-04-51, UNDATED

Harding Lawson Associates
Engineering and Environmental Services
131 North Third Street
Philadelphia, PA 19106
215-627-4505

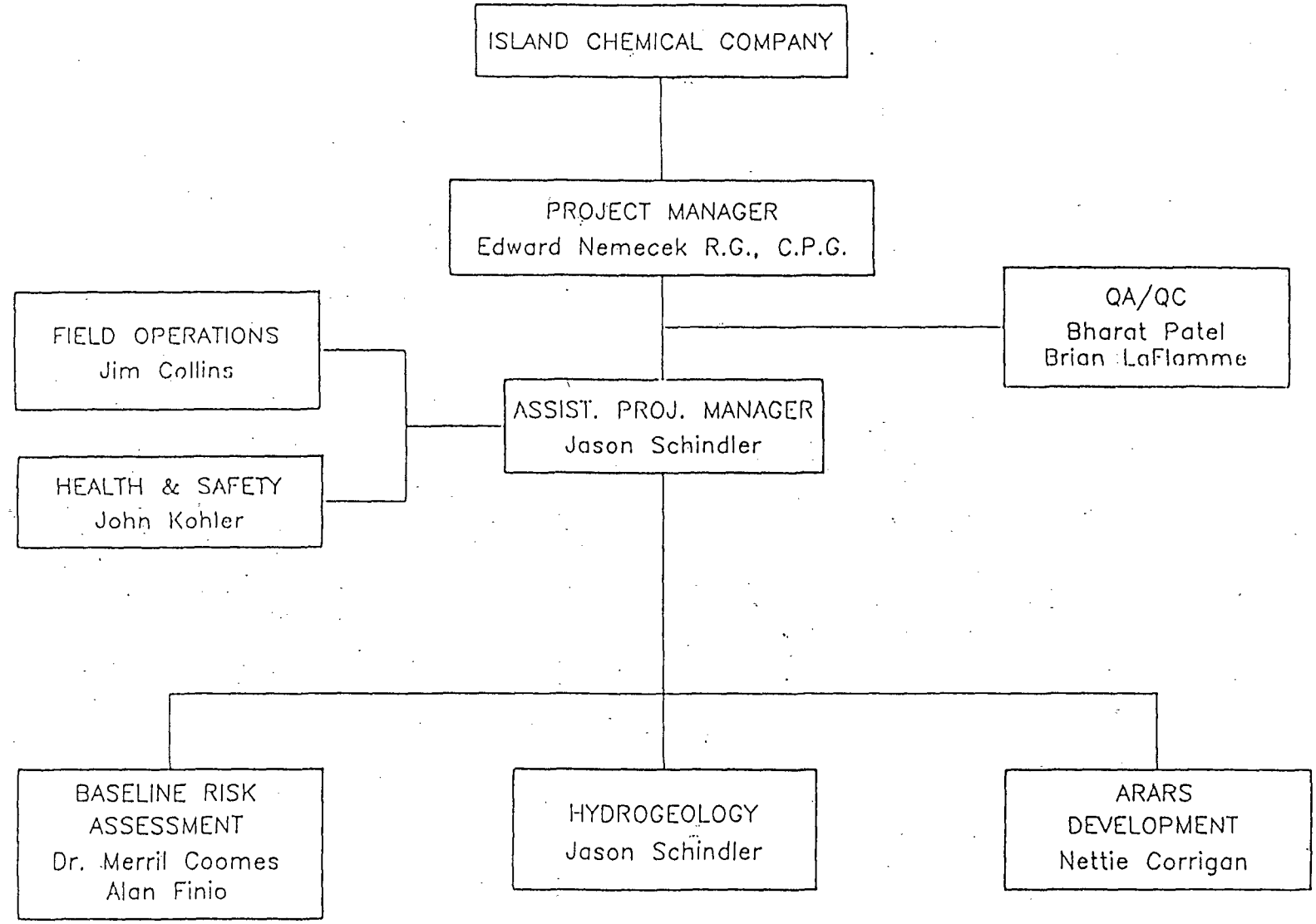
AREAS OF CONCERN

ISLAND CHEMICAL COMPANY
St. Croix, U.S. Virgin Islands

FIGURE 3-

DRAWN	JOB NUMBER	APPROVED	FILE	DATE	REVISED D
JSW	24231.2		24231B01	1/31/94	

301886



Harding Lawson Associates
Engineering and Environmental Services
131 North Third Street,
Philadelphia, PA 19106
215-627-4505

PROJECT ORGANIZATION

ISLAND CHEMICAL COMPANY
ST. CROIX, U.S. VIRGIN ISLANDS

FIGURE 7-1

DRAWN	JOB NUMBER	APPROVED	FILE	DATE	REVISED DATE
JSW	24231.2.C.I		24231A01	2/14/94	8/4/94

Task Name	
Effective Date of ACO	09/30/94
Access and Preparation for Field Work	10/31/94
ollect Potable Water Sample	11/07/94
Laboratory Analysis of Potable Water	11/30/94
a Validation (Potable Water Sample)	12/31/94
EPA Review of Potable Water Results	12/31/94
Project Planning and Management	
EPA Kickoff Meeting	10/13/94
Monthly Progress Reports	
Background Investigation	01/03/95
Permitting	12/01/94
Site Clearing/Reconnaissance	01/10/95
Field Sampling Program	
Soil Boring Program	
Lab Analysis of Soil Samples	
Well Installation/Rehabilitation	01/30/95
Well Equilibration	02/07/95
Well Survey	
Continuous Water Level Monitoring	
Quarterly GW Sampling and Analysis	
Data Validation	
Data Evaluation	
Develop/Track ARARs	
Data Summary Report (DSR)	08/09/95
Pathways Analysis Report (PAR) & Phase I Baseline Risk Assessment Summary	08/09/95
EPA Review of DSR	08/30/95
EPA Review of PAR and Baseline Risk Assessment Summary	08/30/95
resentation of DSR/PAR/Risk Assessment Summary to EPA and VIDPNR	08/23/95
Revised PAR and Risk Assessment Summary to EPA	09/21/95
Phase II Risk Assessment (if necessary)	01/22/96
EPA Review of Phase II Baseline Risk Assessment Summary	02/12/96
Revised Phase II Risk Assessment to EPA	03/05/96
Begin Phase III Baseline Risk Assessment (if necessary)	03/05/96
RI Report (assumes no further investigation or Phase II Risk Assess.)	11/27/95
Remedial Action Objectives and Screening of Alternatives	11/27/95
EPA Review of RI Report	12/11/95
EPA Review of RAO/SOA	12/18/95
Present RAO/SOA to EPA and VIDPNR	12/11/95
Revisions to RI	01/10/96
Revise RAO/SOA	01/10/96
Begin Feasibility Study, if necessary	01/10/96
Management of Investigation-Derived Waste	
Waste Sampling/Analysis	
Disposal Coordination	
Waste Removal	

Notes:
1. Schedule is based on months from approval of Consent Order and Work Plan
2. Schedule assumes final access agreements will be obtained within one month of USEPA approval. Schedule will require revisions if agreements cannot be obtained in this time frame
3. Assumes weather-related delays will not exceed [illegible] working days total.

Figure 8-1
Work Plan Implementation Schedule
Island Chemical Company
St. Croix, U.S. Virgin Islands

Revised September 19, 1994.

Appendix A
Sampling and Analysis Plan

Appendix A
Draft Sampling and Analysis Plan
Island Chemical Company Site
Remedial Investigation
St. Croix, U.S. Virgin Islands

Prepared for

Island Chemical Company, Inc.

HLA Project No. 24231 2.C.2

Jason M. Schindler
Senior Geologist

Edward A. Nemecek, R.G., C.P.G.
Principal Hydrogeologist

August 5, 1994

Harding Lawson Associates
Engineering and Environmental Services
131 North Third Street
Philadelphia, PA 19106 – (215) 627-4505

CONTENTS

LIST OF APPENDICES

A1.0 INTRODUCTION

This *Sampling and Analysis Plan* (SAP) has been prepared by Harding Lawson Associates (HLA) on behalf of Island Chemical Company, Inc. (ICC). It responds to requirements set forth in the National Contingency Plan. As requested by the U.S. Environmental Protection Agency Region II (USEPA), this SAP has been prepared as an appendix to the Remedial Investigation Work Plan (RIWP) for this site. The RIWP includes the following activities:

- Review existing data;
- Acquire access approvals and permits;
- Clear the site of vegetation and preform a reconnaissance;
- Collect surface soil samples;
- Collect subsurface soil samples;
- Repair existing wells;
- Install new monitoring wells;
- Collect groundwater samples; and
- Survey wells and borings;
- Ecological Assessment; and
- Human Health Assessment

The objectives of the aforementioned activities are presented in the RIWP.

This Draft SAP has been prepared in accordance with the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, (OSWER Directive 9355.3-01 [1988]), *A Compendium of Superfund Field Operations Methods* (OSWER Directive 9355-0-14 [December 1987]), and *EPA National Enforcement Investigation Center Policies and Procedures Manual* (EPA 330/978-001 [May 1978 revised November 1984]) and other documents noted in the References section.

A1.1 Purpose and Scope

The objectives of the SAP are to present details (including sampling, testing, and analysis protocols) necessary to guide personnel performing the tasks outlined in the RIWP. The SAP includes sample locations, methods, and procedures and a discussion of how the Plan will produce data useful for the remedial design.

The SAP was written consistent with USEPA guidance documents and recently approved SAPs for EPA Region II. The SAP describes the specific activities to be conducted under the RIWP and presents methodology for the field investigation.

A1.2 Background

Information regarding the location, setting, history and previous investigative and remedial activities is discussed Sections 2 and 3 of the RIWP and is not repeated here.**A2.0 FIELD INVESTIGATION PROGRAM**

Planned field activities are as follows:

- Acquire Access and Permits
- Site Clearing
- Site Reconnaissance
- Soil Sampling and Monitoring Well Installation
- Groundwater Groundwater Sampling
- Rehabilitating Existing Wells
- Surveying Well Locations and Elevations
- Ecological Assessment Environmental Media Sampling

These tasks will be performed sequentially. Field activities to be conducted are summarized in the following subsections by type of activity.

A2.1 Acquire Access and Permits

A2.1.1 Access

The following general procedure will be followed to obtain access to private property for the purposes of completing Remedial Investigation activities such as well installation.

1. Contact the Township of Christiansted to obtain a listing of landowners' telephone numbers and addresses.

2. Contact landowners to achieve the following:

   - Describe the Remedial Investigation program and the purpose of the requested access
   - Record the correct name, address, and telephone number of the landowner(s).

3. Perform a field check of selected locations checking for the following:
   - Physical access
   - Hydrologic access and advantages/disadvantages (i.e., avoid tops of hill and bedrock highs)
   - Adjust locations if required and where appropriate

4. Prepare a detailed information package and letter agreement that includes the name, address, and telephone numbers of the owner(s) and the map locations and legal description of the property.

5. Contact the landowner(s) to review the paperwork, and obtain and witness their signature(s) and tell the landowner(s) when work is anticipated to start.

A2.1.2 Permits

At this time, several permits have been identified which may be required to initiate or complete Remedial Investigation activities. Permits and procedures to obtain them are discussed in the Section 5.3.1 of the RIWP.

The following Remedial Investigation activities are expected to require permits and/or approvals:

- Installation of monitoring wells
- Shipment of samples to continental United States
- Disposal of water and soil generated during field activities

Throughout project implementation, planning of activities will be made with regard to permit requirements and regulatory time frames. HLA will coordinate with federal and local agencies to ensure compliance with applicable regulations and will attempt to accelerate the permitting process as specific permit requirements are identified.

A2.2 Site Clearing

The ICC site has been inactive for several years. During that time, heavy vegetation has covered much of the site. The heavy vegetation obscures much of the site and impedes access to work areas, making a detailed inspection impractical. Prior to field investigation activities, HLA will contract a local firm to clear the site of heavy vegetation. Site clearing will not include vegetation within 25 feet of the River Gut as required under the Virgin Islands Statute pertaining to trees and water courses (see RIWP).

A2.3 Site Reconnaissance

In preparing work documents, HLA conducted a preliminary review of information made available by ICC and the USEPA and performed a brief site visit. Based on this review, a more complete evaluation of existing data is required to provide a basis for further investigation and other activities, if necessary. HLA will obtain available background data for the ICC site and adjoining properties as discussed in Section 5.2 of the RIWP.

A detailed site inspection will be performed after the vegetation is cleared. The site reconnaissance will include visual inspection of the following areas:

- Area A - Laboratory and Warehouse Buildings;
- Area B - Above-Ground Storage Tank Farm;
- Area C - Former Process Pit;
- Area D - Loading Dock and Former Lab Pit Area;
- Area E - Concrete Pad Near ASTs;
- Area F - Concrete Storage Pad;
- Storm Drains and River Gut;
- Sump;
- Septic Tanks;
- Dryer Building;
- 4,000-Gallon AST Area;
- Former Location of Paint Cans and Drums;

- Other onsite structures including the Generator Building, R/O Unit and Water Storage Building; Cooling Towers; Generator and Fire Pump Building; Maintenance Building; Reactor Area and Process Area.
- Edges of paved areas and drains;
- Property boundaries; and
- Other areas, if any, identified during the Background Investigation (see Section 5.2 of the RIWP).

The areas will be inspected for evidence of residual waste, staining, spillage, potential asbestos containing materials and other possible sources of environmental concern.

A2.4 Soil Sampling Program

Ten soil borings will be completed to obtain supplemental data on the geology of the site and to collect soil samples for laboratory analysis. The proposed boring locations are shown on Figure 3-1 of the RIWP. Boring locations and rationale are discussed in Section 5.5.1 of the RIWP; however, soil boring locations may be altered based on the results of the Background Investigation and the Site Reconnaissance.

Soil borings will be completed in overburden, and will be drilled using the hollow stem auger drilling method (Section A2.4.1). Sampling methods are discussed in Section A2.4.2. Soil samples will be screened in the field for the presence of volatile organic compounds (VOC) using a flame- or photo-ionization detector (FID or PID) as described in Section A2.4.3 to establish appropriate sample collection depths. Samples will be analyzed using Contract Laboratory Program (CLP) protocol by a CLP participating laboratory.

A2.4.1 Hollow Stem Auger Drilling Method

The hollow stem auger drilling method will be used for all borings and wells. Drilling procedures will follow USEPA's *A Compendium of Superfund Field Operations Methods* (USEPA, 1987a).

Soil borings will be advanced using a truck-mounted drilling rig capable of rotating a drill bit into the subsurface on a string of hollow stem augers. Drill cuttings will be continuously lifted to the surface on the outside of the auger flights while rods and a plug are used inside to prevent material from entering the interior of the augers. The plug will be removed for split-spoon sampling. Soil samples for lithologic, field screening and/or chemical analyses will generally be collected at continuous intervals to 10 feet and at 5-foot intervals past 10 feet, using a 2-inch outside diameter (O.D.) split-spoon sampler.

Drilling equipment will be decontaminated by steam cleaning and a potable water wash, in accordance with USEPA procedures (1989a). Sampling equipment will be decontaminated as described in Section A2.4.2 of this SAP. Soil cuttings, water derived from development and decontamination activities and spent personal protective equipment will be contained onsite in 55-gallon drums. Drummed investigation-derived waste will remain onsite until proper disposal arrangements can be completed.

EPA notes that potable water used must come from a municipal water supply system and that the water will have to be analyzed to ensure that it is free of contamination. Potable water will be obtained, if possible, from desalinization plant located near the site. The island is currently in a state of drought and water may not be available. If this is the case, water will be obtained from the onsite cistern. Water from the desalinization plant and/or the cistern will be tested for VOCs and metals and will be provided to EPA at least one month prior to use.

Soils will be logged under the supervision of an HLA geologist or engineer, using the Unified Soil Classification System. Split-spoon samples will be screened to evaluate the presence of VOCs in the soil as described in Section A2.4.4. This screening will be used as a basis for selection of samples for soil chemical analyses.

Five of the soil borings will be completed as described in Section A2.5. The remaining five borings will be abandoned using a 2 percent bentonite/Type II Portland cement slurry. The slurry will be emplaced using a tremie pipe after the augers are removed.

A2.4.2 Decontamination Procedures

A2.4.2.1 Heavy Equipment

The drilling rig and augers will be decontaminated upon mobilization, between soil boring locations, and prior to demobilization to prevent cross-contamination. Drilling equipment will be decontaminated by steam cleaning and/or a potable water wash.

A2.4.2.2 Sampling Equipment

Sampling equipment will be decontaminated in accordance with the following eight-step procedure as described on page 38 of the USEPA Region II CERCLA Quality Assurance Manual (1989a):

1. Wash and scrub with low phosphate detergent;
2. Tap water rinse;
3. Rinse with 10 percent nitric acid;
4. Tap water rinse;
5. An acetone only rinse or a methanol rinse followed by hexane rinse (solvents must be pesticide grade or better);
6. Thoroughly rinse with deionized analyte-free water. The volume of water used during this rinse must be at least five times the volume of solvent used in step 5.
7. Air dry; and
8. Wrap in aluminum foil for transport.

Tap water may be from any municipal water treatment system. The use of an untreated potable water supply is not an acceptable substitute. If metals samples are not being collected, steps 3 and 4 may be omitted. If organics samples are not being taken, steps 4 and 5 may be omitted.

When it is necessary to use split-spoon sampling devices which are composed of carbon steel instead of stainless steel, the nitric acid rinse may be lowered to a concentration of one percent instead of ten percent so as to reduce the possibility of leaching metals from the spoon itself.

A2.4.2.3 Pumps, Tubing and In-Line Sampling Devices

Purge pumps, dedicated tubing and in-line sampling devices will be rinsed with soapy water and deionized water prior to use. The outside of the pumps and tubing will be washed and the insides will be flushed with a non-phosphate detergent. After washing, the pumps and tubing will be thoroughly rinsed and flushed with deionized water.

A2.4.3 Soil Sample Collection Procedures

Soil samples obtained for chemical or lithologic description purposes will be collected using split-spoon samplers. The split-spoon sampler is a thick-walled steel tube that is split lengthwise. A cutting shoe is attached to the lower end; the upper end contains a check valve and is connected to the drill rods. When the boring is advanced to the point that a sample will be taken, the drill rods will be removed and the sampler will be lowered through the hollow-stem augers to the bottom of the boring. The sampler will be driven 24 inches into the ground in accordance with the American Society for Testing and Materials (ASTM) publication 1586-87 (1974). A conventional 140-pound hammer will be dropped from a height of 30 inches onto the sampling assembly. The blow counts necessary to drive the sampler will be recorded in the boring log in 6-inch intervals. A blow count of 50 for less than 6 inches of movement or 100 for 18 inches will be considered refusal. Split-spoons

will be decontaminated prior to each use. Decontamination procedures and quality assurance protocol are discussed in Section A2.4.2.

A field geologist or engineer will keep a detailed sample log for each borehole. The standard reporting sheets for soil borings are included in the Appendix AA. Information recorded will include the following:

- drilling contractor and driller's name ;
- name of geologist or engineer maintaining the log;
- boring designation and location;
- drilling and sampling method;
- date;
- split spoon sample depth;
- blow counts;
- length of sample recovered;
- classification of the soil recovered as per the Unified Soil Classification System (based on factors including color, particle size, sorting, structure, plasticity, moisture content, stratification, cementation);
- organic vapor readings; and
- Depth to water.

Observations of changes in drilling speed and drill rig performance which could indicate differences in subsurface conditions, will also be noted. The field geologist or engineer will monitor drilling progress, describe samples as detailed above, collect analytical samples and decontaminate the split-spoons in accordance with the following protocols:

1. The sampling equipment will be decontaminated prior to initial use in the field and between sampling locations as described in Section A2.4.2.

2. The driller will advance the augers to the desired sampling depth. A clean split-spoon sampler will be given to the driller by the field geologist/engineer, both of whom will be wearing clean, disposable gloves.

3. The sample will be collected by the driller using the standard penetration method for split-spoon samples.

4. The field geologist/engineer will take the split-spoon sampling device from the driller and place it on clean polyethylene sheeting.

5. The end cap will be unscrewed and the split-spoon opened.

6. Sample material to be analyzed for VOCs will immediately be placed into laboratory-prepared sample containers using a decontaminated stainless steel trowel or spatula. At this time, the sampler will scan the material contained in the open split spoon using the PID and FID and note the soil classification and description.

7. After the VOC sample containers have been filled, a small portion of the sample material will be placed in a clean, resealable plastic bag for field screening as described in Section A2.4.4.

8. Sample material to be analyzed for parameters other than VOCs will be thoroughly homogenized before placement in sample containers using the procedures described in the Region II QA Manual, page 57, outlined below:

8a. Rocks, twigs, leaves and other debris should be removed if they are not considered part of the sample;

8b. Sample material will be removed from the split-spoon using a stainless steel trowel or spatula and placed in a stainelss steel pan;

8c. The sample material in the stainless steel pan will be mixed throroughly using the stainless steel trowel or spatula;

8d. The material in the pan will be scraped from the sides, corners and bottom of the pan, rolled to the middle of the pan, and initially mixed;

8e. The sample material will then be quartered and moved to the four corners of the pan;

8f. Each quarter will be mixed individually and then rolled to the center of the pan and the entire sample will be mixed again.

8g. The sample material will then be divided and placed into laboratory-prepared sample containers.

The spatula or trowel and the pan will be decontaminated prior to use. Decontamination procedures are discussed in Section A2.4.2. Sample containers, preservation methods, packing and shipping requirements are summarized in Appendix AB.

9. If insufficient sample material is obtained to adequately fill the sample containers or for field screening, the split-spoon will be driven into the boring a second time, in an attempt to collect additional sample material from the selected depth interval (i.e. immediately below the selected sampling depth).

10. Excess sample material will be handled with the drill cuttings.

11. The sample label will be completed as discussed in the QAPP, attached to the sample container, and covered with transparent tape.

12. The HLA sample log form will be completed along with chain-of-custody documentation for each sample selected for laboratory submittal. Appendix AA contains copies of these forms.

13. Each sample scheduled for laboratory analysis will be preserved by cooling to 4°C using ice packs or wet ice and shipped to the laboratory via an overnight courier.

A2.4.4 Field Headspace Screening Procedures

Soil samples will be screened for VOCs using the following procedures.

1. Sample material to be screened will be collected after sample containers for all other parameters are secured;

2. The sample will be placed in a clean, resealable plastic bag (such as an unused Zip-Loc™ bag) and the bag will be sealed;

3. The sample material will be allowed approximately 15 minutes to one hour to reach approximate ambient air temperature;

4. The bag's seal will be broken and the probe of the PID or FID will be inserted. Care will be taken to limit the infiltration of ambient air by opening the seal only sufficiently to allow the instrument's probe to penetrate.

5. A duplicate headspace sample will be prepared for every 20 samples to assess the precision of the measurements.

The relative VOC concentration within the bag headspace will be read directly from the instrument and recorded in the field notes. The used sample material will be placed in the drums with the drill cuttings.

A2.5 Monitoring Well Installation and Development

A2.5.1 Well Construction

Five of the soil borings will be completed as groundwater monitoring wells. The wells will be constructed such that the screened interval intercepts the first water bearing zone encountered (anticipated to be approximately 20 feet below grade). Proposed well locations are shown on Figure 3-1. however, these locations may be subject to change based on the results of the Background Investigation or the Site Reconnaissance. USEPA will be advised immediately, if proposed locations are altered more than 5 feet.

Prior to the installation of any monitoring wells, the proper St. Croix Department of Planning and Natural Resources (DPNR) well permits will be obtained (see Section 5.3.2 of the RIWP). The DPNR and USEPA will be informed by telephone six weeks prior to initiation of drilling and sampling activities. However, it is possible that schedules will have to be modified with less than six-weeks notice. In such a case, EPA and DPNR will be notified immediately.

The wells will be constructed using 10 foot lengths of schedule 40, flush-jointed, threaded PVC. The screened section will consist of 0.020-inch factory-slotted pipe installed approximately 5 feet above and 5 feet below the water table. If evidence of separate-phase floating liquids, such as toluene or pyridine, is encountered, the wells may be replaced with stainless steel.

A minimum annular clearance of 2 inches will be provided for final well construction. Riser pipe and screen will be steam cleaned prior to use in the well. The bottom of the well will be capped with a stainless steel or PVC bottom plug. The well will be constructed using the following procedures:

1. The boring will be advanced five feet below the water table as initially encountered during drilling;

2. The drill rods and plug will be removed from the augers and the decontaminated screen and riser will be inserted through the augers to the bottom of the boring. The top of the well casing will be capped.

3. The driller will back the auger out of the hole five feet or less to expose the annulus around the screen.

4. Number 2 Jessie Morie™ sand (or equivalent) will be poured slowly through the augers into the annulus around the lower portion of the well screen. The sand level will be measured periodically, as it settles through the groundwater, using a properly decontaminated weighted tape. When the sand has reached the bottom of the augers, the driller will back the auger out

another 5 feet. This process will continue until approximately 2 feet of sand is accumulated above the screen interval.

5. After installation of the sand pack, one to two feet of bentonite pellets will be poured into the hole utilizing the same method as for the sand pack.

6. Approximately 5 gallons of potable water will be poured into the hole after the bentonite pellets to cause them to swell and seal the annular space above the sand pack. At least 1 hour will elapse to enable the bentonite pellets to swell properly.

7. After the pellets have been allowed to swell, the augers will be removed from the hole completely and the remaining annular space will be filled with a 2 percent bentonite/Type II Portland cement slurry emplaced using a tremie pipe. The bentonite/cement slurry will extend to approximately three feet below grade.

8. Pre-mixed concrete (such as Sacrete™) will be emplaced over the cement-bentonite slurry.

9. A steel protective casing with a locking cap will be set approximately 2 feet into the concrete mixture. The casing will be permanently marked with the well designation and DPNR permit number.

10. The wells will be allowed to set for a 24-hour period to allow the cement slurry and concrete time to cure.

11. Following the waiting period, the wells will be developed as described in Section A2.5.2. Site personnel will stay clear of the well during development and will monitor breathing space using an FID or PID during development. Personnel Protective Equipment levels will be commensurate with vapor levels recorded and compared to the action levels reported in the HASP (Appendix B). Development will continue for one hour or until the well discharge is free of visible sediments. Typical overburden monitoring well construction details are shown in Appendix AC.

A2.5.2 Well Development

Following the 24-hour waiting period, the new monitoring wells will be developed by pumping and surging. Bailing may also be performed if the amount of sediment is great. The water level in the well will be measured prior to initiating development. During development, pumping will be performed alternately with surging. Turbidity, conductivity, pH, and temperature will be measured periodically during pumping. In general, the well will be pumped until turbidity has decreased to a field determined level and pH, conductivity and temperature have stabilized. Pumping will then be discontinued and the well will be surged. Following surging, pumping will be resumed. This process will be repeated until the discharge water has a turbidity of 10 NTUs (nephelometric turbidity units) or less or remains stable through a period of surging. Conductivity, pH and temperature should also stabilize prior to cessation of development. If turbidity, conductivity, pH and temperature do not stabilize, the wells will be pumped for a period of one-hour or until up to 100 gallons of water have been removed.

Site personnel will stay clear of the well during development and will monitor breathing space with a PID throughout.

A2.6 Rehabilitate Existing Wells

Two wells are present onsite. The age and construction of these wells is unknown. The wells will be modified as described in Section 5.5.3 of the RIWP. If possible these wells will be used to supplement water level data. The wells will be developed as described in Section A2.5.2.

A2.7 Survey

The relative locations and elevations of the new monitoring wells and the rehabilitated existing wells will be surveyed by a licensed surveyor. Elevations surveyed will include the inner casing, outer casing and ground elevations. The surveyor will record the latitude, longitude, and elevation of the ground surface, top of well casing with the cap off, and the top of the inner casing. Elevations will be measured with respect to mean sea level (MSL). Locations will be measured with respect to an assigned onsite benchmark.

The surveyor will notch the inner casing to indicate the exact location surveyed. If practicable, the casing will be surveyed on the northern side.

A2.8 Groundwater Sampling

Groundwater sampling will be performed approximately two weeks following well installation and development. Prior to sampling, water level measurements will initially be taken at the five new and two existing wells (Figure 3-1 of the RIWP). Procedures for water level measurements are described below.

Groundwater samples will be collected from the five new monitoring wells. Samples may also be collected from the rehabilitated existing wells. The groundwater samples will be analyzed for Target Compound List (TCL) VOCs, semi-volatile organic compounds (SVOs), pesticides and PCBs, both total and dissolved Target Analyte List (TAL) inorganics, and pyridine.

BEFORE ENTERING THE FIELD

- Project objectives and quality assurance procedures, sampling locations, sampling procedures, preservation, packaging and shipping requirements, and analytical parameters will be reviewed with field personnel.
- Previous water level measurements for each well, if available, will be reviewed before leaving for the site, and a summary of previous water level data will be taken to the field.
- Health and safety procedures will be reviewed with all personnel.
- A listing of wells to be sampled and analyses to be performed by the CLP protocol will be prepared and transmitted to the laboratory.
- All field equipment wil be tested to ensure that it is operating properly. Because of the remote location of the site, duplicate instruments will be mobilized to limit down time due to possible equipment malfunction.
- The laboratory will provide clean glassware required to collect the samples. The glassware will be cleaned in accordance with OSWER Directive 92540.0-05A. The glassware will include required preservatives and a list of which preservatives correspond to each analyte will be included with the glassware. The laboratory will provide sufficient glassware and/or samples

for trip blanks, field blanks, and/or duplicate samples to be collected at the frequency described in the QAPP.

IN THE FIELD

1. Sampling crews, consisting of two experienced geologists, hydrogeologists, or field technicians, will receive labeled sample kits from the field manager and will confirm that the kits contain appropriate sample bottles, preservatives, filter pumps, ice, sample labels, chain-of-custody records, and well completion information.

2. Before purging or sampling each well, equipment will be decontaminated. Decontamination of pumps will include rinsing the pump and tubing with soapy water and deionized water before use. For bailer decontamination, USEPA's eight-step procedure, described in the Region II Quality Assurance Manual, will be followed (see Section A2.4.2).

3. Well number, date, pertinent observations (e.g., weather, well condition), station elevation, casing diameter, screened interval, and field instrument identification will be recorded on groundwater sampling forms (Appendix AA).

4. Monitoring instruments will be calibrated against known standards before making well measurements (generally calibrated once per day). Calibration will be recorded in field calibration data sheets as included in Appendix AA.

5. The well will be uncapped from the upwind direction and a PID or FID will be used to record relative VOC concentrations upwind from the well, at the top of the casing and within the well casing. Procedures for use of the FID or PID will be consistent with the manufacturer's manual, which may vary slightly from model to model. The manual will be kept onsite at all times during equipment use.

6. Sampling equipment such as bailer cords will be placed on plastic sheeting or aluminum foil to be placed around the well to prevent the equipment from contacting the ground.

7. The first time a well is sampled, the depth will be verified prior to sampling. This allows the sampling team to calculate the volume of water in the well and to determine if formation material has accumulated in the well. The well depth will be measured to an accuracy of 0.1 foot with a steel tape with a steel weight secured to the end. The tape and weight will be decontaminated prior to use.

8. Depth to water will be measured using an electronic interface probe. The probe will be lowered into the well until a contact with the water surface is indicated by an electronic signal.

9. The tape will be marked or held at the measuring point.

10. The electric tape will be checked to ensure that it has not been cut by a sharp casing edge after it is placed in and removed from the well.

11. The distance from the mark to the nearest tape band or marker will be measured by using a folding ruler. The depth to water to an accuracy of 0.01 foot will be determined.

12. The probe will then be lowered below the water table and raised until the signal indicates that the probe us above the water table. The depth to water will be measured again as described in steps 9 through 11 above.

13. The water-level elevation relative to mean sea level (MSL) will be determined by subtracting the depth to water from the surveyed top of casing elevation (measuring point). Measurements at each well will only be taken at the marked survey point on the inner casing and will be repeated until two consecutive measurements are obtained that agree within ±0.02 foot. Water level measurements will be recorded on water level measurement forms (Appendix AA). Well identification, date, time, depth in feet to groundwater and remarks relevant to groundwater level measurements will be noted. Previous water level measurement for the well will be checked. If the difference between the current water level and the previous month's water level is greater than one foot, the water level will be remeasured.

14. The volume of water (equal to three times the volume of standing water) to be removed from the well casing prior to collection groundwater samples will be calculated using the following equation: $V = r^2h$ where:

    V = well volume (ft^3)

    = 3.1416

    r = well radius (ft)

    h = column of water in the well (total depth minus depth to water) (ft)

15. A decontaminated transparent bailer will be lowered until it is approximately half submerged. The bailer will be withdrawn and inspected for evidence of light (floating) non-aqueous phase liquids (LNAPL). If LNAPLs are present, a sample of this material will be collected using the procedures outlined below:

    15a. The apparent thickness will be measured, recorded and compared to the thickness, if any, indicated by the electronic interface probe;

    15b. If LNAPL is less than several inches thick, it may not be possible to collect a sample with no water. In such a case, as much water as possible will be drained from the bailer by holding the bailer upright and pushing the check valve aside. Water will be collected in a bucket and transferred to the containers used to store purge water;

    15c. After the water is removed, the remaining LNAPL will be poured from the top of the bailer into laboratory-prepared sample containers. VOC sample containers will be filled first;

    15d. Steps 15b and 15c will be repeated until all of the sample containers are filled sufficiently or the LNAPLs in the well are reduced to a thickness insufficient for recovery (less than 1 inch).

    15e. Samples containing LNAPLs will be analyzed separately from the groundwater samples.

16. The wells will be purged using a standard decontaminated centrifugal or submersible pump or using a stainless steel or a Teflon™ bailer. Except as discussed in Step 16, a minimum of three well volumes of water will be purged from each well before sampling. If a pump is used, the intake will be placed just below the water table and lowered as the water level drops to ensure that purged water is completely replaced with fresh water from the aquifer. If water levels do not drop, the pump intake will be lowered slowly through the water column during purging. Decontamination procedures are outlined in Section A2.4.2.

17. Field measurements of specific conductivity, temperature, and pH will be taken after each purged well volume and before sampling. Calibration and operation and maintenance procedures for the conductivity, temperature and pH meters will be consistent with manufacturers' specifications. PID readings, pumping rate, cumulative purged volume, and time will also be recorded for each purged volume. Field measurements will be used to evaluate the stabilization of parameters to ensure the wells have been sufficiently purged. Stabilization is defined as less than 10 percent variation between two successive measurements.

18. If a well is pumped or bailed dry before three well volumes have been removed, well purging activities will be halted and the well will be allowed to recover sufficiently to permit sample collection. Efforts will be made to avoid pumping or bailing the wells dry. Purge rates will be lowered if insufficient recharge is occurring. Samples will be obtained within a 3-hour period after purging and two hours after evacuation is completed to minimize loss of volatile constituents.

19. If the parameters measured during development (see Step 16) do not stabilize, a maximum of five well volumes will be purged.

20. Data on method and amount of water purged will be recorded on a groundwater sampling form (Appendix AA).

21. Water purged from the monitoring wells will be collected and stored at the site in properly labeled 55-gallon drums. The information specified on the drum label(s) will include, at a minimum, the date and well number(s) corresponding to the wells from which the water was removed. The water will continue to be stored on-site in accordance with applicable Resource Conservation and Recovery Act requirements until an appropriate treatment or disposal method is identified. The disposal methods will depend on the concentrations and nature of constituents in the water. Potential disposal methods may include discharge to a publicly owned treatment works, surface water, or off-site transportation and disposal, as permitted.

22. If a sampling pump is used to purge the monitoring wells, it will be properly decontaminated and samples will be collected directly from the pump discharge at a low flow rate to avoid agitating samples. Teflon™ tubing will be used if the same sampling pump is to be used for both evacuation and sampling.

23. Samples will be collected using decontaminated, stainless-steel or Teflon™ bottom-filling bailers or a sampling pump. Dedicated cords will be used at each well. Bailer cords will be stainless steel, single-stranded wire, polypropylene monofilament or Teflon™-coated wire, and will be cleaned with soap and water before use. Sampling pumps, if used, will be submersible stainless steel or Teflon™, such as a Rediflo II system, with variable flow-rate controls. If used to sample for VOCs, sampling pump flow rates will be less than 100 milliters per minute.

24. Except as noted in Step 24 and in Section A2.9, groundwater samples will be transferred directly from the bailer to the sample containers. VOC vials will be filled in a manner that minimizes head space or air bubbles. Samples for VOC analyses will be collected first. VOC sample vials will be filled to capacity and tightly capped to avoid retention of air bubbles. Remaining sample containers will be filled to approximately 90 percent of capacity. VOC sample containers will be preserved and filled according to EPA Region II CERCLA Quality Assurance Manual protocol (p. 31) as follows:

a. Collect three 40-milliliter vials of sample for VOC analysis.
b. Adjust the pH of one of the vials to <2 by carefully adding 1:1 HCl drop by drop to the required two 40-milliliter VOA vials. The number of drops of 1:1 HCl required should be recorded. The first vial may then be discarded.
c. Carefully add the same number of drops to the remaining two vials to be submitted for laboratory analysis. (The pH in the two vials for laboratory analysis should not be tested directly.)
d. Seal the vials.
e. The pH test is to be performed at each sampling location.

A fresh sample with a fresh preserved vial will be collected if an air bubble is detected in a VOC sample vial after sampling is complete.

Non-VOC samples will be placed into prepreserved laboratory-prepared sample bottles. A small portion of the sample will be poured from the filled sample bottle into a second clean container. The pH of the sample material in the second container will be tested in the field to confirm that it falls within the requirements of the QAPP. Additional preservative and sample material will be used to adjust the pH of the sample, if necessary.

25. Field-filtered samples will be obtained for analysis of metals where required. A 0.45-micron filter of compatible inert material will be used in filtering the samples. The filtering device will be either an in-line filter or pressure filter apparatus. The filtering apparatus currently planned for use on this project is the GelmanSciences AquaPrep™ Flex Filter. The device uses a 10 mil PVC medical grade bag film with a Supor (inherently hydrophilic polysulfone) membrane. A rinse blank of the filtering apparatus will be performed for each day the apparatus is decontaminated prior to use.

Preservation of samples to be analyzed for metals will be conducted after filtering. The filtered samples will be transferred directly from the filter appartus to pre-preserved sample bottles. A small portion of the sample will then be poured out of the bottle for pH testing. If necessary, the pH of the sample will be adjusted by adding additional preservative.

26. Immediately after filling, samples will be placed in storage coolers on ice. Samples will be checked periodically with a thermometer to ensure preservation requirements are met. The temperature of the samples will also be recorded by the laboratory upon receipt.

27. Sample depth will be recorded, the groundwater sampling field data sheet will be completed and signed, and the chain-of-custody form will be signed.

28. The well cap will be closed and the well will be locked.

29. The bailer line, gloves, and sheeting will be disposed in a proper manner, and the bailer will be decontaminated and wrapped in clean aluminum foil between uses. Surgical gloves will be

changed between each sample location. The portion of the water level probe or steel tape that has been in contact with the well water will be cleaned in detergent and water, and rinsed with distilled water prior to use at each well.

Quality assurance/quality control (QA/QC) samples are discussed in the QAPP (Appendix C).

The water level elevation relative to MSL will be calculated by subtracting the depth to water from the elevation of the surveyed top of casing elevation measuring point. Newly acquired water level data will be compared with current and past water level data. Hydrographs for each well will be prepared and updated.

A2.9 Procedures for Splitting Samples with USEPA

USEPA or their oversight contractors may require split-samples. Solid samples requested for splitting by USEPA must be homogenized prior to distribution between HLA and USEPA sample containers. All sampling, homogenization (solid samples), and filling of containers will be performed by HLA personnel. HLA will provide USEPA at least six weeks notice in advance of any sampling activities. Sample containers for split samples will be provided by USEPA. USEPA will be responsible for handling, packaging and shipping of split samples.

Solid samples being collected for volatile organic analysis cannot be split. Samples for volatile analyses must be collected as co-located grab samples, as grab samples from the same split-spoon, trowel, or grab samples from other sampling devices. For all remaining solid sample analyses, a large enough sample volume must be procured to fill all necessary sample containers of both parties. Following the collection of the VOC portion of the sample, the remaining sample volume will be placed in a stainless-steel bowl and thoroughly homogenized with a stainless-steel spatula or trowel. Sample aliquots for the remaining analyses (non-volatile) will then be distributed to HLA's and USEPA's sample containers.

Aqueous samples only require homogenization if heterogeneity is suspected. Again, sample aliquots for volatile organic compound analysis are not to be homogenized. HLA and USEPA sampling representatives will jointly decide if homogenization is required for a particular split sample location. In the event of a dispute, USEPA or its representatives will make the final determination. Homogenization is encouraged in questionable circumstances. A large (2 to 4 liter) glass container will be used to transfer the aqueous sample from the sample-collection device. When a sufficient volume has been procured to fill all necessary HLA and USEPA containers, the sample aliquots will be dispensed to both parties.

Aqueous samples for volatile organic analysis will be collected as co-located grab samples. If sufficient volume is procured in the collection device the volatile vials will be filled concurrently from the same aliquot source.

Both parties must document in their respective field books the sample identification numbers each party is using so that the results can be accurately cross-referenced in the future.

A2.10 Ecological Assessment Environmental Media Sampling

Sampling and analysis of potentially impacted environmental media such as water, sediments, soils, and shallow groundwater will be determined as described in the project work plan. Sampling locations, media and analytical parameters will be developed, if necessary, based on results of the Phase I investigation.

A2.10.1 Methodology

If media sampling becomes necessary as part of the risk assessment, volatile organic compounds, semivolatile organic compounds, and inorganic compounds will be analyzed using the current Contract Laboratory Program protocols as specified in the QAPP. If water samples are necessary, sampling will include field measurement of the following physical parameters for the appropriate media: Oxidation Reduction Potential (ORP), Dissolved Oxygen (DO), conductivity, temperature, pH and color. Field measurements will be taken by field personnel and recorded in daily logs.

Samples will be placed into appropriate laboratory prepared containers and labeled with the following information:

Site Name;
Location and Designation;
Date and Time;
Analytical Parameters;
Sampler's Name and Company.

Samples will be logged on a chain of custody form and kept cool (4 degrees C) prior to delivery to the laboratory.

A2.10.2 Surface Water

If necessary, surface water samples may be collected. The samples would be analyzed for volatile and semivolatile organic compounds and inorganic compounds to be determined based on the site investigation discussed in the project work plan. Additional parameters to be analyzed would included Total Organic Carbon (TOC), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), Total Dissolved Solids (TDS), alkalinity, and hardness. These parameters may be revised based on results of the site investigation. Dissolved Oxygen (DO). Oxidation Reduction Potential (ORP), temperature, conductivity, and pH will be measured in the field. Samples would be collected in the sampling container directly from the stream with minimal agitation, and before stream sediments samples are collected.

A2.10.3 Stream Sediments

If necessary, stream sediment samples will be collected and analyzed for VOC+15 (3/90 SOW), SVOC+15 (3/90 SOW), Inorganics (3/90 SOW), TOC, particle grain size (ASTM Method D421 and D422), ORP (ASTM Method D1498), pH (EPA Method 9045), and conductivity (Modified EPA Method 120.1). These parameters may be revised based on results of the site investigation. Sediment color (Munsell Soil Color Chart) will be measured in the field. Sediment analytical results will be reported on a dry weight basis.

Samples would be collected from the stream bottom using a decontaminated grab sampler after stream water samples are collected. If stream sediment sampling locations are located in deep water (> 2m) samples will be collected using a decontaminated Ponar grab sampler. Stream sediment sampling locations in shallow water areas (< 2m) will be sampled with a decontaminated Ekman Dredge grab sampler. Stream samples will be collected starting from the most downstream location and working upstream to avoid cross contamination of downstream locations from upstream sampling. Where practical, sampling personnel wearing decontaminated waders will walk in the stream to collect samples. Sampling personnel will approach from, and stand downstream of, sampling locations to avoid disturbance of the sampling area.

A2.10.4 Soils

If soil samples are necessary, they would be collected and analyzed for VOC+15 (3/90 SOW), SVOC+15 (3/90 SOW), Inorganics (3/90 SOW), TOC, pesticides, herbicides and carbamates, ORP (ASTM Method D1498), pH (EPA Method 9045), and conductivity (Modified EPA Method 120.1). These parameters may be revised based on results of the site investigation. Soil color (Munsell Soil Color Chart) will be measured and recorded in the field.

The soils will be collected with a dedicated decontaminated stainless steel trowel and placed directly into the sample container.

A2.10.5 Shallow Groundwater

If it becomes necessary to sample in wetland areas where groundwater is present within 30cm (12in) of the ground surface, a shallow groundwater sample may be collected. The shallow groundwater samples will be analyzed for VOC+40 (3/90 SOW), SVOC+40 (3/90 SOW), Inorganics (3/90 SOW) and TOC. These parameters may be revised based on results of the site investigation. ORP, DO, pH, conductivity and temperature will be measured in the field.

To collect a shallow groundwater sample a depression will be excavated with a dedicated decontaminated stainless steel trowel to a point immediately below the top of the water table. This depression will be no more than 41cm (16in) deep. After the depression has filled with water, a sample will be collected directly into the laboratory supplied sampling jars with minimal agitation of the sample.

A2.10.6 Quality Assurance/Quality Control

Samples collected by HLA field personnel will be shipped to a CLP laboratory for analysis. Samples will be handled as described in the project QAPP. If necessary, the QAPP will be amended during preparation of the ecological assessment technical memorandum. Amendments to the QAPP would include procedures for parameters not currently proposed.

A3.0 SAMPLE DESIGNATIONS

HLA will use a standardized nomenclature for all samples collected, and each sample will be assigned a unique name. Groundwater samples will be designated by the name of the well from which they are collected and the date (six digit number indicating the calendar month, day and year) on which they are collected. For example a groundwater sample collected from monitoring well MW-1 on August 1, 1994 would be designated MW-1/080194.

Soil samples from soil borings will be identified by the prefix "SB" followed by the area of concern, the boring location within that area, location of the soil boring sampled followed by the sample depth (measured in feet below grade) and the date. As an example a soil sample collected from 8 to 8.5 feet below grade in the first soil boring from Area B on March 1, 1994 would be designated SBB1/8.0-8.5/030194.

Quality assurance/quality control (QA/QC) sample designations will indicate the type of QA/QC sample, date collected, and for rinse blanks, the matrix of the associated environmental samples. The following abbreviations will be used in addition to those listed above:

TB	Trip Blank
RB	Rinse Blank
GW	Groundwater
SO	Soil

For example, a rinse blank collected during a groundwater sampling event on March 1, 1994 would be designated RBGW/030194, and a trip blank for that event would be designated TB/030194.

Laboratory blind duplicate samples will be designated the same as the duplicated sample, but the digits "10" will be placed in front of the well number or sample location designation. For example, a laboratory blind duplicate of a sample from well MW-2 collected on March 1, 1994 would be designated MW-102/030194. Similarly, a duplicate soil sample SBB1/0.0-0.5/030194 would be designated SBB101/0.0-0.5/030194.

A4.0 FIELD MEASUREMENTS

A4.1 Turbidity, Dissolved Oxygen, Oxidation-Reduction Potential, Electrical Conductivity, pH, Temperature, and Purge Volume and Rate Measurements

The field parameters turbidity, dissolved oxygen and oxidation-reduction potential will be measured while purging groundwater at each sampling location by using either an in-line device or external meters. Conductivity, pH and temperature will be measured prior to sample collection using either an in-line device or conductivity, pH and/or temperature meters and/or a thermometer.

In-line monitors and monitoring chambers will be decontaminated in accordance with the procedures described in Section A2.4.2.3. External probes will be decontaminated prior to each use in accordance with the the procedures described in Section A2.4.2.2. The pH meter will be recalibrated using two standard buffer solutions before each use. The conductivity meter will be calibrated before leaving the office and then onsite prior to the start of the sampling event using 200 mhos/cm and 1000 mhos/cm or equivalent solutions. Calibration procedures for the in-line monitoring device and the various meters to be used will be in accordance with manufacturer's instructions and are discussed in the QAPP.

Flow rate for low flow pumps will be measured by measuring with a stopwatch the time required to fill a container of known volume. Flow meters will be used to measure the flow rate of standard submersible or centrifugal pumps. The flow meter will be calibrated with a stop watch and 5- to 15-gallon container during initial purging of the first well to be sampled. The flow meter will be calibrated for flow rate by starting the stop watch at an initial volume then stopping the watch at a later known volume. This will give the time, in minutes and seconds, that it took to discharge the known volume of water from the well. The rate of discharge in gallons per minute (gpm) can then be calculated.

Manufacturer instructions for use of the in-line monitoring device and meters will be followed and will be available for use in the field. Measurements made with external meters will be made directly at the well discharge point. Procedures for measurements using these meters and measurement of flow rates consist of the following:

- The monitoring chamber(s) and probe(s) will be decontaminated, as noted above, prior to recording measurements.
- Purge volumes will be read directly from the calibrated flow meter.

A4.2 Flow Rates and Purge Volumes

Flow rate for low flow pumps, if used, will be determined by measuring the time required to fill a container of known volume. Flow meters will be used to measure the flow rate of standard submersible or centrifugal pumps. The flow meter will be calibrated with a stop watch and 5- to 15-gallon container during initial purging of the first well to be sampled. The flow meter will be calibrated for flow rate by starting the stop watch at an initial volume then stopping the watch at a later known volume. This will give the time, in minutes and seconds, that it took to discharge the known volume of water from the well. The rate of discharge in gallons per minute (gpm) can then be calculated.

Manufacturer instructions for use of the in-line monitoring device and meters will be followed and will be available for use in the field. Measurements made with external meters will be made directly

at the well discharge point. Procedures for measurements using these meters and measurement of flow rates consist of the following:

- The monitoring chamber(s) and probe(s) will be decontaminated, as described in the previous section, prior to recording measurements.

- Purge and rates will be read directly from the calibrated flow meter.

During development and purging activities using pumps, purge volumes will be estimated based on calculated flow rates and purge time. Final purge volumes will be estimated based on the volume of water contained within the 55-gallon storage drums.

If a bailer is used to purge the wells, the purge rate will be estimated based on the total volume of water removed during the time bailing activities were underway at each well.

A5.0 SAMPLE HANDLING AND ANALYSES

A5.1 Sample Documentation

A5.1.1 Field Data Forms

A record of sample identification numbers will be maintained on standardized groundwater sampling forms. Additionally, the groundwater sampling form includes a record of significant events, observations, and measurements during sampling, such as personnel present, site conditions, sampling procedures, measurement procedures, and instrument calibration records.

All entries on the groundwater sampling forms are to be in ink, signed, dated, and kept as a permanent record. The information contained in these forms is intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project. Corrections of erroneous entries will be made by crossing a line through the error and entering the correct information. Corrections will be initialed and dated by the person making the re-entry. An example of the standardized groundwater sampling form used during water quality sampling is contained in Appendix AA.

A5.1.2 Chain of Custody and Requests for Analyses

Sample identification documents are to be carefully prepared so that sample identification and chain of custody can be maintained and sample disposition can be controlled. The sample identification documents to be used as part of this investigation are defined as:

- Sample identification labels
- Chain of custody records
- Laboratory analysis and scheduling form

Examples of the sample identification label and chain of custody documents are provided in Appendix AA.

Pre-printed adhesive sample identification labels will be secured to the sample containers by the field personnel. Sample documentation forms and labels will be completed with waterproof ink. Sample documentation forms include the following information:

- Sample number
- Project number
- Sample site name/code
- Sampling date and time
- Sampling personnel
- Shipping method and date
- Sample description
- Sample matrix
- Sample volume and number of containers
- Sample destination
- Preservatives used
- Analyses required
- Special handling procedures

Official custody of samples is maintained and documented from the time of sample collection up to the presentation of analytical results in the final report. The chain of custody record form serves to cross-reference with the sample identifier assigned by the Project Manager with the laboratory identification number. To document sample possession, chain of custody procedures are followed as outlined in the sections below.

A5.2 Sample Transport

Upon collection, all samples will be sealed with custody seals, labeled, and stored at 4°C in plastic ice chests with ice or blue ice and kept chilled until analyses are performed. Samples will be shipped within 24 hours of collection. For each group of samples transported to the laboratory by overnight transportation, all completed letters of transmittal, chain of custody records and laboratory schedules will be placed in a waterproof bag within the cooler. The bag containing chain of custody records and other traffic reports will be taped to the underside of the cooler lids. Samples are to be packed in plastic packing material to avoid breakage. The ice chest containing samples will be clearly labeled and sealed with nylon or fiber strapping tape to prevent tampering. Two custody seals will be placed across opposite corners of the lid of each cooler so that the lid cannot be opened without breaking the seal. The serial number of each seal will be recorded on the chain of custody form for each shipment.

The field sampler will be responsible for the care and custody of the samples collected until they are transferred or dispatched properly. The method of transport, courier name(s), and other pertinent information will be entered on the chain of custody accompanying the samples.

Once received at the laboratory, laboratory custody procedures will apply. At that point, it is the laboratory's responsibility to acknowledge receipt of samples and verify that the containers have not been opened or damaged. It will then be the laboratory's responsibility to maintain custody records throughout sample preparation and analysis. A designated sample custodian accepts custody of the shipped samples and verifies that the sample identification numbers of the contents match those on the chain of custody record and notes the laboratory identification number on the form. Pertinent information as to shipment, pickup, and courier is entered in the "Remarks" section of the chain of custody record. A copy of the chain of custody record is then sent to the Project Manager.

A6.0 BIBLIOGRAPHY

Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA): Public Law 96-510, 42 USC 9601 et.seq.

U.S. Environmental Protection Agency, 1983, *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans: QAMS-005/80; Office of Monitoring Systems and Quality Assurance, ORD, Washington, D.C.*, February.

U.S. Environmental Protection Agency, 1984, *Guidelines Establishing Test Procedures for the Analysis - Final Rule and Proposed Rule, 40 CFR Part 136*, October.

U.S. Environmental Protection Agency, 1987a, *A Compendium of Superfund Field Operations Methods, OSWER Directive 9355-0-14*, December.

U.S. Environmental Protection Agency, 1987b, *Data Quality Objectives for Remedial Response Activities (development process): USEPA/540/G-87/003, Office of Emergency and Remedial Response, Washington, D.C.*, March.

U.S. Environmental Protection Agency, 1986c *Draft Supplement to Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans: QAMS-005/80, Office of Monitoring Systems and Quality Assurance, ORD, Washington, D.C.*, December.

U.S. Environmental Protection Agency, 1986e, *National Enforcement Investigations Center Policies and Procedures Manual, EPA -330-9-78-001-R.*

U.S. Environmental Protection Agency, 1986f, *Test Methods for Evaluating Solid Waste: Office of Solid Waste and Emergency Response (OSWER) Directive SW-846, Vol. 1B.*

U.S. Environmental Protection Agency, 1988a, *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Atmospheric Research and Exposure Assessment Laboratory*, June.

U.S. Environmental Protection Agency, 1988b, *Laboratory Data Validation - Functional Guidelines for Evaluating Inorganics Analyses, Hazardous Site Evaluation Division*, July.

U.S. Environmental Protection Agency, 1988c, *Laboratory Data Validation - Functional Guidelines for Evaluating Organics Analyses: TDD Doc. No. HQ-8401-01, Hazardous Site Evaluation Division*, February.

U.S. Environmental Protection Agency, 1988d, *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final, EPA/540/6-89/004*, October.

U.S. Environmental Protection Agency, 1989a, *Region II CERCLA Quality Assurance Manual, Revision I.*

U.S. Environmental Protection Agency, 1989b, *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A, Interim Final, Office of Emergency and Remedial Response*, December.

U.S. Environmental Protection Agency, 1990c, *Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule, 40 CFR Part 261*, Thursday, March 29.

U.S. Environmental Protection Agency, Region III, 1990d, *Field Filtration Policy for Monitoring Well Groundwater Samples Requiring Metals Analysis*, Bulletin No. QAD009, April 23.

U.S. Environmental Protection Agency, 1991a, *User's Guide to the Contract Laboratory Program: Office of Emergency and Remedial Response, Sample Management Office*, January.

U.S. Environmental Protection Agency, 1991c, *Model Quality Assurance Project Plan: Office of Superfund, Region V*, May.

U.S. Environmental Protection Agency, 1992a, *Region II SOP HW-6, CLP Organic Data Review and Preliminary Review, Revision 8*, January.

U.S. Environmental Protection Agency, 1992b, *Region II SOP #W-2 Evaluation of Metals Data for the CLP* Revision II, January.

U.S. Environmental Protection Agency, 1992c, *Ground Water Forum, Monitoring Well Development Guidenines for Superfund Project Managers*, April.

U.S. Environmental Protection Agency, 1992d, *Superfund Analytical Methods for Low Concentration Water for Organic Analysis, 10/92*, October.

U.S. Environmental Protection Agency, 1993a, *Contract Laboratory Program Statement of Work for Inorganic Analysis - Multi-Media Multi-Concentration, ILM03.0*, May.

U.S. Environmental Protection Agency, 1993b, *Contract Laboratory Program Statement of Work for Organic Analysis - Multi-Media Multi-Concentration, OLMO1.9*, July.

U.S. Environmental Protection Agency, 1993c, *Administration Order on Consent for Remedial Investigation/Feasibility Study*, Docket No. III-93-21-DC, July.

APPENDIX AA

FIELD DOCUMENTATION FORMS

APPENDIX AA

FIELD DOCUMENTATION FORMS

- Water Level Measurement Form
- Groundwater Sampling Form
- Field Log of Boring Form (2 pages)
- Field Well Completion Form
- Well Development Form
- Chain of Custody Form
- Sample Labels
- Field Calibration Data Sheets
- Custody Seal

WATER LEVEL DATA SHEET

INSTRUMENT/MODEL # : ______________________ NAME:

PROJECT: ______________________ DATE:

JOB NUMBER: ______________________ SHEET OF

WELL NUMBER	TIME	DEPTH TO WATER 1st READING	DEPTH TO WATER 2nd READING	DEPTH TO WATER 3rd READING	COMMENTS SECTION

Harding Lawson Associates
Engineering and
Environmental Services

GROUND-WATER SAMPLING FORM

Job Name _____
Job Number _____
Recorded by _____ (Signature)

Well No. _____
Well Type: ☐ Monitor ☐ Extraction ☐ Other _____
Well Material: ☐ PVC ☐ St. Steel ☐ Other _____
Date _____ Time _____
Sampled by _____ (Initials)

WELL PURGING

PURGE VOLUME

Casing Diameter (D in inches):
☐ 2-inch ☐ 4-inch ☐ 6-inch ☐ Other _____
Total Depth of Casing (TD in feet BTOC): _____
Water Level Depth (WL in feet BTOC): _____
Number of Well Volumes to be purged (# Vols)
☐ 3 ☐ 4 ☐ 5 ☐ 10 ☐ Other _____

PURGE METHOD

☐ Bailer - Type: _____
☐ Submersible ☐ Centrifugal ☐ Bladder; Pump No.: _____
☐ Other - Type: _____

PUMP INTAKE SETTING

☐ Near Bottom ☐ Near Top ☐ Other _____
Depth in feet (BTOC): _____ Screen Interval in Feet (BTOC) from _____ to _____

PURGE VOLUME CALCULATION

$$\left(\underset{\text{TD (feet)}}{\_\_\_\_} - \underset{\text{WL (feet)}}{\_\_\_\_}\right) \times \underset{\text{D (inches)}}{\_\_\_\_}^{2} \times \underset{\text{\# Vols}}{\_\_\_\_} \times 0.0408 = \underset{\text{Calculated Purge Volume}}{\_\_\_\_} \text{ gallons}$$

PURGE TIME

_____ Start _____ Stop _____ Elapsed

PURGE RATE

Initial _____ gpm Final _____ gpm

ACTUAL PURGE VOLUME

_____ gallons

FIELD PARAMETER MEASUREMENT

Minutes Since Pumping Began	pH	Cond. (µmhos/cm)	T ☐ °C ☐ °F	Other ____

Minutes Since Pumping Began	pH	Cond. (µmhos/cm)	T ☐ °C ☐ °F	Other ____
Meter Nos.				

Observations During Purging (Well Condition, Turbidity, Color, Odor): _____
Discharge Water Disposal: ☐ Sanitary Sewer ☐ Storm Sewer ☐ Other _____

WELL SAMPLING

SAMPLING METHOD

☐ Same As Above
☐ Bailer - Type: _____
☐ Grab - Type: _____
☐ Submersible ☐ Centrifugal ☐ Bladder; Pump No.: _____
☐ Other - Type: _____

SAMPLING DISTRIBUTION

Sample Series: _____

Sample No.	Volume/Cont.	Analysis Requested	Preservatives	Lab	Comments

QUALITY CONTROL SAMPLES

Duplicate Samples

Original Sample No.	Duplicate Sample No.

Blank Samples

Type	Sample No.

Other Samples

Type	Sample No.

301920

FIELD LOG OF BORING

SHEET_____ OF____

LOCATION OF BORING:

PROJECT:

BORING NO.

TOTAL DEPTH:

JOB NO.:

LOGGED BY:

PROJ. MGR.:

EDITED BY:

DRILLING CONTRACTOR:

DRILL RIG TYPE:

DRILLERS NAME:

SAMPLING METHODS:

HAMMER WT.:

DROP:

STARTED, TIME:

DATE:

COMPLETED, TIME:

DATE:

BORING DEPTH (ft.)			
CASING DEPTH (ft.)			
WATER DEPTH (ft.)			
TIME:			
DATE:			

BACKFILLED, TIME: DATE: BY:

SURFACE ELEV.: DATUM:

CONDITIONS:

SAMPLE DEPTH	SAMPLER TYPE	BLOWS/6-IN.	INCHES DRIVEN	INCHES RECOVERED	SAMPLE CONDITION	DRILLING RATE (min/ft)				DEPTH IN FEET	GRAPHIC LOG
										1	
										2	
										3	
										4	
										5	
										6	
										7	
										8	
										9	
										10	

FF7

HARDING LAWSON ASSOCIATES

301921

FIELD LOG OF BORING (CONTINUED)

SHEET _____ OF _____

PROJECT:	NO.	BORING NO.

DEPTH	TYPE	BLOWS	DRIVEN	REC'V'D	COND.	D.RATE				DEPTH	GRAPHIC LOG
										1	
										2	
										3	
										4	
										5	
										6	
										7	
										8	
										9	
										0	
										1	
										2	
										3	
										4	
										5	
										6	
										7	
										8	
										9	
										0	

FF8

HARDING LAWSON ASSOCIATES

FIELD WELL COMPLETION FORM

Harding Lawson Associates

JOB NAME:

JOB NUMBER: | PROJECT MANAGER:

LOGGED BY: | EDITED BY:

WELL NAME: | DATE:

DRILLING COMPANY:

EQUIPMENT: ☐ _____ INCH HOLLOW STEM AUGER | DRILLER:

☐ _____ INCH ROTARY WASH | HOURS DRILLED:

GALLONS OF WATER USED DURING DRILLING: GALLONS

METHOD OF DECONTAMINATION PRIOR TO DRILLING:

DEVELOPMENT

METHOD OF DEVELOPMENT:

DEVELOPMENT BEGAN DATE: TIME:

YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:
YIELD: GPM	TIME: FROM TO	DATE:

TOTAL WATER REMOVED DURING DEVELOPMENT: GALLONS

DESCRIPTION OF TURBIDITY AT END OF DEVELOPMENT: ☐ CLEAR ☐ SLIGHTLY CLOUDY ☐ MOD. TURBID ☐ VERY MUDDY

ODOR OF WATER:

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANK ☐ DRUMS ☐ OTHER _____

DEPTH TO WATER AFTER DEVELOPMENT: FEET

MATERIALS USED

_____ SACKS OF _____ SAND

_____ SACKS OF _____ CEMENT

_____ GALLONS OF GROUT USED

_____ SACKS OF POWDERED BENTONITE

_____ POUNDS OF BENTONITE PELLETS

_____ FEET OF ____ INCH PVC BLANK CASING

_____ FEET OF ____ INCH PVC SLOTTED SCREEN

_____ FEET OF ____ INCH STEEL CONDUCTOR CASING

_____ YARD^3 CEMENT-SAND (REDI-MIX) ORDERED

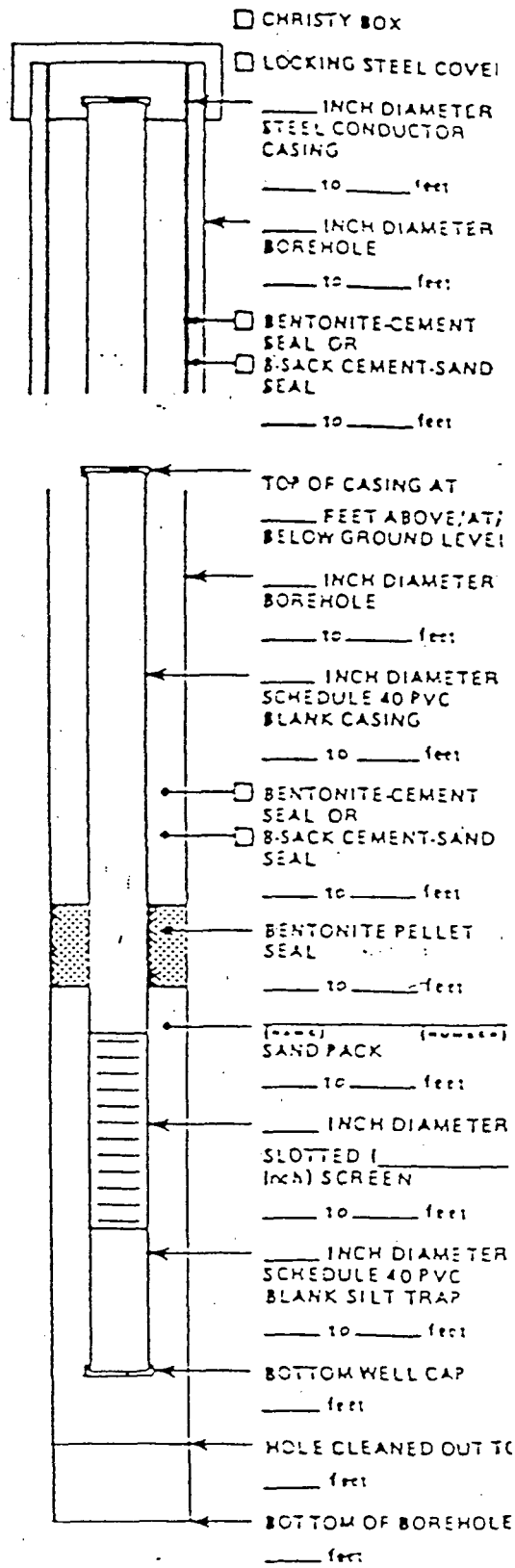
_____ YARD^3 CEMENT-SAND (REDI-MIX) USED

CONCRETE PUMPER USED? ☐ NO ☐ YES

NAME _____

WELL COVER USED: ☐ LOCKING STEEL COVER ☐ CHRISTY BOX ☐ OTHER _____

SILT TRAP USED? ☐ NO ☐ YES



NOT TO SCALE

ADDITIONAL INFORMATION: _____

301923

Harding Lawson Associates

Well Development Form

Project: _____ Well No. _____

Personnel: _____ Development Method _____ Date: _____

Time	Depth to Water (ft)	Gallons Removed	Turbidity (Ntu)	pH	Temp °C	E.C.	Recovery Rate Inches/min	Recovery Rate gpm	Observations

301924

Total Gallons Removed _____

Harding Lawson Associates
131 North Third Street
Philadelphia, PA 19106-1903
215/627-4505
Fax: 215/627-4250

CHAIN OF CUSTODY FORM

Lab: _____

Samplers: _____

Job Number: _____

Name/Location: _____

Project Manager: _____ Recorder: _____ *(Signature Required)*

SOURCE CODE	MATRIX: Water	Sediment	Soil	Oil	#CONTAINERS & PRESERV.: Unpres.	H_2SO_4	HNO_3	SAMPLE NUMBER OR LAB NUMBER: Yr	Wk	Seq	DATE: Yr	Mo	Dy	Time	STATION DESCRIPTION/ NOTES	ANALYSIS REQUESTED: EPA 601/8010	EPA 602/8020	EPA 624/8240	EPA 625/8270	ICP METALS	EPA 8015M/TPH

LAB NUMBER: Yr	Wk	Seq	DEPTH IN FEET	COL MTD CD	QA CODE	MISCELLANEOUS

CHAIN OF CUSTODY RECORD

RELINQUISHED BY: *(Signature)*	RECEIVED BY: *(Signature)*	DATE/TIME
RELINQUISHED BY: *(Signature)*	RECEIVED BY: *(Signature)*	DATE/TIME
RELINQUISHED BY: *(Signature)*	RECEIVED BY: *(Signature)*	DATE/TIME
RELINQUISHED BY: *(Signature)*	RECEIVED BY: *(Signature)*	DATE/TIME
DISPATCHED BY: *(Signature)* DATE/TIME	RECEIVED FOR LAB BY: *(Signature)*	DATE/TIME
METHOD OF SHIPMENT		

301925

Laboratory Copy Project Office Copy Field or Office Copy

6522

GROUNDWATER AND SOIL SAMPLE LABELS

Harding Lawson Associates

Job Name _____

Job Number _____

Collector _____ Date _____
(Signature)

Time _____ Place _____

Sample No. _____

Well/Boring No. _____

Depth _____

Harding Lawson Associates

Date: ___/___/___ By: _____

Job: _____ No: _____

Boring No: _____ Depth: _____

Full☐ Partial☐ Remarks:

HLA **CAUTION**

CONTAMINATED SAMPLE

Job: _____ Date: _____

No.: _____ By: _____

Contaminant: _____ Boring No.: _____

Remarks: _____ Depth: _____

301926

Custody Seal

Sealed by: _____ Date: _____

301927

APPENDIX AB

CONTAINER PRESERVATION, PACKAGING AND SHIPPING REQUIREMENTS

Appendix AB. Containers, Preservation, Packaging, and Shipping Requirements

Island Chemical Company
St. Croix, U.S. Virgin Islands

Analysis	Containers	Preservation	Technical Holding Time[1]	Volume of Container	Shipping	Normal Packaging
Groundwater Organic Analyses						
TCL VOCs	Three 40-ml glass vials with Teflon septum-lined caps	1:1 HCl to pH <2, cool to 4°C in dark storage	14 days	Fill completely, no air bubbles	Ship within 24-hours of collection by overnight carrier	Bubble pack
TCL SVOs	Two 1-liter amber glass bottles with Teflon™-lined caps	Cool to 4°C in dark storage	Extract within 7 days, analyze within 40 days after extraction	Fill 90% full	Ship within 24-hours of collection by overnight carrier	Bubble pack
Pyridine	Two 1-liter amber glass bottles with Teflon™-lined caps	Cool to 4°C in dark storage	Extract within 7 days, analyze within 40 days after extraction	Fill 90% full	Ship within 24-hours of collection by overnight carrier	Bubble pack
TCL Pesticides and PCBs	Two 1-liter amber glass bottles with Teflon™-lined caps	Cool to 4°C, $Na_2S_2O_3$	Extract within 7 days, analyze within 40 days after extraction	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Groundwater Inorganic Analyses						
TAL metals (unfiltered)	One 1-liter polyethylene bottle	HNO_3 to pH <2.0	6 months, except Hg - 28 days	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
TAL metals (filtered)	One 1-liter polyethylene bottle	HNO_3 to pH <2.0	6 months, except Hg - 28 days	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Cyanide	One 1-liter polyethylene bottle	NaOH to pH >12, cool to 4°C	14 days	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Soil Organic Analyses						
TCL VOCs	One 120-ml vial with Teflon™-septa lined lid	Cool to 4°C in dark storage	10 days	Fill completely	Ship within 24-hours of collection by overnight carrier	Bubble pack

Revised per USEPA August 5, 1994
\WORK\24231\02\SAP-CONT.RV1

Appendix AB. Containers, Preservation, Packaging, and Shipping Requirements

Island Chemical Company
St. Croix, U.S. Virgin Islands

Analysis	Containers	Preservation	Technical Holding Time[1]	Volume of Container	Shipping	Normal Packaging
TCL SVOs and Pyridine	Two 16-oz. amber glass jars with Teflon™-lined lid	Cool to 4°C in dark storage	Extract within 7 days and analyze within 40 days after extraction	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
TCL Pesticides and PCBs	One 4-oz wide-mouth glass jar with Teflon™-lined lid	Cool to 4°C	Extract within 7 days and analyze within 40 days after extraction	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Soil Inorganic Analyses						
TAL Metals	One 8-oz wide-mouth glass jar with Teflon™-lined lid	Cool to 4°C	6 months, except Hg - 28 days	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack
Cyanide	One 8-oz wide-mouth glass jar with Teflon™-lined lid	Cool to 4°C	14 days	Fill 90%	Ship within 24-hours of collection by overnight carrier	Bubble pack

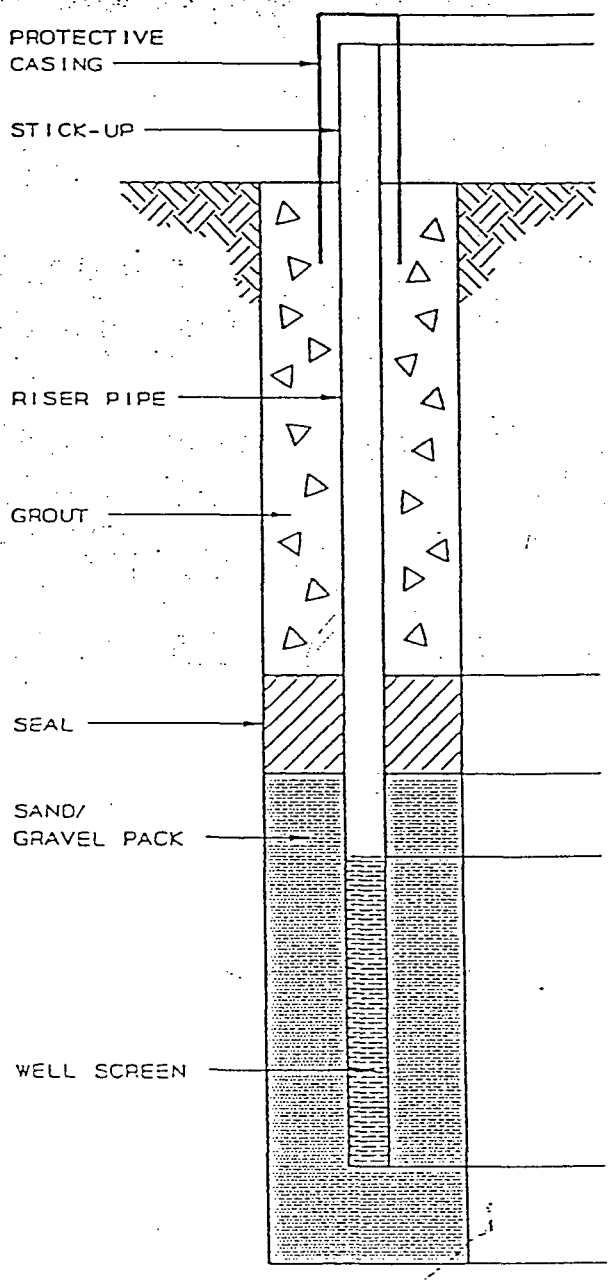
Parameters and detection limits will be consistent with methods listed in Tables C1-2 through C1-7 of the Quality Assurance Project Plan.
Sample containers will be prepared according to OSWER Directive No. 9240-05-05A, "Specification and Guidance for Obtaining Contaminant-Free Sample Containers, (December 1992)" or certified clean containers (e.g., I-Chem 300 series) will be used. Certificates of analysis verifying sample container cleanliness will be retained and available for review by USEPA.

[1]	The time of sample collection to extraction/analysis.	<	less than
>	greater than	°C	degree Celsius
g	gram	HCl	hydrochloric acid
H_2SO_4	sulfuric acid	Hg	mercury
HNO_3	nitric acid	ml	milliliter
NaOH	sodium hydroxide	$Na_2S_2O_3$	Sodium thiosulfate
oz.	ounce	SVOs	semivolatile organic compounds
TAL	Target Analyte List	TCL	Target Compound List
VOCs	volatile organic compounds		

APPENDIX AC

WELL CONSTRUCTION DETAILS

UNCONSOLIDATED MONITORING/RECOVERY WELL SPECIFICATION DIAGRAM



HLA PROJECT NUMBER: _____
WELL NUMBER: _____
WELL LOCATION: _____
DATE INSTALLED: _____
DRILLING CONTRACTOR: _____

DRILLING SPECIFICATIONS

DRILLING METHOD: _____
BOREHOLE DIAMETER: _____ IN.
DRILLING FLUID: _____
TOTAL BOREHOLE DEPTH: _____ FT.

WELL SPECIFICATIONS

SCREEN LENGTH: _____ FT.
DIAMETER: _____ IN.
SLOT SIZE: _____ IN.
MATERIAL: _____
COUPLING TYPE: _____

RISER LENGTH: _____ FT.
DIAMETER: _____ IN.
MATERIAL: _____
COUPLING TYPE: _____

STICK-UP: _____ FT. (AGS)
PROTECTIVE CASING HEIGHT: _____ FT. (AGS)
DIAMETER: _____ IN.
MATERIAL: _____
OTHER: _____

SAND/GRAVEL PACK SIZE: _____
MATERIAL: _____
SEAL MATERIAL: _____
GROUT MATERIAL: _____
GROUTING METHOD: _____

DEVELOPMENT METHOD: _____
DEVELOPMENT TIME: _____
ESTIMATED YIELD: _____
STATIC WATER DEPTH (IC): _____ FT.
DATE: _____
ELEVATION OF IC (NGVD 29): _____

REMARKS: All measurements are from ground surface unless stated otherwise.
NGVD 29 is National Geodetic Vertical Datum of 1929.

301932

Appendix B
Draft Health and Safety Plan
Island Chemical Company
St. Croix, U.S. Virgin Island

Prepared for

Island Chemical Company

HLA Project No. 24231 2.C.4

John J. Kohler
Designated Health and Safety Officer

Jason M. Schindler
Senior Geologist

August 5, 1994

Harding Lawson Associates
Engineering and Environmental Services
131 North Third Street
Philadelphia, PA 19106 – (215) 627-4505

PREFACE

Personnel participating in field activities must be trained in the general and specific hazards unique to this job and meet medical examination requirements as well as other requirements as set forth in 29 Code of Federal Regulations 1910.120 or other Occupational Safety and Health Administration regulations, as applicable. Site personnel and visitors must follow the guidelines, rules, and procedures in this document. The Project Manager or Site Health and Safety Officer may impose any other procedures or prohibitions judged necessary for safe operations.

This document is prepared to inform field personnel, including Harding Lawson Associates' contractors and subcontractors, of potential hazards onsite. However, each contractor or subcontractor must assume direct responsibility for the health and safety of their own employees.

This document was prepared for the sole use of Island Chemical Company, the only intended beneficiary of our work. No other parties should rely on the information contained herein without the prior written consent of HLA.

APPROVAL

Health and Safety Plan
Island Chemical Company
St. Croix, U.S. Virgin Islands

Plan Approved By:

John J. Kohler, Health and Safety Manager	Date
Edward A. Nemecek, HLA Project Manager	Date
Jason M. Schindler, HLA Assistant Project Manager	Date

Emergency Phone Numbers and Directions to St. Croix Hospital

Pertinent phone numbers for emergency situations are listed below:

Ambulance	922
Hospital	(809) 778-6311 St. Croix Hospital
Police	915
Fire	921

St. Croix Hospital has been contacted to assure that they can handle chemical exposure cases.

Directions to St. Croix Hospital are outlined below.

Turn left out of facility. Follow Melvin H. Evans Highway east. Pass a shopping center and stay in the left lane. Make a left at the traffic light (at Texaco service station). Follow around curve past a Kentucky Fried Chicken Restaurant (KFC) and stay in the center lane. Make the next right (after the KFC) and follow signs to St. Croix Hospital.

Emergency Contacts:

Corporate Health and Safety Officer (CHSO)	Peter Rice	(415) 892-0821 (office)
DHSO	John Kohler	(215) 627-4505 (office) (609) 273-0194 (home)
Project Manager	Edward Nemecek	(215) 627-4505 (office) (215) 428-1950 (home)
Asst. Project Manager	Jason Schindler	(215) 627-4505 (office) (215) 884-6085 (home)
Client Contact	Santo Guillermain	(201) 305-5408 (office)
USEPA Site Manager	Sherrel Henry	(212) 264-8675 (office)
GOVI Site Manager	_____	(___) ___-____ (office)

Emergency Signals

All field activities will cease in the event that an emergency situation occurs. The emergency situation will be signaled by a blast from a CO_2-propelled air horn.

The following hand/body emergency communication signals should be used when other forms of communication are difficult or impossible:

Signal	Meaning
Hand clutching throat	Out of air/can't breathe
Hands on top of head	Need assistance
Thumbs up	OK/I'm all right/I understand
Grip partner's wrist or both hands around partner's waist	Leave area immediately

If the emergency occurs in the Exclusion Zone, all field personnel will quickly move to the Contamination Reduction Zone for an appropriate decontamination before exiting to the Support Zone. In life-threatening emergencies, decontamination may not be appropriate. The emergency decontamination decision will be made by the SHSO. Emergency situations occurring outside of the Exclusion Zone or when using Level D PPE will not require decontamination at the Contamination Reduction Zone before administering first-aid.

Minor emergencies will be handled within the Support Zone utilizing the onsite first-aid kit. A portable emergency eyewash or a total of 32 ounces of eyewash fluid will be available in the CRZ. If working at a remote location (more than 15 minutes from an emergency medical facility), at least one HLA field person will be trained in first aid. The appropriate emergency response personnel (i.e., ambulance and fire department) will be contacted for all major emergencies.

The SHSO will drive the hospital route before field activities begin. A written report of all emergencies will be submitted to the DHSO. Accident related forms are located in Appendix BF. Copies of this report will also be sent to the appropriate agencies.

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

TABLES

FIGURES

APPENDIXES

B-1.0 INTRODUCTION

This Draft *Health and Safety Plan* (HASP) has been prepared by Harding Lawson Associates (HLA) on behalf of Island Chemical Company. This HASP describes health and safety aspects of work planned for the following activities, described in the Work Plan:

- Site Clearing;
- Monitoring well installation;
- Soil and groundwater sampling;
- Surveying;

The purpose of this HASP is to assign responsibilities, specify mandatory operating procedures, establish personal protection standards, and provide for contingencies that may arise during completion of the tasks listed above. The HASP addresses safety protocols which will be followed during field operations to minimize the probability of employee exposure.

The HASP has been developed to meet the requirements of the Occupational Safety and Health Administration (OSHA) regulations, Title 29, Code of Federal Regulations, Part 1910.120 (29 CFR 1910.120), *Hazardous Waste Operations and Emergency Response* and OSHA's Construction Industry Standard (29 CFR 1926).

B-2.0 SITE BACKGROUND

The site occupies approximately three acres in south central St. Croix, U.S. Virgin Islands. The site is located on Route 66 approximately 0.5 miles north of Alexander Hamilton Airport. A site location map is provided as Figure B-1 and a site map is provided as Figure B-2.

The site is bordered by an intermittent stream to the northeast and southeast; Route 66 to the southwest; and a cement plant to the east.

The site was formerly used to store and manufacture chemicals under several different companies from approximately 1969 through 1982. In January of 1989, the site was occupied by the St. Croix Security Kennels and VIAG Fuels Inc. (VIAG). VIAG used some office space in the main building and stored ethanol in four above-ground tanks. The facility is currently unoccupied.

A detailed description of the study area and history of the facility are presented in the project Work Plan.

B-3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

B-3.1 Harding Lawson Associates

The Island Chemical Company Work Plan, submitted to U.S. Environmental Protection Agency (USEPA) with this document, presents the overall project organization and responsibility structure. The health and safety responsibilities of key project personnel are discussed below.

B-3.1.1 HLA Corporate Health and Safety Officer

Mr. Peter B. Rice is responsible for development and oversight of HLA's health and safety program.

B-3.1.2 Regional Designated Health and Safety Officer

Mr. John J. Kohler is responsible for ensuring that corporate Health and Safety procedures are implemented throughout the region and for the development of this HASP. Questions regarding specific items on the HASP should be directed through Mr. Kohler.

As part of HLA's ongoing health and safety program, the CHSO has established a network of DHSOs who educate, update, and ensure compliance with HLA's *Corporate Health and Safety Procedures Manual* (HLA, November 1992). A DHSO is located in every HLA office. The DHSO will maintain contact with USEPA and the Government of the Virgin Islands (GOVI), as necessary, regarding health and safety issues. The DHSO will also be responsible for periodic field audits to verify compliance with the HASP.

B-3.1.3 Site Health and Safety Officer

Mr. Michael P. Sobel has been assigned the role of Site Health and Safety Officer (SHSO) for this project. Mr. Sobel will check that the guidelines, rules and procedures in this document are followed for all site work. He will be familiar with local emergency services. He will conduct a tailgate health and safety meeting before work start-up and at least weekly thereafter. Additional tailgate meetings may be required for specific job tasks, site activities, or when visitors come to the site. He will check that visitors have had hazardous waste site training and a medical examination within the past year. He will maintain and inspect PPE, monitor work area hazards, and monitor the physical condition of site personnel. He will shut down operations that pose a potential threat to field personnel.

The SHSO will be responsible for Health and Safety throughout the field operations. He/she will monitor work locations for proper procedures. The SHSO will have the authority to stop work if health and safety procedures cannot be followed. In addition, the SHSO will be responsible for producing written reports of health and safety incidents.

B-3.1.4 Field Operations Manager

Mr. James L. Collins has been assigned the role of Field Operations Manager for this project. Mr. Collins will check that all field personnel have read and signed the master copy of this document. He will check that all site personnel meet Occupational Safety and Health Administration (OSHA) requirements regarding training, medical examinations, and fit testing. He will conduct accident investigations in conjunction with the DHSO, as necessary.

B-3.1.5 Assistant Project Manager

Mr. Jason M. Schindler has been assigned the role of Assistant Project Manager. Mr. Schindler will acquaint field personnel with the overall scope of the project and ensure that project personnel have signed the master copy of this document. In conjunction with the DHSO, Mr. Schindler will check that all site personnel meet Occupational Safety and Health Administration (OSHA) requirements regarding training, medical examinations, and fit testing, conduct accident investigations, as necessary. Mr. Schindler will be responsible for preparation of project documents.

B-3.1.6 Project Manager

Mr. Edward A. Nemecek as been assigned the role of Project Manager. Mr. Nemecek will be responsible for conduct of HLA's work effort, coordination with ICC and regulatory agencies. Mr. Nemecek will complete an independent review of the data and final review of project documents.

B-3.2 Contractors and Subcontractors

Subcontractors will receive a copy of HLA's HASP for use as a guideline and for reference. Contractors will be required to indicate their understanding of the HASP by signing the appropriate personnel acknowledgement records in Appendix BB. However, subcontractors performing site work will be responsible for the health and safety of their own employees. The subcontractor(s) will identify a lead individual responsible for checking that each of their employees are in compliance with health and safety procedures.

Prior to start of work, each subcontractor conducting subsurface or onsite investigations will supply HLA with documentation that personnel under their control are participants in a medical monitoring program and have acceptable health and safety training. This documentation will be maintained with the subcontractor at the site and will include the following:

- Worker's name;
- Training program attended, trainer, and hours of training received;
- Statement from an occupational physician certifying participation in an annual and post employment medical surveillance program. The statement must include verification that the person is fit to wear a respirator;
- Documentation demonstrating successful respirator fit testing within the last year prior to Level C work activities.

B-3.3 Others

Other persons (visitors) such as USEPA and GOVI personnel who may enter the work areas or otherwise observe field activities should follow the guidelines, rules, and procedures in this document, and conduct work in a safe manner. Prior to entering any work areas, visitors supply the SHSO with documentation consistent with that listed in Section 3.2 above, and must attend a tailgate safety briefing given by the SHSO. The SHSO may restrict visitors from work areas if they do not have their own HASP or proper PPE.

B-4.0 PLANNED FIELD ACTIVITIES

Several types of field activities are planned. Some, but not all, include intrusive work. The level of health and safety protection varies, according to the type of activity. Field activities are listed below.

- Site Clearance;
- Monitoring well installation;
- Soil and groundwater sampling;
- Surveying;

Detailed descriptions of the procedures associated with each activity are provided in the Field Sampling Plan. Descriptions of health and safety procedures associated with each of these activities as well as recommended initial PPE levels are addressed in Section 11.0. The recommended initial levels may be modified by the SHSO depending on site conditions. Hazardous property information on chemicals that may be encountered is included in Appendix BA.

B-5.0 HARDING LAWSON ASSOCIATES' HEALTH AND SAFETY PROGRAMS

Required HLA health and safety programs, including training and medical monitoring, respiratory protection, and hazard communication are presented in this section.

B-5.1 Required Personnel Training

Specific training requirements for personnel, including subcontractors conducting field activities, are divided into the following training categories:

- Regular Site Personnel Exposed to Hazardous Materials
- Regular Site Personnel Potentially Exposed to Hazardous Materials Below Permissible Exposure Limits
- Occasional Site Personnel Potentially Exposed to Hazardous Materials Below Permissible Exposure Limits
- Management and Supervisory Training
- Refresher Training

These categories, as well as documentation, exempt personnel, tailgate meetings, and audits, are discussed in the following sections.

B-5.1.1 Regular Site Personnel Exposed to Hazardous Material

Site personnel whose job responsibilities cause them to be exposed to or to have the potential to be exposed to hazardous materials or health hazards are required to comply with 29 CFR Section 1910.120(e)(3)(i) and applicable local regulations. This regulation requires site personnel exposed to hazardous materials to complete 40 hours of offsite instruction and three days of field experience supervised by a trained supervisor.

B-5.1.2 Regular Site Personnel Potentially Exposed to Hazardous Materials Below Permissible Exposure Limits

Regular site personnel are persons whose job responsibilities cause them to be potentially exposed to hazardous substances below permissible exposure limits (PELs) or health hazards are required to comply with 29 CFR 1910.120(e)(3)(iii) and applicable local regulations. This regulation requires that these personnel receive a minimum of 24 hours of offsite instruction and one day of field experience supervised by a trained supervisor. The project SHSO or designated representative must check that these personnel will not be exposed above PELs. This decision will be made based on a review of previous monitoring in these work areas and historical site background information.

B-5.1.3 Occasional Site Personnel Potentially Exposed to Hazardous Materials Below Permissible Exposure Limits

Occasional site personnel who visit the site for a specific limited task and whose exposure is designated by the SHSO to be under PELs are required to comply with 29 CFR 1910.120(e)(3)(ii) and applicable local regulations. This regulation requires that these personnel receive the same training as that indicated in Section 5.1.2 above.

In accordance with 29 CFR 1910.120(e)(3)(iv) and applicable local regulations, regular (as defined in Section 5.1.2 above) and occasional site personnel having completed an initial 24-hour classroom instruction must complete an additional 16 hours of offsite instruction and two days of field experience supervised by a trained supervisor before they are qualified to engage in activities that may expose them to hazardous substances above PELs.

B-5.1.4 Management and Supervisory Training

In accordance with 29 CFR 1910.120(e)(4) and applicable local regulations, individuals who manage or supervise personnel engaged in hazardous waste operations at the site must receive 40 hours of offsite instruction and three days of field experience supervised by a trained supervisor. In addition, management and supervisory personnel shall receive an additional 8 hours of specialized training that addresses the safety and health program, training requirements, PPE and respiratory equipment programs, health hazard monitoring procedures, accident investigation, and emergency response procedures.

B-5.1.5 Refresher Training

Annual refresher training in accordance with 29 CFR 1910.120(e)(8) and applicable local regulations shall be completed at least annually following the completion of the individual's 40-hour or 24-hour training course. Personnel will be required to attend the annual refresher training to maintain their qualifications for hazardous waste site operations.

B-5.1.6 Documentation

Training must be properly documented and filed onsite for reference by the SHSO or designated representative. Personnel required to meet the training requirements must present evidence of this training at the site. The SHSO is responsible for checking before each activity to verify complete and current documentation. A copy of the documentation will be kept readily available or onsite, as applicable.

B-5.1.7 Exempt Personnel

Exempt personnel requesting access to the work areas could include personnel making deliveries or performing repairs to utilities, public or government officials, untrained visitors, or local residents. Individuals from these groups will not be required to comply with the training requirements as previously stated or the medical monitoring as discussed in Section 5.2. However, access will be limited to designated work, delivery, or observation areas to minimize potential exposure. Observation areas will be located upwind from site operations, as determined on the basis of predominant wind directions, so as to limit exposure to dust or chemical contaminants. Access to observation areas may be restricted by weather conditions or site activities. Approvals for exempting personnel and decisions on access limitation for other personnel will be handled on a case-by-case basis by the Field Operations Manager in consultation with the SHSO.

B-5.1.8 Tailgate Safety Meetings

A tailgate safety meeting shall be conducted at least weekly, whenever risks or hazards change, whenever new site personnel arrive, and when site operations warrant indoctrination and training. Tailgate safety meetings shall be conducted by the SHSO or another qualified individual. Where

procedural deficiencies are identified, additional safety meetings will be conducted to address the situation. The following will be addressed during the meetings:

- Review of planned activities
- Hazards suspected
- PPE required
- Communications procedures
- Field personnel responsibilities
- Decontamination procedures
- Emergency procedures

The tailgate safety meetings will be documented on the appropriate form (see Appendix BB).

B-5.1.9 Safety Inspections and Audits

The SHSO will inspect the site daily to identify potential hazardous conditions or work areas. The DHSO may visit the site periodically to evaluate whether that work operations are being conducted in compliance with the protocols and procedures outlined in this HASP.

B-5.2 Medical Monitoring

HLA field employees working at hazardous sites more than 30 days per year will receive a baseline and annual comprehensive medical evaluation to qualify for hazardous waste site assignments and to monitor work-related illness or contamination. Other employees who are exposed to hazardous substances or waste or who participate in physically challenging work will receive a baseline and periodic exams (less frequently than annually). The frequency of these exams will be determined upon consultation with HLA's medical consultant, Environmental Medicine Resources, Inc. (EMR), in Atlanta, Georgia.

Any employee who suffers an illness or injury that imposes a medical restriction on his or her job duties must have a physician's release statement indicating that he or she is fit for duty before the SHSO will permit that employee to return to full duty. This release must be issued by the area office contract physician.

Site personnel also receive exit medical examinations at the termination of their employment with HLA. Medical records of HLA employees are kept on file at EMR in Atlanta, Georgia. Clearance letters from EMR are kept at the HLA Philadelphia office. HLA is not responsible for subcontractor medical monitoring; however, subcontractors are expected to monitor their employees according to OSHA requirements.

Medical monitoring will include a medical examination and work history for each employee. Each employee will be evaluated to assess their ability to wear required PPE for site work. EMR is acquainted with 29 CFR 1910.120 and applicable local regulations. EMR will also be supplied with the employee's duty description, anticipated exposure levels, PPE to be used, and any applicable information from previous medical examinations. A copy of EMR's written opinion of the employee's fitness for hazardous duty will be provided to the employee.

Medical monitoring will be required for personnel at the site, including visitors, subcontractors, client representatives, USEPA and GOVI officials, and others visiting the work sites who may be exposed to contaminants exceeding accepted PELs. HLA is responsible for providing medical monitoring to HLA

personnel only. HLA is not responsible for providing medical monitoring for other parties visiting the site. However, HLA will review visitor certifications to assess whether the monitoring is up to date. Copies of the documentation will be kept readily available or onsite, as applicable.

B-5.3 Respiratory Protection Policy

HLA's respiratory protection program is managed by the DHSOs of the individual offices. The purposes of the program are as follows:

- Provide adequate respiratory protection to site personnel where there is a potential for exposure to toxic or nuisance substances in excess of allowable concentrations.
- Provide adequate respiratory equipment to employees who may request such equipment.
- Determine that employees assigned to site work requiring respiratory protection are physically able to wear respiratory protection equipment.
- Protect the employee's health during normal job duties.

Objectives of the respiratory protection program are as follows:

- Address the site hazards, the need for respiratory protection, and the selection of the appropriate National Institute for Occupational Safety and Health (NIOSH) or Mine Safety and Health Administration (MSHA)-approved equipment during preparation of this HASP.
- Use engineering controls at the work site to minimize the potential for exposure. If engineering controls are not feasible, respiratory equipment must be used.
- Make available to employees the HLA Health and Safety Policy and Procedures Manual describing the issuance, cleaning, inspection, and storage of respirators. This document is in each HLA office and is available for review by employees upon request.
- Fit test employees required to wear respirators using isoamyl acetate and/or irritant smoke or a quantitative fit test. Testing shall be conducted annually for work on hazardous waste sites or every six months for asbestos work. Records are maintained by the DHSOs in each office regarding whether the employee passed the fit test and what type and size respirator he or she is assigned.
- Inspect, maintain, sanitize, and appropriately store respirators, as determined by the DHSOs.

Site visitors, subcontractors, or others who may request entry into the work area where the potential for Level C activities exists must show proof of current (annual) respirator fit testing. Copies of this documentation will be kept readily available onsite, as applicable.

B-5.4 Hazard Communication

The DHSO in each HLA office is responsible for administering the program in his or her office. The hazard communication program governs "hazardous substances" and excludes "hazardous waste." This program is part of the Health and Safety Policy and Procedures Manual, which is generally kept in the DHSO's office and is available to employees for review.

B-5.4.1 Container Labeling

HLA requires that containers and secondary containers of hazardous substances both in the office and at the job site be labeled as to the contents and appropriate hazard warning.

B-5.4.2 Material Safety Data Sheets

Material Safety Data Sheets (MSDS) are obtained from the manufacturer when hazardous substances are purchased to conduct field activities. If the manufacturer does not include the MSDS when the item is shipped, the manufacturer will be contacted by telephone for a facsimile transmittal of the MSDS. The MSDSs are kept in the DHSO's office and at the support facility for field activities, as applicable. The DHSO of each office must maintain and review all MSDSs for new information. Significant health and safety information is made available to affected employees. Employees may request any or all MSDSs for review at any time. MSDSs for substances expected to be used during this investigation are included in Appendix BC.

B-6.0 KNOWN SUBSTANCES IN THE STUDY AREA

Available information indicates that volatile organic compounds (VOCs), semivolatile organic compounds (SVOs), and metals are the primary chemicals found in soils at the site. Chemicals previously identified as present onsite, the media in which they were detected, and the maximum detected concentrations are listed in Table B-1. Table 2-4 of the RIWP presents a complete list of substances reported at the site.

B-7.0 HAZARD EVALUATION AND MITIGATION

A summary of potential hazards thought be present in work areas are listed below. Procedures for first aid and emergency care are included in Appendix BD.

B-7.1 Chemical Hazards

Based on planned field activities, the following are potential chemical exposure pathways:

- Inhalation of airborne vapors and contaminated particulates;
- Eye and skin contact and absorption due to direct contact with vapors, liquids, and contaminated soil and sediment; and
- Incidental ingestion of contaminated liquids, particulates, and sediment.

Symptoms of exposure to VOCs and SVOCs may include headache, vertigo, visual disturbance, tremors, somnolence, nausea, vomiting, eye irritation, dermatitis, cardiac arrhythmias, paresthesia, central nervous system (CNS) depression, lassitude, fatigue, dilated pupils, insomnia and throat irritation. Carcinogenic effects may also be possible.

Mitigation of chemical hazards may include the use of PPE indicated in Section 9.0 and air monitoring with direct reading instruments to evaluate respiratory and explosion hazards. Underground pipelines should be located before drilling or excavating and the use of spark-ignition equipment prohibited in areas where the potential for explosion exists. No smoking will be permitted, except in designated areas.

Hazardous property information for common chemicals is included in Appendix BA.

B-7.2 Physical and Mechanical Hazards

Physical and mechanical hazards associated with the heavy equipment, tools, and field activities to be conducted include the potential for being struck by flying or falling objects during site clearance; slipping and falling due to wet or uneven surfaces; backstrain when moving equipment. Tripping hazards may be present in uneven, sloping, or wooded terrain.

Mitigation of physical and mechanical hazards may include the following:

- Stay clear of earth moving equipment whenever possible;
- Verify that equipment is in good condition;
- Use of proper lifting techniques;
- Do not stand or walk under elevated loads or ladders;

B-7.3 Electrical and Utility Hazards

Subsurface utilities may be present in work areas. In addition, overhead power lines may also be present. Electrical generators, submersible pumps, and other electrical equipment may also be used during this project. Mitigation of utility and electrical hazards may include but not be limited to the following:

- Buried utilities should be located and marked before drilling or excavating;
- A minimum of 10-foot clearance should be maintained from overhead power lines;

- If unavoidably close to buried or overhead power lines, have the power turned off, with the circuit breaker locked and tagged;
- Maintain at least a 30-foot clearance from overhead power lines;
- Properly grounded electrical equipment. Use only three-wire grounded receptacles and extension cords;
- Do not stand in water when operating electrical equipment;
- If equipment must be connected by splicing wires, make sure all connections are properly taped;
- Consider all wires live until locked and tagged out;
- Be familiar with specific operating instructions for each piece of equipment; and
- Obtain permits, licenses, or right of entry required by local authorities.

B-7.4 Acoustical Hazards

Acoustical hazards may be present during drilling, pumping, and sampling activities. When a noise level prevents conversation in a normal voice at a distance of 3 feet, use proper National Institute of Occupational Safety and Health (NIOSH)-approved hearing protection.

B-7.5 Heat Stress and Cold Stress

Heat stress may be a hazard depending on the time of year the work plan and sampling plans are implemented. See Appendix BD for first aid and emergency care.

B-7.6 Natural Hazards

Natural hazards such as sunburn or lightning may be present during field activities. On sunny days, wear long sleeves and/or sunblock. During severe storms, cease field activities and seek shelter until the storm has passed. For other natural hazards, consult the DHSO.

B-7.7 Biological Hazards

Biological hazards may include toxic plants, infectious waste, rabid, agitated, or disease carrying animals or pets, poisonous snakes, and disease carrying or stinging insects. Mitigation of these hazards may include the following:

- Learn to recognize toxic plants, such as poison ivy, poison oak, and poison sumac;
- Wear long-sleeved shirts, sturdy trousers, and boots when working near toxic plants to minimize the potential for skin contact;
- If exposed to toxic plants, shower as soon as possible with a strong soap (e.g., Fels Naphtha). Launder clothing;
- Do not touch plants that have hairy leaves, milky sap, thorny leaves, or fruit or seed pods;
- Do not touch infectious waste or any items suspected of being infectious waste;
- Do not approach or agitate animals, especially ones behaving strangely or foaming at the mouth;
- Use insect repellent to avoid contact with ticks, mosquitoes, and other insects, as necessary. Avoid contamination of field samples when using repellent;
- If possible, avoid contact with poisonous snakes or other reptiles by quietly walking away. If bitten, seek medical assistance immediately;
- Avoid contact with rodents because they are frequently hosts to fleas, which can carry typhus and other diseases. Rodent urine may also contain spirochetes harmful to human health; and
- Avoid encounters with stinging insects.

B-7.8 Fire/Explosion Hazards

Fires and explosions are not expected; however, ABC-rated fire extinguishers will be brought to the site. Drill rigs must have a 20-pound ABC-rated fire extinguisher. Fire extinguisher use is limited to fighting very small fires. Do not attempt to fight large fires.

Explosive or flammable material should only be stored in approved facilities as described in 27 CFR Section 181 or applicable local regulation, and there will be no smoking or spark equipment allowed within 50 feet of explosive or flammable storage or where flammable liquid or vapor is present. The SHSO may use a combustible gas indicator if he/she deems there is potential for explosive gas.

B-7.9 Airborne Dust Hazards

Airborne dust hazards may develop when strong winds or vehicle traffic are present. Take precaution to avoid breathing airborne dusts. Dust originating from the site may be contaminated (see Section B-7.1). If potentially contaminated dust is noticed in the breathing zone, employees must either don a respirator with HEPA filters, or spray the area with surfactant to minimize the respiration of dust particles.

B-7.10 Other Hazards

Confined space work, radiation hazards, and hazards associated with impoundments or bodies of water are not anticipated at this time. Should these or other hazards arise, either known or suspected, consult the DHSO.

Zones will be established to prevent or minimize exposure to hazards by establishing boundaries to reduce migration of contaminants into clean areas. For this site, a three-zone approach will be used for all field activities. The zones will be identified during safety briefings and will be clearly marked by traffic cones, barricades, signs, or other means. These three zones shall be designated as the Support Zone, the Contamination Reduction Zone, and the Exclusion Zone. Work area entrance and exit shall be through controlled access points established for each work location.

B-8.1 Support Zone

The Support Zone is the clean area in which the possibility of encountering hazardous materials or conditions is minimal. PPE and respiratory equipment are not necessary in the support zone. Inside the Support Zone, the following will be available: an effective means of communication, first-aid supplies, drinking water, and other equipment used on the project. The Support Zone shall also serve as the main point of contact for the visitor check-in and initiation of emergency services when necessary.

B-8.2 Contamination Reduction Zone

The Contamination Reduction Zone (CRZ) is the area where equipment and personnel are decontaminated before leaving the Exclusion Zone. Personnel will remove and/or decontaminate PPE and place it in appropriate containers. Site vehicles will be washed or steam cleaned and equipment will be decontaminated with soap and water in the CRZ. The CRZ will consist of a decontamination pad; a means of washing PPE, site vehicles, and equipment; containers for waste liquids, solids, CO_2-propelled air horns, and PPE; an eyewash/emergency shower; and a fire extinguisher.

Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in the CRZ.

B-8.3 Exclusion Zone

The Exclusion Zone includes the work activities at the site (e.g., drilling, sampling, etc.). Only authorized, trained, and qualified personnel with the appropriate PPE shall be admitted. Personnel entering the Exclusion Zone must use the buddy system. If a situation arises where the buddy system cannot be used, constant visual contact will be maintained with at least one other worker. The maximum distance permitted for visual contact is 200 feet.

Work activities within the Exclusion Zone pose the greatest possibility of exposure to personnel and equipment. The Field Operations Manager shall be responsible for controlling the access points and limiting needs for authorized personnel. The Exclusion Zone will be clearly marked with flagging, barricade tape, traffic cones, or other signals to limit access.

A "hot line" will be established between the CRZ and the Exclusion Zone. Unless emergency conditions exist, (see Section B-14.0) no one will exit the Exclusion Zone or CRZ without first implementing decontamination procedures. For drilling, well installation, sampling, and other intrusive work, a central decontamination station will be established for decontamination of material and equipment. Unauthorized personnel will not be permitted to pass the "hot line" and enter the contamination reduction zone or the exclusion zone. As the locations of field activities change, differing contaminant reduction and support zones may be established. Work areas are to be set-up similar to those depicted in Figure B-3.

Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material are prohibited in the Exclusion Zone.

B-8.4 Work Zone Control

Work zone layouts and locations will be established by the SHSO at the time of the work and will be demarcated with barrier tape, barrier ribbon, or other suitable warning devices.

B-8.5 Pre-determined Emergency Assembly Point

A pre-determined assembly point will be established daily for emergency purposes. The assembly point will be located in an upwind direction away from the work zone.

B-9.0 PERSONAL PROTECTIVE EQUIPMENT AND ACTION LEVELS

PPE is required to be worn by workers while conducting intrusive field activities. Initially, Modified Level D protection will be used for all intrusive activities. This will be upgraded to Level C or Level B, as necessary, if action levels or conditions warrant. Should air monitoring indicate sustained airborne concentrations of organic vapors in the breathing zone above 500 parts per million, Level A PPE would be required. However, work requiring Level A PPE is beyond the anticipated scope of this project and is therefore, not described. Should a situation requiring Level A PPE arise, personnel shall evacuate the area and the DHSO should be notified.

PPE levels to be used are defined as follows:

Level D PPE

Cloth coveralls/field clothes
Cloth or latex gloves
Chemical splash goggles when liquids present or safety glasses
Steel-toed chemical-resistant boots or leather workboots (use of butyl rubber overboots is dependent on site conditions and the likelihood of working in wet areas)

Modified D PPE

Tyvek™ or Saranex™ coveralls
Inner latex gloves and nitrile outer gloves
Hardhat
Chemical splash goggles when liquids are present or safety glasses
Steel-toed chemical-resistant boots with butyl rubber overboots
Foam earplugs or ear muffs (when necessary as defined in Section B-7.4)

Level C PPE

Inner latex gloves and nitrile outer gloves
Hardhat
Safety glasses or chemical splash goggles (if use of a 1/2-face respirator is permitted by the SHSO)
Steel-toed chemical-resistant boots with butyl rubber overboots
Foam earplugs or ear muffs (when necessary as defined in Section B-7.4)
Full-face or half-face air-purifying respirator

Level B PPE

NIOSH-approved supplied air respirator with escape self contained breathing apparatus
Tyvek™ or Saranex™ coveralls
Inner latex gloves and nitrile outer gloves
Hardhat
Steel-toed chemical-resistant boots with butyl rubber overboots
Foam earplugs or ear muffs (when necessary as defined in Section B-7.4)

Action levels for known contaminants shall be based on the PEL or Threshhold Limit Values (TLVs) of the contaminants, whichever is the most conservative. Air monitoring will indicate airborne concentrations of organic vapors in the breathing zone. Action levels for unknown contaminants are based on the following:

Sustained Instrument Reading for One Minute of Unknown Substance in Breathing Zone	Action
Background	Modified Level D
Above background to 5 ppm	Level C
5 to 500 ppm above background	Level B
Greater than 500 ppm above background	Evacuate the area and notify the DHSO

PPE for HLA employees will be supplied by the SHSO. Subcontractors and visitors will be required to supply their own PPE. Organic vapor respirator cartridges must be replaced daily or whenever evidence of contaminant breakthrough occurs. Breakthrough describes a situation where the respirator cartridge filtering media no longer filters out contaminants, and contaminants can pass through the respirator cartridge, rendering it ineffective. Noticeable odors inside the respirator indicate breakthrough has occurred.

B-10.0 AIR MONITORING AND SITE OPERATIONS

This section describes instruments and procedures that will be used for air monitoring activities. It may not be necessary to perform all of these activities at every work location. Decisions regarding air monitoring will be made by the DHSO and the SHSO.

A daily monitoring log will be kept by the SHSO for each piece of air monitoring equipment. The following information will be recorded:

- Name and model number of the equipment;
- Calibration information;
- Field work to be performed;
- Air monitoring results and monitoring locations;
- PPE worn;
- Accidents or incidents; and
- Unusual occurrences and personnel complaints.

B-10.1 Gases and Vapors

A flame ionization detector (FID) will be used to monitor breathing zone concentrations of VOCs. Monitoring will be conducted continuously during sampling or intrusive activities. Due to low response, detector tubes will be used for carbon tetrachloride and chloroform when the FID shows sustained readings above background. Calibration of monitoring equipment will be performed daily before start-up of work. Calibration gases to be used will be specific to the instrument per manufacturer instructions. HLA's standard operating procedures for field calibration and maintenance of direct reading instruments, personal sampling pumps, and detector tubes is presented in Appendix BE.

B-10.2 Explosion Hazard

A combustible gas indicator (CGI) may be used at the work areas as appropriate to monitor the possible presence of flammable gases (e.g., methane) or vapors. Equipment calibration will be performed daily before start-up of work as described in Appendix BE. The alarm will be set to 10 percent of the LEL. If feasible, the calibration gas used will be specific to the combustible gases that may be present.

Periodic monitoring for the presence of combustible gases will be performed at the sampling point. If the monitoring instrument indicates the LEL is greater than 10 percent, immediately shut down all equipment, if possible, and personnel must leave the area. Notify DHSO immediately. Explosion-proof engineering controls, such as supply fans should be used to lower the LEL if possible. Personnel must not reenter the area until the LEL is less than 10 percent.

B-10.3 Oxygen Deficiency in Confined Spaces

Confined space entry is not anticipated during this project. Should the need arise, however, before entering a confined space, an oxygen meter must be used to measure the oxygen concentration in air. If the oxygen concentration is less than 19.5 percent or greater than 23 percent, entry to the space is prohibited. Supply fans should be used to ventilate the area. If the oxygen concentration cannot be stabilized between 19.5 and 23.5 percent, Level B PPE must be donned to enter the confined space. Contact DHSO before proceeding into confined spaces. Permits may be required to enter confined spaces.

B-11.0 RECOMMENDED LEVELS OF PROTECTION AND SAFETY PRECAUTIONS

Initial recommended levels of PPE for the various field activities are described below. They may be upgraded or downgraded, as necessary, by the SHSO as air monitoring results or site conditions permit.

B-11.1 Site Clearance and Surveying

Site clearance and surveying should present the lowest chemical hazard to personnel since these operations result in minimal disturbance of contaminated areas. Level D protection has been initially selected for site clearance and surveying.

B-11.2 Monitoring Well Installation, Soil Sampling, and Groundwater Sampling

Modified Level D PPE has been initially selected for soil sampling, groundwater sampling and slug unless air monitoring results exceed the action levels described in Section B-9.0, in which case the PPE will be upgraded appropriately. For groundwater sampling, the well head should first be opened and allowed to vent for at least one minute prior to performing the work and personnel should approach the wells from an upwind direction. Personnel should remain in an upwind direction whenever possible.

The St. Croix Department of Public Works (DPW) will be advised of proposed well locations prior to drilling. The DPW will advise whether proposed drilling locations will intercept underground utilities in the area, if any.

Safety cones, safety vests, barrier ribbon, or other types of highly visible placarding or warning devices will be used if drilling activities take place on or near roadways or railways.

B-12.0 PERSONNEL DECONTAMINATION PROCEDURES

Equipment decontamination procedures are described in the Sampling and Analysis Plan (Appendix B).

The sequence for personnel decontamination for Level C PPE or Level B PPE field activities is described below. Personnel decontamination for Level D PPE or Modified Level D PPE activities will include the applicable procedures described below. Decontamination will occur at a temporary job site decontamination pad as follows:

1. If gross contamination is present, remove using water or other appropriate solution and rinse in clean water taking care to prevent moisture from entering respirator cartridges.

2. Remove disposable overboots (if used). Remove outer gloves.

3. Wash chemical-resistant boots with detergent solution and rinse with clean water.

4. Remove belt of SCBA straps (if used) and remove coveralls. Starting at the neck, roll the coveralls off from the inside out and down past the boots. Take care to prevent the release and dispersion of dusts or prevent contact with decontamination water that may have accumulated on the coveralls. Do not contaminate clothing inside the coveralls during removal.

5. Place disposable PPE in an appropriate container for disposal.

6. Remove the respirator. Clean and disinfect the respirators and place into a plastic bag for storage.

7. Remove inner gloves.

8. Thoroughly wash hands and face.

Information as to the container contents, the location the contents were collected, and the date filled will be recorded on the container and in the daily log.

B-13.0 GENERAL HEALTH AND SAFETY PROCEDURES

The following health and safety procedures will be used:

- HLA personnel conducting work activities at the site will be participants in the Company's Health and Safety Program which includes mandatory OSHA training and medical surveillance.
- A copy of the HASP will be kept onsite at all times
- A supply of PPE will be kept onsite in sufficient quantity to enable field personnel to conduct their duties in a safe manner.
- Tailgate safety meetings will be conducted daily or on an as needed basis to discuss hazards associated with tasks to be performed, personnel protection protocol, and emergency procedures.
- A copy of the HASP will be supplied to all field HLA field employees for their review and signature.
- No eating, drinking, or smoking will be permitted in contamination reduction or exclusion zones.
- No source ignition will be permitted in contamination reduction or exclusion zones areas unless cleared by the DHSO or SHSO.
- Work will cease during hazardous weather conditions such as thunderstorms or tornadoes.

B-14.0 EMERGENCY INFORMATION AND CONTINGENCY PLAN

B-14.1 Emergency Phone Numbers and Directions to St. Croix Hospital

Pertinent phone numbers for emergency situations are listed below:

Ambulance	922
Hospital	(809) 778-6311 St. Croix Hospital
Police	915
Fire	921

St. Croix Hospital has been contacted to assure that they can handle chemical exposure cases.

Directions to St. Croix Hospital are outlined below.

Turn left out of facility. Follow Melvin H. Evans Highway east. Pass a shopping center and stay in the left lane. Make a left at the traffic light (at Texaco service station). Follow around curve past a Kentucky Fried Chicken Restaurant (KFC) and stay in the center lane. Make the next right (after the KFC) and follow signs to St. Croix Hospital.

Emergency Contacts:

Corporate Health and Safety Officer (CHSO)	Peter Rice	(415) 892-0821 (office)
DHSO	John Kohler	(215) 627-4505 (office) (609) 273-0194 (home)
Project Manager	Edward Nemecek	(215) 627-4505 (office) (215) 428-1950 (home)
Asst. Project Manager	Jason Schindler	(215) 627-4505 (office) (215) 884-6085 (home)
Client Contact	Santo Guillermain	(201) 305-5408 (office)
USEPA Site Manager	Sherrel Henry	(212) 264-8675 (office)
GOVI Site Manager	_____	(___) ___-____ (office)

B-14.2 Emergency Signals

All field activities will cease in the event that an emergency situation occurs. The emergency situation will be signaled by a blast from a CO_2-propelled air horn.

The following hand/body emergency communication signals should be used when other forms of communication are difficult or impossible:

Signal	Meaning
Hand clutching throat	Out of air/can't breathe
Hands on top of head	Need assistance
Thumbs up	OK/I'm all right/I understand
Grip partner's wrist or both hands around partner's waist	Leave area immediately

If the emergency occurs in the Exclusion Zone, all field personnel will quickly move to the Contamination Reduction Zone for an appropriate decontamination before exiting to the Support Zone. In life-threatening emergencies, decontamination may not be appropriate. The emergency decontamination decision will be made by the SHSO. Emergency situations occurring outside of the Exclusion Zone or when using Level D PPE will not require decontamination at the Contamination Reduction Zone before administering first-aid.

Minor emergencies will be handled within the Support Zone utilizing the onsite first-aid kit. A portable emergency eyewash or a total of 32 ounces of eyewash fluid will be available in the CRZ. If working at a remote location (more than 15 minutes from an emergency medical facility), at least one HLA field person will be trained in first aid. The appropriate emergency response personnel (i.e., ambulance and fire department) will be contacted for all major emergencies.

The SHSO will drive the hospital route before field activities begin. A written report of all emergencies will be submitted to the DHSO. Accident related forms are located in Appendix BF. Copies of this report will also be sent to the appropriate agencies.

B-14.3 Contingency Plan

This Contingency Plan has been developed by HLA to present procedures that should be followed in the event of an emergency at a field operation. A variety of events that are potential hazards to human health and the environment are discussed, including the following:

- Personnel Injury
- A funnel cloud or tornado sighting
- An explosion
- A chemical or petroleum spill or accident
- Other events presenting a hazard to human health or the environment

This section also specifies the general procedures you should follow, whom you should notify, and the information you should report if you are the first on the scene of an emergency.

B-14.3.1 Response Sequence for First Arrivals

If you are first on the scene, respond as follows:

1. Evacuate the incident area (if necessary). Remember that your safety must be the primary consideration.

2. Restrict access to the incident area.

3. Restrict the use of ignition sources for incidents involving flammable substances.

4. Contact the Field Operations Manager or the local emergency response organization (see Section B-14.1 for telephone numbers). Report the following information:

   - Your name
   - Company affiliation
   - Telephone number from which you are calling
   - Location and type of incident

- Injuries, if any, and the number and type of those injuries (note respiration, consciousness and heart beat)
- Details concerning the substance(s) involved (identification, amount, spill rate, size of area involved), if known
- Direction the spill is moving and the direction the wind may be dispersing airborne contaminants
- Surficial material on which the spill occurred (i.e., asphalt, gravel, etc.)
- Any first response action that has been taken
- The time the incident occurred or when you discovered it
- Any additional pertinent information

5. Notify the SHSO after the emergency response team has been contacted. The SHSO will then notify the local DHSO.

6. Coordinate with emergency response personnel when they arrive.

B-14.3.2 Response for Incidents Involving Another Contractor

If the incident involves another contractor's activity:

- Evacuate the area immediately. Proceed to the predetermined assembly point (see Section B-8.5).
- Decontaminate and remove PPE if the incident is not life- or health-threatening.
- Make sure the SHSO knows you are present.

B-14.3.3 Emergency Response for Severe Weather Conditions

This section specifies what you should do in the event of a severe weather emergency, including electrical storms, high winds, heavy rain or hail, and tornados.

Electrical Storms

- Seek shelter at the support facility or in the field vehicles.
- Do not stand near or under high objects, such as trees and drilling rigs.
- If possible, lower the drilling rig mast.

High Winds

- Seek shelter at the support facility (if anchored) or in the field vehicles.
- Do not drive high-profile vehicles at high speeds.
- Park vehicles heading into the wind.
- Avoid breathing dust (don a respirator or wear safety goggles and a kerchief covering your nose and mouth).

Heavy Rain or Hail

- Seek shelter at the support facility or in the field vehicles.
- Do not attempt to drive a vehicle if you are in an area that is or has the potential for flooding unless you are moving out of a low area.

Tornadoes

- Seek shelter underground or in a closet, bathroom, or interior wall of a substantial building.
- Get under something sturdy and cover your head.
- Do not stay in a trailer or vehicle. If you cannot get to shelter leave the trailer or vehicle and lie flat in the nearest ditch if substantial shelter is not available.
- Stay away from large areas of glass.
- Be aware of the potential for live downed wires.
- Make sure the telephone handset is on the hook. Do not use the telephone for non emergency calls.

B-14.3.4 Emergency Response for Earthquakes

Inside

If an earthquake occurs while you are in a building, follow these instructions:

- If near an exit, leave the building fast.
- Stand in an interior doorway or get under a desk or table.
- Stay away from areas containing a large amount of glass.
- Do not use stairways or elevators during the tremor.
- If possible, turn off gas supplies and ignition sources.
- Be aware of the potential for live downed wires.
- Make sure the telephone handset is on the hook. Do not use the telephone for non emergency calls.
- Evacuate the building when the tremors have ceased. Be aware of the potential for aftershocks.
- Report to a predetermined assembly area and notify your supervisor or the area monitor that you are safe.
- Report missing persons.

Outside

If an earthquake occurs while you are outside, follow these instructions:

- Avoid buildings, trees, areas with large amounts of glass, and power lines.
- Avoid downed wires.
- If operating heavy equipment or a motor vehicle, stop immediately but stay in the vehicle until the tremors have stopped.
- If operating a motor vehicle on a bridge, proceed to solid ground if the end of the bridge is close.
- If operating a motor vehicle on a bridge at mid-span, get out of the vehicle and walk to the nearest solid ground.

B-14.3.5 Emergency Response for Flash Floods

If a flash flood warning is issued, climb to higher ground. Seek shelter on stable ground. Do not stay in an area that is characterized by uncompacted material on a steep slope.

B-14.3.6 Emergency Response for Fires

If a small fire occurs, extinguish it with the fire extinguisher in the field vehicle (ABC extinguisher). Remember to follow these directions to put out the fire:

- Use the appropriate type of fire extinguisher (e.g., do not use a water type fire extinguisher on an electrical fire).
- Aim at the base of the flame.
- Remember that the contents of the extinguisher only lasts a few seconds.

If a large fire occurs at the work site, follow these instructions:

- Move flammable and combustible items, if possible, out of the path of the fire.
- Call the fire department.
- Do not attempt to put out a large fire with the field vehicle fire extinguisher.
- Report the incident to the Field Operations Manager.

B-14.3.7 Fire Prevention

Steps to be taken to minimize the potential of a fire include the following:

- Obey "No Smoking" signs
- Label and store flammable liquid containers in a protected, ventilated and approved area
- Use only approved containers for flammable liquid storage
- Use minimal amounts of flammable liquids
- Shut off engines before refueling, if possible
- Do not refuel a hot engine unless an ABC-rated fire extinguisher is nearby
- Store oily rags in a self-closing metal container. Dispose container properly
- Bond and ground all flammable liquid containers and transfer equipment when transferring or filling product
- Use intrinsically safe equipment in areas potentially containing flammable vapor.

B-14.3.8 Emergency Response for Explosions

If an explosion occurs, follow these instructions:

- Evacuate the site immediately.
- If feasible, decontaminate yourself and others.
- Do not address medical emergencies until you are out of danger.
- Call the Field Operations Manager or local emergency response organization when you are out of danger to report the incident.

B-14.3.9 Emergency Response for Spills

The following sections provide guidance regarding emergency response to a chemical spill or accidental discharge of groundwater, including initial response to the incident and cleanup. Precautions you should take to minimize the likelihood of a spill are presented in Section B-14.3.9.4.

B-14.3.9.1 Initial Spill Response

When a spill occurs:

- Minimize or contain the flow by shutting off a valve, repairing the leak, righting an overturned barrel, or whatever action is appropriate. Remember that your safety is of primary concern. Only attempt emergency response actions if you can do so without injury or harm to yourself.

- Provide first-aid to injured persons as needed.

- If the spill occurs on a porous surface (e.g., soil, gravel) mark the area in preparation for excavation if that is determined to be the appropriate response action. If the spill occurs on concrete, asphalt, or similar material, use sorbent material to contain the spill. Adsorbent materials will be kept in the support facility. Cover the area with soil, a tarp, plastic, or other appropriate material if the spilled material is volatile and cannot be cleaned up immediately.

- Contact the Field Operations Manager or the local emergency response organization (as applicable) to report the incident. At least two HLA personnel must remain near the work area in a safe location 30 feet upwind of the spill until emergency response representatives arrive.

- Depending on the location and chemical nature of the spilled liquid, initial response action may require donning Level C or Level B PPE.

B-14.3.9.2 Spill Site Decontamination

HLA and subcontractor site personnel involved in the response action will undergo personal decontamination upwind of the incident site. The SHSO will authorize field personnel to leave the job site or continue work, as appropriate. The Field Operations Manager will provide guidance regarding decontamination and/or disposition of equipment and vehicles.

If personnel come in contact with fuel, they should remove and dispose contaminated PPE, change out of contaminated field clothing, and wash exposed skin with soap and water.

B-14.3.9.3 Cleanup Materials and Used Personal Protective Equipment Disposal

- Materials used in spill cleanup must be containerized. The Field Operations Manager should assess whether the surficial material on which the spill is located requires treatment or removal and relay this information to the project manager.

- Equipment and tools used during spill cleanup will be decontaminated following procedures described in the Sampling and Analysis Plan (see Appendix A).

B-14.3.9.4 Spill Prevention

To minimize the potential for a spill, you should follow these guidelines:

- Inspect stored materials at the beginning of each work shift. Any abnormalities and steps taken to remedy the situation must be reported immediately to the Field Operations Manager.

- Inspect equipment at the beginning of each day. Equipment condition, as well as any notation of leaks or staining that may be related to or indicative of a potential spill, will be recorded in a field logbook and reported to the field operating manager. Loose and or worn connections and worn hoses will also be noted. Any abnormalities must be reported immediately to the Field Operations Manager and steps will be taken to remedy the situation before continuing transfer activities.

- Make sure materials being stored are compatible with the containers in which they are being stored. Materials that are likely to react when exposed together will not be stored in the same area. Caustics and corrosives will be stored in separate cabinets affixed with caution labels. Spillable items, if stored on shelves, will be no higher than 4 feet off the floor surface. (This height is to limit the potential for getting a toxic substance in the eyes).

- Liquid storage containers must have a secondary containment system such as a liner with a berm constructed of 4-inch by 4-inch boarding that can contain a quantity 10 percent greater than that of the original container.

- Transfer liquid with catch basins under each joint or valve or with the hose or pipe lined so that no liquid can escape.

B-14.3.10 Responsibilities of Field Personnel

- Wear the correct and appropriate PPE for the task.
- Use monitoring equipment applicable to the anticipated hazards
- Have a decontamination area set up for fieldwork.
- Use approved decontamination procedures as discussed in Section B-12.0 of this HASP and in the project Sampling and Analysis Plan (Appendix A).
- Maintain a means to decontaminate affected personnel.
- Treat minor injuries using the onsite first-aid kit.
- Take personnel with serious injuries to St. Croix Hospital or contact a medical emergency response team.
- Contact emergency response for health- or life-threatening injuries. Victims should be taken to St. Croix Hospital by the medical emergency response team
- All personnel at the site where the incident has occurred must completely decontaminate and be debriefed by the SHSO before leaving the job site (see Section B-15.0).

B-14.3.11 Emergency Response Equipment

The following is a list of equipment that is required to be available for emergency response actions:

- 10-pound ABC-rated fire extinguisher
- First-aid kit
- Eyewash station or eyewash bottles
- Cellular phone or radio

B-15.0 EMPLOYEE EXPOSURE/INJURY INCIDENT REPORT

In the event of an employee exposure or injury incident, an employee accident report will be filed with the DHSO and Project Manager. This form is included in Appendix BF.

TABLES

Table BA1. Hazardous Property Information

Island Chemical Company, Inc.

ompound	Water Solubility[a]	Specific Gravity	Vapor Density	Flash Point (° F)[b]	Vapor Pressure[c]	LEL/UEL	TLV-TWA[d]	IDLH Level	Hazard Properties[e]	Acute Exposure Symptoms[f]
cenaphthene	Insoluble	1.024	5.32	N/A	10 @ 131.2°F	N/A	N/I	N/I	Tox	Eye, Skin
cenaphthylene	3.93 @ 25°C	0.8988	N/I	N/I	9.12×10^{-4}	N/I	0.2 mg/m^3	N/I	Flam, Tox, Carc	Eye, Resp, Skin
cetic acid esters	Soluble	1.0492	5.32	110	11 mm	5.4%/16%	10 mg/m^3	1000 mg/m^3	Flam	Eye, Resp, Skin
cetic acid [glacial]	Miscible	1.05	N/I	102	11 mm	4.0%/19.9%	10 ppm	1000 ppm	Comb, Cor, Tox	Eye, Resp, Skin
cetic anhydride	12%	1.08	N/I	120	4 mm	2.7%/10.3%	5 ppm	1000 ppm	Comb, Cor, Tox	Eye, Resp, Skin
cetone	Miscible	0.8	2.0	0	180	2.5%/13%	750 ppm	20,000 ppm	Flam, Tox, Vol	Diz, Drow, Eye, Resp, Skin
cetonitrile	Miscible	0.78	N/I	42	73 mm	3.0%/16.0%	20 ppm	4,000 ppm	Comb, Tox	CNS, Eye, Skin
crolein	40%	0.8410	1.9	-15	210	2.8%/31%	0.1 ppm	5 ppm	Flam, Tox, React, Vol	Alxl, CNS, Conv, Diz, Diar, Drow, Eye, Head, Naus, Resp, Skin, Trem, Uncon, Vom, Weak,
crylonitrile	7.0%	0.8000	1.8	30	83	3%/17%	1 ppm	50 ppm	Flam, Tox, React, Carc	Diz, Eye, Head, Naug, Resp, Skin, Trem, Weak
ldrin	Insoluble	1.7	N/A	121	6×10^{-6}	N/A	0.25 mg/m^3	100 mg/m^3	Flam, Tox, Scarc	CNS, Coma, Conv, Diz, Eye, Head, Naus, Resp, Skin, Uncon, Vom
lpha-endosulfan	Insoluble	1.74	N/A	N/A	1×10^{-5}	N/A	0.1 mg/m^3	N/E	Tox	Coma, Conv, Diar, Eye, Head, Naus, Resp, Skin
uminum	Insoluble	2.708	N/A	N/I	N/A	—[h]	5 mg/m^3	N/I	Flam, Tox, Scarc	Eye
mmonia	Soluble	0.77	0.59	N/A	6460	16%/25%	25 ppm	500 ppm	Cor, Tox	Eye, Resp, Skin
nthracene	Insoluble	1.25	6.15	250	1.0	0.6%/?	0.2 mg/m^3	200 mg/m^3	Flam, Tox, Carc	Skin
ntimony	Insoluble	6.69	N/A	N/A	0.0	N/A	0.5 mg/m^3	80 mg/m^3	Tox	Diar, Eye, Head, Vom
rochlor 1254	12 µg/l	1.50	N/I	>286	7.7×10^{-5}	N/I	0.5 mg/m^3	5 mg/m^3	Tox, Scarc	Eye, Resp, Skin
rochlor 1260	Slightly	1.58	N/I	>286	4.05×10^{-5}	N/I	0.5 mg/m^3	5 mg/m^3	Tox, Scarc	Eye, Resp, Skin
rsenic	—[i]	5.727	N/A	N/A	N/A	N/A	10 µg/m^3	100 mg/m^3	Tox, React, Carc	Abd, Coma, Conv, Diar, Fevr, Resp, Skin, Trem, Vom, Weak
sbestos	Insoluble	Variable	N/A	N/F	N/A	N/F	0.2 to 2 fibers/cc	N/E	Tox, Carc	Resp, Skin
nzine	70 ppm	1.07	N/A	N/A	3.0×10^{-7}	N/A	5 mg/m^3	N/E	Tox	Eye, Resp, Skin

last page for notes

Table BA1. Hazardous Property Information

Island Chemical Company, Inc.

ompound	Water Solubility[a]	Specific Gravity	Vapor Density	Flash Point (° F)[b]	Vapor Pressure[c]	LEL/UEL	TLV-TWA[d]	IDLH Level	Hazard Properties[e]	Acute Exposure Symptoms[f]
irium	Soluble	3.6	N/A	N/A	N/A	N/A	0.5 mg/m^3	250 mg/m^3	Flam, Tox	Eye, Resp, Skin
entonite	N/A	2.5	N/A	N/A	N/A	N/A	0.3 mg/m^3	N/I	Tox	Resp
enzaldehyde	Soluble	1,043	NI	62	NI	NI	NI	NI	Cor, Tox	NI
enz(a)anthracene	Slightly	N/I	N/I	N/I	38 x 10^{-7}	N/I	N/I	N/I	Tox, Scarc	N/I
enzene	820 ppm	0.8765	2.8	12	75	1.3%/7.9%	0.1 ppm	3000 ppm	Flam, Tox, Carc	CNS, Coma, Conv, Diz, Drow, Eye, Head, Naug, Resp, Skin, Trem, Vom, Weak
enzene alcohol	No Information Found									
enzenethiol	Insoluble	1.0728	N/I	127	2	N/I	.05 ppm	N/I	Flam, Tox	Diz, Eye, Head, Naus, Resp, Skin, Vom
enzidine	Soluble	1.250	0.36	N/A	N/I	N/A	No safe level	N/E	Flam, Tox, Carc	Eye, Resp, Skin
enzo(a)pyrene	Slightly	1.351	0.7	N/I	>1	N/I	0.1 mg/m^3	N/I	Tox, Scarc	Eye, Resp
enzo(ghi)perylene	Insoluble	N/I	N/I	N/I	1 x 10^{-10}	N/I	N/I	N/I	Tox, Scarc	N/I
enzoic acid	Slightly soluble	1.2659	4.21	121	1 @ 95°C	N/A	N/I	N/I	Cor, Flam, Tox	Eye, Resp, Skin
enzophenone	Insoluble	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I
enzoquinone	Slightly	1.32		100	0.1 mm	N/I	0.4 mg/m^3	300 mg/m^3	Cor, Tox	Eye, Skin
nzothiazol	Slightly	1.246 @ 20°C	N/I	N/I	N/I	N/I	N/I	N/I	React	N/I
nzyl alcohol	Slightly soluble	1.040 to 1.050	3.72	220	0.0	0.0	0.5 mg/m^3	N/I	Tox	Diar, Head, Naus, Skin, Vom
ryllium	—[i]	1.85	N/A	N/A	N/A	—[h]	2 µg/m^3	10 mg/m^3	Tox, Carc	Resp, Weak
IC, A, G (lindane)	Insoluble	1.85	N/A	N/A	0.32	N/A	0.5 mg/m^3	1000 mg/m^3	Tox, Carc	CNS, Eye, Resp, Skin
-2(Ethylhexyl)-thalate	2000 ppm @ 25°C	0.9861	16.0	420	N/I	N/I	5 mg/m3	N/E	Tox, Tera	Abd, Diar, Eye, Resp, Naus
ron	Insoluble	2.45	N/I	N/I	11.856 x 10^{-3} @ 2140°C	—[h]	N/I	N/I	Flam, React, Scarc Expl	N/I

last page for notes

Table BA1. Hazardous Property Information

Island Chemical Company, Inc.

Compound	Water Solubility[a]	Specific Gravity	Vapor Density	Flash Point (° F)[b]	Vapor Pressure[c]	LEL/UEL	TLV-TWA[d]	IDLH Level	Hazard Properties[e]	Acute Exposure Symptoms[f]
1-Bromo-2-chloroethene	Slightly	1.70	4.94	N/A	760 @ 82.7°C	N/F	N/I	N/I	Tox	Eye, Resp, Skin
Bromodichloro-methane	Insoluble	1.980	N/I	N/F	N/A	N/F	N/E	N/E	Tox, Vol, Scarc	CNS, Eye, Resp, Skin
Bromoform	0.01 g	2.887	N/I	N/F	5	N/F	0.5 ppm	N/A	Flam	CNS, Conv, Eye, Head, Naus, Resp
Bromomethane	0.1 g	1.732	3.3	N/F	1428.8	10%/16%	5 ppm[g]	2000 ppm	Tox, Vol, Carc	CNS, Coma, Conv, Conf, Eye, Fevr, Head, Naus, Resp, Skin, Trem, Vom, Weak
Butanol	Soluble	0.8063	2.6	99	6	1.4%/11.2%	50 ppm	8000 ppm	Flam	Diz, Drow, Eye, Skin
Methyl ethyl ketone	353 g/l	0.805	2.41	16	77.5	1.4%/11.4%	200 ppm	3000 ppm	Flam, Tox	Diz, Eye, Head, Resp, Skin, Vom
2-Butoxyethanol	Soluble	0.9012	4.07	N/I	0.76	N/I	25 ppm	N/I	Flam, Tox, Vol	Diz, Eye, Resp, Skin
Butylated hydroxy toluene	Soluble	N/I	N/I	260	N/I	N/I	N/I	N/I	N/I	N/I
Butylbenzyl-phthalate	Insoluble	1.12	10.8	300	8.6×10^{-9}	N/I	N/I	N/I	Flam, Tox	Skin
Butyl chloride	Insoluble	N/I	N/I	-6.7	N/I	N/I	N/I	N/I	Flam, Tox	CNS, Exe, Resp, Skin
Butylphthalate	Insoluble	1.0484	9.58	340	<0.01	0.5%/?	5 $\mu g/m^3$	9300 mg/m^3	Flam	Eye, Resp, Skin
Cadmium	—[i]	8.642	N/A	N/A	N/A	—[h]	0.2 mg/m^3	50 mg/m^3	Tox, Carc	Abd, CNS, Diar, Drow, Eye, Head, Naus, Resp, Skin Vom, Weak
Calcium hypochloride	No Information Found									
Carbon disulfide	Slightly	1.2632	2.67	-22	297	1.3%/50.0%	1 ppm	500 ppm	Flam, Tox	Eye, Head, Naus, Resp, Skin
Carbon tetrachloride	0.8%	1.5967	5.3	N/F	91	N/F	2 ppm[g]	300 ppm	Tox, Vol, Carc	Abd, CNS, Coma, Diz, Diar, Drow, Fevr, Head, Naus, Resp, Skin, Trem
Carboxylic acids	Insoluble	0.982	N/I	N/I	N/I	N/I	N/I	N/I	Tox	Eye, Skin
Cement	Soluble	Variable	N/A	N/A	N/A	N/A	5-15 mg/m^3	N/E	Tox	Eye, Resp, Skin
Chlordane (alpha and gamma)	Insoluble	1.59 to 1.63	14	225	0.00001 @ 68°C	12%/74%	0.5 mg/m^3	500 mg/m^3	Flam, Tox	CNS, Conv, Eye, Resp, Skin, Uncon
Chloroacetic acid	Very soluble	1.58	3.26	302	1 @ 43°C	8%/?	N/E	N/E	Cor, Flam, Tox	Eye, Resp, Skin

See last page for notes

Table BA1. Hazardous Property Information

Island Chemical Company, Inc.

ompound	Water Solubility[a]	Specific Gravity	Vapor Density	Flash Point (° F)[b]	Vapor Pressure[c]	LEL/UEL	TLV-TWA[d]	IDLH Level	Hazard Properties[e]	Acute Exposure Symptoms[f]
lorobenzene	0.05 g	1.11	3.9	85	8.8	1.3%/9.6%	75 ppm	2400 ppm	Flam, Tox, Vol	CNS, Coma, Diz, Eye, Head, Naus, Resp, Skin, Trem, Uncon, Vom, Weak
-Chloro-3-cresol	Soluble	N/I	N/I	N/I	N/I	N/I	N/I	N/I	Tox	Skin
hloroethane	0.6 g	0.8978	2.2	-58	1033.6	3.8%/15.4%	1000 ppm	20,000 ppm	Flam, Tox, Vol	CNS, Diz, Drow, Eye, Head, Resp, Skin, Uncon
-Chloroethylvinyl ther	Insoluble	1.0475	3.7	80	30	N/I	N/E	N/E	Flam, Tox, Vol	Eye, Resp, Skin
hloroform	0.8 g	1.4832	4.12	N/F	160	N/F	2 ppm[g]	1000 ppm	Tox, Vol	CNS, Coma, Conv, Diar, Eye, Head, Naus, Resp, Skin
hloromethane	0.74%	0.9159	1.8	32	30,000	8.1%/17.4%	50 ppm[g]	10,000 ppm	Flam, Tox, Vol, Carc	Alxl, CNS, Coma, Conv, Conf, Diz, Diar, Eye, Fevr, Head, Naus, Trem, Vom, Weak
Chloro-ethylbenzene	Slightly	1.06	N/I	123	N/I	N/I	50 ppm	N/I	Tox	CNS, Conf, Diz, Eye, Resp, Skin
Chloro-3-methyl-henol	Soluble	N/I	N/I	N/A	N/I	N/A	N/I	N/I	Tox	N/I
Chloronaphthalene	6.74 mg/l	1.1371	N/I	N/I	0.017	N/I	N/I	N/I	Tox	Eye, Resp, Skin
Chlorophenol	Slightly	1.24	N/I	107	1.0	N/A	N/E	N/E	Cor, Tox	Eye, Resp, Skin
Chlorotoluene	No Information Found									
romium	—[i]	7.20	N/A	N/A	N/A	—[h]	0.5 mg/m^3[(h)]	N/E	Tox, Carc	Diz, Resp, Skin, Vom
rysene	Insoluble	1.274	N/I	N/A	6.3×10^{-7}	N/A	0.2 mg/m^3	200 mg/m^3	Scarc	Resp, Skin
balt	Insoluble	8.92	N/A	N/A	0.0	N/A	0.5 mg/m^3	20 mg/m^3	Tox	Skin
pper	—[i]	8.92	N/A	N/A	N/A	—[h]	1.0 mg/m^3	N/E	Tox	Diz, Diar, Eye, Fevr, Resp, Skin, Trem, Vom, Weak
esol (all isomers)	2%	1.03	N/I	178	1.0	1.1%/?	5 ppm	250 ppm	Flam, Tox	CNS, Conf, Resp, Eye, Skin
anides	58 to 72%	1.5	N/A	N/F	0.0	N/F	5 mg/m^3	50 mg/m^3	Tox, React	Diz, Head, Naus, Resp, Uncon, Vom
yclopyridine										
-D	0.07 ppm	1.416	N/A	N/A	0.0	N/A	10 mg/m^3	500 mg/m^3	Tox	Conv, Conf, Eye, Resp, Skin, Trem, Weak

last page for notes

Table BA1. Hazardous Property Information

Island Chemical Company, Inc.

ompound	Water Solubility[a]	Specific Gravity	Vapor Density	Flash Point (° F)[b]	Vapor Pressure[c]	LEL/UEL	TLV-TWA[d]	IDLH Level	Hazard Properties[e]	Acute Exposure Symptoms[f]
,4'-DDD	Insoluble	1.476	11	150	10.2×10^{-7}	N/A	N/A	N/A	Flam, Tox, Scarc	Abd, CNS, Coma, Conv, Head, Naus, Skin, Trem, Vom, Weak
,4'-DDE	0.010 ppm	0.99	N/I	N/A	6.5×10^{-6}	N/A	N/I	N/I	Tox, Scarc	Eye, Resp, Skin
,4'-DDT	Insoluble	0.99	N/I	1.62	1.7×10^{-7}	N/A	1 mg/m^3	N/E	Tox, Carc	CNS, Conv, Conf, Diz, Eye, Head, Resp, Skin, Trem, Vom
,p'-DDD	0.005 ppm	1.385	11	N/I	10.2×10^{-7}	N/I	N/I	N/I	Tox, Scarc	CNS, Skin
,p'-DDE	0.010 ppm	N/I	N/I	N/I	6.5×10^{-6}	N/I	N/I	N/I	Tox	Eye, Resp, Skin
,p'-DDT	N/I	1.1678	3.73	N/I	N/I	N/I	N/I	N/I	Tox, Scarc	Resp, Skin
i-n-butylphthalate	Insoluble	1.05	9.58	322	1 mm @ 150°C	0.5%/?	5 mg/m^3	9300 mg/m^3	Tox	Eye, Resp, Skin
i-n-octylphthalate	Insoluble	0.99	10.0	420	<0.01	N/I	5 mg/m^3	N/E	Tox, Carc	Eye, Resp, Skin
iazinon	Slightly	1.117	N/A	N/A	4.1×10^{-4}	N/A	0.1 mg/m^3	300 mg/m^3	Tox, React	Skin
ibenz(a,h)anthracene	Slightly	1.282	N/I	N/I	1×10^{-10}	N/I	N/I	N/I	Flam, Tox	Eye, Resp, Skin
ibenzofuran	Insoluble	1.08863 @ 99°C	5.8	32	0.0044 @ 25°C	2%/14%	N/E	N/E	Flam, Carc	N/I
ibromochloro-ethane	Insoluble	2.451	N/I	N/I	N/I	N/I	N/E	N/E	Flam, Tox, Vol	CNS, Diz, Drow, Eye, Resp, Skin, Uncon, Vom
ibromochloro-opane	0.1%	2.8	2.09	170	0.8	N/F	10 ppb	N/I	Cor, Flam, Tox, Carc	Eye, Naus, Resp, Skin
2-Dibromomethene	Slightly	2.48	N/I	N/F	N/I	N/F	N/I	N/I	N/I	N/I
ichlorobenzene	Slightly	1.30	N/I	151	1.2	2.2%/9.2%	500 ppm	1000 ppm	Flam, Tox	Eye, Resp, Skin
2-Dichlorobenzene	Insoluble	1.234	N/I	150	1.2	2.2%/9.2%	50 ppm	1000 ppm	Flam, Tox, Scarc	Diz, Eye, Head, Resp, Skin
3'-Dichloro-nzidine	Insoluble	N/I	N/I	N/I	N/I	N/I	N/E	N/E	Tox, Scarc	Eye, Resp, Skin
chlorodifluro-ethane	Insoluble	1.466 @ 30°C	4.1	N/A	3800 @ 16.1°F	N/A	1000 ppm	50,000 ppm	Tox, Vol	CNS, Conf, Diz
1-Dichloroethane	0.1 g	1.1757	8.4	22	182	6%/16%	100 ppm	4000 ppm	Flam, Tox, Vol	Abd, Diar, Drow, Eye, Resp, Skin, Trem

last page for notes

Table BA1. Hazardous Property Information

Island Chemical Company, Inc.

Compound	Water Solubility[a]	Specific Gravity	Vapor Density	Flash Point (° F)[b]	Vapor Pressure[c]	LEL/UEL	TLV-TWA[d]	IDLH Level	Hazard Properties[e]	Acute Exposure Symptoms[f]
1,2-Dichloroethane	0.9%	1.2554	3.4	55	64	6.2%/16%	1 ppm[g]	1000 ppm	Flam, Tox, Vol, Carc	CNS, Coma, Diz, Diar, Eye, Naus, Resp, Skin, Trem, Vom
1,1-Dichloroethene	2250 mg/l	N/I	3.4	14	591	5.6%/11.4%	1 ppm[g]	N/E	Flam, Tox, Vol, React, Carc	CNS, Eye, Resp, Skin
1,2-Dichloroethene	Soluble	1.27	3.34	N/I	N/I	9.7%/12.8%	200 ppm	4000 ppm	Flam, Tox, Vol	Eye, Resp, Skin
rans-1,2-Dichloroethene	Slightly soluble	1.2565	N/I	36	400	9.7%/12.8%	N/E	N/E	Flam, Tox, Vol	Abd, CNS, Diz, Eye, Naus, Trem, Vom
Dichloromethane	Miscible	1.33	2.9	N/A	350	12%/19%	50 ppm	5000 ppm	Tox, Carc	Eye, Naus, Resp, Skin
,3-Dichlorophenol	N/I	N/I	N/I	237	.170 mm	N/I	N/I	N/I	Cor, Flam, Tox, Scarc	Eye, Resp, Skin
,4-Dichlorophenol	Soluble	1.383	5.62	200	0.075 mm	N/A	N/E	N/E	Tox	Abd, CNS, Conf, Eye, Head, Naus, Resp, Vom, Weak
icyclopentadiene	Slightly	0.9302	4.55	32	1.4	0.8%/6.3%	5 ppm	N/E	Flam, Tox, Vol	Diz, Eye, Resp, Skin
,2-Dichloropropane	0.25%	1.6	3.9	72	40	3.4%/14.5%	75 ppm	2000 ppm	Flam, Tox, Vol, Carc	Abd, CNS, Diar, Drow, Eye, Head, Resp, Skin, Trem, Vom
s-1,3-Dichloro-opene	Insoluble	1.2	3.8	83	28	5%/14.5%	1 ppm[g]	N/E	Flam, Tox, Vol	Abd, CNS, Diar, Eye, Head, Naus, Resp, Skin, Trem
ans-1,3-Dichloropro-ne	Insoluble	1.2	3.8	83	28	5%/14.5%	1 ppm[g]	N/E	Flam, Tox, Vol	Abd, CNS, Diar, Eye, Head, Naus, Resp, Skin, Trem
cyclopentadiene	Slightly	0.9302	4.55	32°C	1.4	0.8%/6.3%	5 ppm	N/E	Flam, Tox, Vol	Diz, Eye, Resp, Skin
eldrin	0.02%	1.75	N/I	N/A	7.8×10^{-7}	N/A	0.25 mg/m^3	450 mg/m^3	Tox, Carc	Coma, Conv, Diz, Head, Naus, Vom
esel fuel	Insoluble	0.81 to 0.90	N/I	130	N/I	0.6%/7.5%	N/E	N/E	Flam, Tox	Eye, Resp, Skin
ethylamine	Miscible	0.71		-15	192 mm	1.8%/10.1%	10 ppm	2000 ppm	Flam	Eye, Resp, Skin
ethylphthalate	Insoluble	1.12	7.66	325	1.65 x 10-3	N/I	5 mg/m^3	N/I	Tox	CNS, Eye, Resp, Skin
2-Dimethybenz(a)-thracene	Insoluble	N/I	N/I	187	N/I	N/I	N/I	N/I	Flam, Tox, Carc	Eye, Resp, Skin
nethylmethylphosp nate (DMMP)	Soluble	1.15 @ 20°C	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I

last page for notes

Table BA1. Hazardous Property Information

Island Chemical Company, Inc.

Compound	Water Solubility[a]	Specific Gravity	Vapor Density	Flash Point (° F)[b]	Vapor Pressure[c]	LEL/UEL	TLV-TWA[d]	IDLH Level	Hazard Properties[e]	Acute Exposure Symptoms[f]
2,4-Dimethylphenol	Soluble	0.9650	N/I	>112	10 @ 92.3°C	N/I	N/I	N/I	Tox, Scarc	N/I
Dimethylphthalate	Slightly	1.189	6.69	295	0.01°C	0.9%/?	5 mg/m^3	9300 mg/ mg^3	Tox	Eye, Naus, Resp, Skin
Dimethylsulfide	Insoluble	0.8483 @ 20°C	2.14	.55	15	2.2%/19.7%	N/I	N/I	Flam, Tox	Diz, Eye, Resp, Skin
2,4-Dinitrophenol	5600 mg/l	1.683	6.35	N/I	2 x 10^{-5}	N/I	N/I	N/I	Flam, Tox	Drow, Eye, Head, Resp, Skin, Uncon
Di-n-octyl phthalate	No Information Found									
Dinoseb	0.0052 g	1.2647	N/I	164°C	1 @ 151°C	N/I	N/I	N/I	Flam, Tox	Eye, Resp, Skin
Dioxin	10.3 mg/l	N/I	N/I	N/A	7.4 x 10^{-10}	N/A	No safe level	N/E	Tox, Scarc	Eye, Resp, Skin
1,2-Diphenyl hydrazine	Miscible	1.158	N/I	100°C	1 @ 103°C	4.7 ppm 100 ppm	0.1 ppm	80 ppm	Flam, Tox, React, Carc, Expl	Eye, Resp, Skin
Diphenyl methane	No Information Found									
Diphenyl methanone	No Information Found									
Dithiane	1 g	1.625	5.8	N/I	<1	N/I	1.0 mg/m^3	200 mg/m^3	Tox	Eye, Resp, Skin
Dursban	0.7 ppm	1.398	N/I	N/I	1.87 x 10^{-5}	N/A	0.1 mg/m^3	N/E	Flam, Tox	Eye, Resp, Skin
Endosulfan I and II	Insoluble	1.74	N/A	N/A	1 x 10^{-5}	N/A	0.1 mg/m^3	N/E	Tox	CNS, Conv, Conf, Diz, Head, Naus, Trem, Uncon, Vom
Endrin	Insoluble	1.70	N/I	N/A	Low	N/A	0.1 mg/m^3	200 mg/m^3	Tox, Scarc	Abd, Conv, Diz, Head, Naus, Weak, Vom
Ethanol	Slightly	0.789	1.59	12.8	40	3.3%/19%	1000 ppm	N/E	Flam, Tox, Expl	Eye, Resp, Skin
Ethion	Slightly	1.22	N/I	-13°C	1.5 @ 10^{-6}	N/A	0.4 mg/m^3	N/E	Tox	N/I
Ethyl acetate	Slightly	0.90	N/I	24	74 mm	2.0%/11.5%	400 ppm	10,000 ppm	Flam, Tox	Eye, Resp, Skin
Ethyl alcohol	Miscible	N/I	N/I	55.4	N/I	N/I	N/I	N/I	Flam, Tox	Drow, Coma, Diz, Uncon, Vom
Ethylbenzene	0.015 g	0.867	3.7	55	10	1.0%/6.75%	100 ppm	2000 ppm	Flam, Tox, Vol	Abd, CNS, Diz, Drow, Eye, Head, Naus, Resp, Skin, Uncon, Vom, Weak
Ethylene dibromide	Slightly soluble	2.17 to 2.18	5.07	N/F	17.4 @ 30°C	N/F	0.045 ppm	400 ppm	Cor, Flam, Tox, Scarc	Eye, Resp, Skin
Ethylene glycol	Insoluable	1.49	N/I	410	0.05 mm	N/I	0.1 mg/m^3	500 mg/m^3	Expl.	CVS, Skin

» last page for notes

Table BA1. Hazardous Property Information

Island Chemical Company, Inc.

Compound	Water Solubility[a]	Specific Gravity	Vapor Density	Flash Point (° F)[b]	Vapor Pressure[c]	LEL/UEL	TLV-TWA[d]	IDLH Level	Hazard Properties[e]	Acute Exposure Symptoms[f]
Fluoranthene	N/I	N/I	N/I	107	0.0	N/I	0.1 mg/m^3	700 mg/m^3	Tox, Carc	Eye, Resp, Skin
Fluorene	Insoluble	N/I	N/I	N/I	10 @ 146°C	N/I	N/I	N/I	Tox	N/I
9H-Fluorene-9-one; Flurenone	No Information Found									
Fluoroacetic acid	Soluble in hot water	1.3696	N/I	N/I	N/I	N/I	2.5 mg/m^3	N/I	Tox	Eye, Resp, Skin
Freon 113	Slightly	1.5635	6.5	N/A	284	N/A	1000 ppm	4500 ppm	Tox	Drow, Resp
Gasoline	Insoluble	0.72 to 0.76	3.4	-45	Variable	1.4%/7.6%	300 ppm	N/E	Flam, Tox, Vol	Eye, Resp, Skin
Germanium	Insoluble	5.323	N/I	N/I	N/I	—[h]	N/I	N/I	Tox	N/I
Gluconic-delta-lactone	Soluble	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I
Glycol	No Information Found									
Glycerin	No Information Found									
Heptachlor expoxide	Insoluble	N/I	N/I	N/I	N/I	N/I	N/E	N/E	Tox, Scarc	CNS, Conv, Conf
Heptachlor	Insoluble	1.57	N/A	N/A	0.0003	N/A	0.5 mg/m^3	100 mg/m^3	Flam, Tox, Scarc	CNS, Eye
Hexachlorobenzene	0.035 ppm	1.5691 @ 23.6°C	9.83	N/A	1.09 x 10^{-5}	N/A	0.5 mg/m^3	N/E	Tox, Scarc	Eye, Head, Resp, Skin, Trem
Hexachlorobutadiene	Insoluble	1.5542	8.99	N/A	1.675 @ 20°C	N/A	0.02 ppm	N/I	Tox, Scarc	Eye, Resp, Skin
Hexachlorocyclo-pentadiene	Insoluble	1.7019	9.4	N/F	0.080	N/F	0.01 ppm	N/E	Flam, Tox	CNS, Diar, Eye, Naus, Resp, Skin, Vom
Hexane	0.002%	0.66	2.97	-21.67°C	10	1.1%/7.5%	50 ppm	5000 ppm	Flam, Tox	Diz, Eye, Head, Naus, Resp, Skin
2-Hexanone	Slightly	0.801	3.5	64	16	1.2%/8.0%	50 ppm	5000 ppm	Flam	Eye, Resp, Skin
Hydrochloric acid	Miscible	N/I	N/I	N/I	N/I	N/I	N/I	N/I	Cor	Abd, CNS, ConV, Eye, Naus, Resp, Skin, Vom
Hydrocyanic acid	Miscible	0.69	0.94	0°F	630	5.6%/40.0%	4.7 ppm	50 ppm	Tox	Eye, Head, Naus, Resp, Skin, Vom
Hydrogen minosulfate	No Information Found									

o last page for notes

Table BA1. Hazardous Property Information

Island Chemical Company, Inc.

Compound	Water Solubility[a]	Specific Gravity	Vapor Density	Flash Point (° F)[b]	Vapor Pressure[c]	LEL/UEL	TLV-TWA[d]	IDLH Level	Hazard Properties[e]	Acute Exposure Symptoms[f]
Hydrogen chloride	Soluble in Warm Water	N/I	N/I	N/A	>/ATM	N/A	5 ppm	100 ppm	N/A	Eye, Resp, Skin
Hydroxyfurano-coumarin	No Information Found									
Indene	Insoluble	0.997	N/I	173	N/I	N/I	10 ppm	N/E	Tox	Resp, Skin
Indeno(1,2,3-CD) pyrene	Slightly/	N/I	N/I	N/I	1×10^{-10}	N/I	0.2 mg/m^3	700 mg/m^3	Tox, Scarc	Eye, Resp, Skin
Iron	Insoluble	7.87	N/A	N/A	N/A	—[h]	5 mg/m^3	N/I	Tox	Resp
Isodrin	Insoluble	1.31	N/A	N/F	N/A	N/A	N/E	N/E	Tox	Eye, Resp, Skin
Isopropanol	Soluble	0.70	2.08	53	33	2%/12%	400 ppm	20,000 ppm	Flam, Tox	Eye, Resp, Skin
Kerosene	Insoluble	0.83 to 1.0	N/I	100 to 165	5	0.7%/5.0%	N/E	N/E	Flam, Tox, Vol	Eye, Resp, Skin
Lead	—[i]	11.3437	N/A	N/A	N/A	—[h]	50 µg/m^3	700 mg/m^3	Tox	Abd, Coma, Conv, Diz, Diar, Head, Trem, Vom, Weak,
Lindane (BHC)	7.3 ppm	1.85	N/I	N/I	9.4×10^{-6}	N/I	0.5 mg/m^3	1000 mg/m^3	Tox	N/I
Magnanese	—[i]	N/I	N/A	N/A	N/A	—[h]	5 mg/m^3	N/I	Tox	CNS, Fevr, Weak
Magnesium	Insoluble	1.74	N/A	N/A	N/A	—[h]	N/E	N/E	Flam, Rad	CNS, Resp, Vom
Magnesium sulfate										
Malathion	145 ppm	1.23	N/I	>325	1.25×10^{-4}	N/I	10 mg/m^3	5000 mg/m^3	Flam, Tox	Eye, Resp
Mercury	—[i]	13.5939	7.0	N/A	0.0012	—[h]	50 µg/m$^{3(b)}$	28 mg/m^3	Tox	Abd, Diar, Naus, Resp, Skin, Trem, Vom
Methane	Slightly	0.7168	0.554	-306	1520 @ -152.3°C	5%/15%	Asphyxiant	N/I	Asphyxiant	N/I
Methanol	Miscible	N/I	N/I	54	N/I	N/I	N/I	N/I	Flam, Tox	Abd, CNS, Coma, Conf, Conv, Diz, Drow, Head, Naus, Nerv, Uncon, Vom
Methycyclohexane	Insoluble	0.7694	3.39	N/I	43	N/I	400 ppm	10,000 ppm	Flam, Tox	CNS, Diz, Eye, Resp, Skin
1-Methyl bis benzene	No Information Found									
Methyl-1-heptane	No Information Found									

to last page for notes

Table BA1. Hazardous Property Information

Island Chemical Company, Inc.

ompound	Water Solubility[a]	Specific Gravity	Vapor Density	Flash Point (° F)[b]	Vapor Pressure[c]	LEL/UEL	TLV-TWA[d]	IDLH Level	Hazard Properties[e]	Acute Exposure Symptoms[f]
ethylene chloride	2%	1.335	22.9	None	350	14%/22%	50 ppm[g]	5000 ppm	Tox, Vol, React	CNS, Coma, Eye, Head, Naus, Resp, Skin, Uncon, Weak
ethyl isobutyl tone	Slightly	1.33	2.93	22.78°C	380	1.4%/7.5%	50 ppm	5000 ppm	Flam, Tox	CNS, Conf, Eye, Resp, Skin
Methylnaphthalene	Insoluble	1.025	N/I	N/I	0.0681	N/I	N/E	N/E	Tox	Eye, Fevr, Head, Skin
Methylphenol	2%	1.047	3.72	178	1	1.35%/?	2.3 ppm	250 ppm	Flam, Tox	CNS, Conf, Eye, Resp, Skin
Methylphenol	2%	1.039	3.72	187	0.2	1.1%/2%	2.3 ppm	250 ppm	Flam, Tox	CNS, Conf, Eye, Resp, Skin
ethylpropanol	No Information Found									
ethyl tertiary butyl ther	No Information Found									
irex	Insoluble	N/I	N/A	N/F	N/A	N/F	N/E	N/E	Tox, Scarc	Skin
olybdenum	Insoluble	10.2	N/A	N/A	20	—[h]	10 mg/m3	N/I	Flam	Eye, Resp
onoethanolamine	No Information Found									
uralic acid	No Information Found									
nitrosodi-enylamine	Insoluble	N/I	N/I	N/I	N/I	N/I	N/I	N/I	Flam, Tox, Scarc	N/I
phthalene	Insoluble	1.15	4.42	174	1 @ 52.6°F	0.9%/5.9%	10 ppm	500 ppm	Flam, Tox	CNS, Eye, Resp, Skin
phthenes	<0.01%	0.7083	N/I	-4	N/I	1.3%/8.4%	N/I	10,000 ppm	Flam, Tox	CNS, Eye, Resp, Skin
ptha	N/I	0.89 to 0.97	N/I	20	<0.0	1.1%/5.9%	100 ppm	10,000 ppm	Flam, Tox	Diz, Drow, Eye, Resp, Skin
ekol	—[i]	8.9	N/A	N/A	N/A	—[h]	0.1 mg/m^3	N/E	Tox, Carc	Conv, Diar, Drow, Naus, Resp, Skin, Vom
ric acid	Miscible	1.50	N/I	N/A	48	N/A	2 ppm	100 ppm	Tox	Eye, Resp, Skin
Vitrophenol	Slightly	1.495	N/I	N/I	1 @ 49.3°C	N/I	N/I	N/I	Tox	Diz, Eye, Head, Skin, Uncon
tane	0.7 µg/ml	0.7028	3.86	56	14.1	1%/6.5%	300 ppm	3750 ppm	Flam, Tox	Eye, Resp, Skin
ntachlorobenzene	0.24 ppm	1.8342	N/I	N/I	16.416 x 10^{-3}	N/I	N/I	N/I	Flam, Tox	Diz, Eye, Resp, Skin
ntachlorophenol	Slightly	1.98	9.20	N/A	0.0001	N/A	0.5 mg/m^3	150 mg/m^3	Tox, Carc	Diz, Eye, Head, Naus, Resp, Skin, Vom, Weak

last page for notes

Table BA1. Hazardous Property Information

Island Chemical Company, Inc.

ompound	Water Solubility[a]	Specific Gravity	Vapor Density	Flash Point (° F)[b]	Vapor Pressure[c]	LEL/UEL	TLV-TWA[d]	IDLH Level	Hazard Properties[e]	Acute Exposure Symptoms[f]
ntane	0.04 ppm	0.63		-57	400 @ 65°F	1.5%/7.8%	120 ppm	15,000 ppm	Flam, Tox	Eye, Resp, Skin
Pentanone	Insoluble	0.8051	3.0	45	16	1.5%/8.2%	200 ppm	5000 ppm	Flam, Tox	Diz, Eye, Resp, Skin
ienanthrene	Insoluble	1.06	6.14	171°C	1 @ 118.3°F	N/A	0.2 mg/m^3	700 mg/m^3	Flam, Carc	Resp, Skin
Phenetidine	No Information Found									
enol	8.4%	1.0576	3.2	175	0.4	1.8%/8.6%	5 ppm	250 ppm	Cor, Tox	Conv, Eye, Resp, Skin, Trem
enyl acetate	Insoluble	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I
lychlorinated phenyls (PCBs)	Insoluble	1.38	N/A	200	0.0006	N/A	1.0 µg/m^3[30]	5 mg/m^3	Tox, Carc	Coma, Drow, Naus, Uncon, Vom, Skin
ssium acetate	Soluble	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I
ssium iodide	No Information Found									
ssium sulfate	Soluble	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I
assium t-butoxide										
ene	1.35 mg/l	1.271	N/I	N/I	6.85 x 10^{-7} @ 20°C	N/I	0.2 mg/m^3	700 mg/m^3	Flam, Tox, Carc	Eye, Resp, Skin
idine	Miscible	0.9780	0.982	68	20	1.8%/12.4%	5 ppm	3600 ppm	Flam, Tox	Diz, Eye, Resp, Skin
inact	No Information Found									
inidine	Soluble	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I
inidine gluconate	Soluble	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I
inine bisulfate	Soluble	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I
inine sulfate	Soluble	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I
inoline	Soluble	1.0900	4.45	N/A	1 @ 59.7°C	1.2%/?	N/I	N/E	Flam, Tox	Eye, Resp, Skin
icylic acid	Slightly Soluble	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I
d	Insoluble	2.65	N/A	N/A	N/A	N/A	5-15 mg/m^3	N/A	Tox, Carc	Eye, Resp
nium	Insoluble	4.5	N/A	N/A	N/A	N/A	0.2 mg/m^3	100 mg/m^3	Tox	Eye, Skin, Resp

ast page for notes

Table BA1. Hazardous Property Information

Island Chemical Company, Inc.

mpound	Water Solubility[a]	Specific Gravity	Vapor Density	Flash Point (° F)[b]	Vapor Pressure[c]	LEL/UEL	TLV-TWA[d]	IDLH Level	Hazard Properties[e]	Acute Exposure Symptoms[f]
ver	—[i]	10.5	N/A	N/A	N/A	—[h]	0.01 mg/m^3	N/E	Tox	Eye, Skin
dium acetate	Slightly Soluble	N/I	N/I	N/I	N/I	N/I	N/I	N/I	NI	N/I
dium benzoate	Soluble									
dium bicarbonate	Slightly Soluble									
dium chloride	Soluble									
dium formate	Soluble									
dium hexametaphosphate	No Information Found									
dium hydroxide	Soluble	2.13	N/A	N/A	1.0	N/A	2 mg/m^3	250 mg/m^3	Tox	Eye, Resp, Skin
dium hypochlorite	Soluble	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	Eye, Resp, Skin
fate acid	No Information Found									
ona	135 mg/l	1.36	N/I	N/I	N/I	N/I	N/I	N/I	Tox	Skin
,7,8-Tetrachloro-di-zo-p-dioxin	19.3 mg/l	N/I	N/I	N/I	7.4 x 10^{-10}	N/I	Lowest poss. exposure	N/E	Tox, Scarc	CNS, Eye, Resp, Skin, Weak
,2,2-Tetrachloro-ane	0.3%	1.5953	5.8	N/F	9 @ 86°F	N/F	1 ppm[g]	150 ppm	Tox, Vol, Carc	Abd, CNS, Coma, Diz, Drow, Eye, Head, Naus, Resp, Skin, Trem, Vom
rachloroethene	0.15 g/ml	1.6227	5.8	N/F	14	N/F	25 ppm[g]	500 ppm	Tox, Vol, Carc	Abd, Coma, Diz, Drow, Eye, Head, Naus, Resp, Skin, Uncon
rachloromethane	Slightly	1.59	5.3	N/A	91	N/A	2 ppm	300 ppm	Tox, Carc	CNS, Eye, Fevr, Naus, Resp, Skin
rachlorphenol	No Information Found									
llium	—[i]	11.85	N/A	N/A	N/A	—[h]	0.1 mg/m^3	20 mg/m^3	Tox	Abd, CNS, Diar, Naus, Skin, Trem, Vom
odiglycol	Soluble	1.18	N/I	320	N/A	N/A	N/E	N/E	Tox, React	Resp, Skin
	Insoluble	5.75 7.28	N/A	N/A	N/A	—[h]	2.0 mg/m^3	N/E	Tox	Abd, Head, Eye, Resp, Skin, Vom

ast page for notes

Table BA1. Hazardous Property Information

Island Chemical Company, Inc.

Compound	Water Solubility[a]	Specific Gravity	Vapor Density	Flash Point (° F)[b]	Vapor Pressure[c]	LEL/UEL	TLV-TWA[d]	IDLH Level	Hazard Properties[e]	Acute Exposure Symptoms[f]
oluene	0.05 g	0.866	3.2	40	22	1.3%/7.1%	100 ppm	2000 ppm	Flam, Tox, Expl	CNS Conv, Conf, Diz, Drow, Eye, Head, Naus, Resp, Skin, Trem, Uncon, Vom, Weak
,4,5-TP (silvex)	140 ppm	1.209	N/I	N/F	N/A	N/A	N/I	N/I	Flam, Tox	Eye, Resp, Skin
richlorobenzene	19 ppm	1.4542	6.26	105	0.29	2.5%/6.6%	5 ppm	N/I	Flam, Tox	Eye, Resp, Skin
,2,4-Trichloro-enzene	19 ppm @ 22°C	1.4634	6.26	210	0.29	N/I	5 ppm	N/I	Flam, Tox	Eye, Resp, Skin
,1,1-Trichloroethane	0.7 g	1.3390	4.6	N/F	100	7.5%[c] 12.5%	350 ppm	1000 ppm	Flam, Tox, Vol, React	Abd, CNS, Conv, Conf, Drow, Eye, Head, Naus, Skin, Trem, Uncon
,1,2-Trichloroethane	0.44 g/100g	1.4397	4.6	N/F	19	N/A	10 ppm	500 ppm	Tox, Carc	CNS, Conv, Conf, Diz, Diar, Drow, Eye, Head, Resp, Skin, Trem, Uncon, Vom
richloroethene	0.1%	1.4642	4.5	90	58	8%/10.5%	50 ppm[g]	1000 ppm	Flam, Tox, Carc	CNS, Diz, Eye, Head, Naus, Skin, Trem, Uncon, Vom
,1,2-Trichloroethene	0.1%	1.4642	4.5	90	58	8%/10.5%	50 ppm[g]	1000 ppm	Flam, Tox, Carc	CNS, Diz, Eye, Head, Naus, Skin, Trem, Uncon, Vom
richlorofluoro-ethane	0.11 g	1.7	N/I	N/F	690	N/F	1000 ppm	10,000 ppm	Tox, Vol	CNS, Diz, Drow, Head, Naus, Vom
,4,5-Trichlorophenol	1190 mg/kg	1.7	None	N/F	0.022	N/F	10 mg/m^3	N/E	Tox	Abd, CNS, Conf, Eye, Naus, Resp, Skin, Vom
,4,5-T	Insoluble	1.8	11	N/A	0.0	N/A	10 mg/m^3	5000 mg/m^3	Tox, Scarc	Resp, Skin
richloropropane	Soluble	1.3889	5.1	180	3	3.2%/12.6%	50 ppm	1000 ppm	Flam, Tox	Eye, Resp, Skin
riethanolamine	Miscible	N/I	N/I	365	N/I	N/I	N/I	N/I	N/I	N/I
riethylamine	Soluble	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	Skin
rimethyl benzene	Insoluble	0.86 to 0.95	4.15	130	N/I	0.9%/6.4%	25 ppm	N/I	Flam, Tox	CNS, Eye, Resp, Skin
rinitrobenzene	Slightly	1.76	N/I	N/I	3.2 x 10^{-6}	N/I	N/I	N/I	Flam, Tox, Expl	Eye, Resp
,4,6-Trinitrotoluene	0.01%	1.65	7.85	240°C	0.04-0.109	N/I	0.5 mg/m^3	N/E	Flam, Tox, Expl	CNS, Coma, Eye, Resp, Skin
anadium	Insoluble	7.14	N/A	N/A	N/A	—[h]	0.05 mg/m^3	N/E	Tox	Eye, Resp, Skin

o last page for notes

Table BA1. Hazardous Property Information

Island Chemical Company, Inc.

ompound	Water Solubility[a]	Specific Gravity	Vapor Density	Flash Point (° F)[b]	Vapor Pressure[c]	LEL/UEL	TLV-TWA[d]	IDLH Level	Hazard Properties[e]	Acute Exposure Symptoms[f]
nyl chloride	Negligible	0.9100	2.24	-108	2515.6	3.6%/33%	1 ppm	N/E	Flam, Tox, React, Carc	Abd, CNS, Diz, Drow, Eye, Head, Naus, Resp, Skin, Weak
nyl acetate	Insoluble	0.9345	3.0	30	115 @ 25°C	2.6%/13.4%	10 ppm	N/E	Tox	Eye, Resp, Skin
lene (o,m,p)	0.00003%	0.8642	3.7	63	7	1.1%/7%	100 ppm	1000 ppm	Flam, Tox, Vol	Abd, Diz, Drow, Eye, Naus, Resp, Skin
ne	—[i]	7.14	N/A	N/A	N/A	—[h]	N/E	N/E	Tox	Conv, Diz, Naus, Vom

ast page for notes

Table BA1. Hazardous Property Information

Island Chemical Company, Inc.

ompound	Water Solubility[a]	Specific Gravity	Vapor Density	Flash Point (° F)[b]	Vapor Pressure[c]	LEL/UEL	TLV-TWA[d]	IDLH Level	Hazard Properties[e]	Acute Exposure Symptoms[f]

lotes:

hading	indicates substance identified onsite.	<	Less than	>	greater than	°C	degrees Celsius
	degrees Fahrenheit	µg/m³	micrograms per cubic meter	µg/l	micrograms per liter	g	gram
/ml	grams per milliliter	IDLH	immediate danger to life and health	lbs	pounds	LEL	lower explosive limit
³	cubic meters	mg/l	milligrams per liter	mg/m³	milligrams per cubic meter	mg/kg	milligrams per kilogram
I/A	not applicable	N/E	none established	N/F	nonflammable	N/I	no information is available
pb	parts per billion	ppm	parts per million	UEL	upper explosive limit		

Water solubility is expressed in different terms in different references. Many references use the term "insoluble" for materials that will not readily mix with water (e.g., gasoline). However, most of these materials are water soluble at the ppm or ppb level. Gasoline, for example, is insoluble in the gross sense and found as a discreet layer on top of the groundwater. But certain gasoline constituents (e.g., benzene, toluene, and xylene) are found in solution in the groundwater at the ppm or ppb level. Water solubility expressed as 0.2 g means 0.2 grams per 100 grams water.

Several chlorinated hydrocarbons exhibit no flash point in the conventional sense but will burn in the presence of a high-energy ignition source or will form explosive mixtures at temperatures above 200°F.

Expressed as milligrams of mercury (mm Hg) under standard conditions (20°F).

Values for Threshold Limit Value - Time Weighted Average (TLV-TWA) are Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs) except where noted.

Hazard properties:

Carc	carcinogen	Cocarc	comb combustile	volatile	corrosive	Expl	explosive	Flam	flammable	Inf	infectious
Mut	mutagenic	Narc	cocarcinogen	Cor	radioactive	React	reactive	Scarc	suspected carcinogen	Tera	teratogen
Tox	toxic	Vol	narcotic	Rad							

Acute exposure symptoms

Abd	abdominal pain	CNS	central nervous system depression			Coma	comatose	Conf	confusion	Conv	convulsions
Diar	diarrhea	Diz	dizziness	Drow	drowsiness	Eye	eye irritation	Fevr	fever	Head	headache
Naus	nausea	Nerv	nervousness	Resp	respiratory system irritation			Skin	skin irritation	Sweat	sweating
Trem	tremors	Uncon	unconsciousness	Vom	vomiting	Weak	weakness				

TLV-TWA adopted by the American Conference of Governmental Industrial Hygienists (ACGIH), which is lower than the OSHA PEL.

Explosive concentrations of airborne dust can occur in confined areas.

Solubility of metals depends on the compound in which the metals are present.

TLV-TWA recommended by the National Institute for Occupational Safety and Health (NIOSH). A TLV or PEL has not been adopted by ACGIH or OSHA.

Table B-1. Summary of Substances Detected

Island Chemical Company
St. Croix, U.S. Virgin Islands

Substance Reported	Maximum Concentration Detected (ppm)	
	Soil or Sediment	Groundwater
Acetone	7	-
Aldrin	30[J]	-
Aluminum	33,600	-
Antimony	26.6[J]	0.003[J]
Arsenic	40	0.007
Barium	196	-
Benzaldehyde	3.0[J]	3.0[J]
Benzene	6.6	0.04
Benzophenone	15,000	0.4[J]
Beryllium	8[J]	-
γ BHC	J	-
Δ BHC	J	-
Bis(2-ethyl hexyl)phthate	51	0.28
2-Butanone	0.15[J]	-
Butylbenzyl phthalate	1	-
Cadmium	4.5	0.003
Calcium	82,100	127
Carbon tetrachloride	10	-
Chlordane	7.5[J]	-
γ Chlordane	4.9[J]	-
Chlorobenzene	J	-
Chloroform	340	0.039
Chloromethylbenzene	-	4,400
1-Chloro-2-methyl benzene	-	40[J]
Chromium	110	0.027

See last page for notes

Table B-1. Summary of Substances Detected
Island Chemical Company
St. Croix, U.S. Virgin Islands

Substance Reported	Maximum Concentration Detected (ppm)	
	Soil or Sediment	Groundwater
Cobalt	25.4	-
Copper	367	0.153
Cyanides	-	0.053
2-Cyclopyridine	J	-
DDE	J	-
4,4-DDT	J	-
1,1-Dichloroethane	0.02	-
1,2-Dichloroethane	4.2	-
trans-1,2-Dichloroethene	4.0	-
Dieldrin	0.0041[J]	-
Di-n-butyl phthalate	75	-
Di-n-octyl phthalate	17	0.0039
Endosulfan I	0.004[J]	-
Endosulfan II	J	-
Endosulfan Sulfate	J	-
Endrin Ketone	J	-
Ethylbenzene	16.1	-
Fluoranthene	J	-
Fluorene	9.2	-
9H-Fluorene-9-one	J	-
Fluorenone	J	-
Fluorethyne	0.45	-
Heptachlor	J	-
Heptachlor epoxide	10[J]	-
Iron	183,000	0.121

See last page for notes
Revised August 5, 1994
\WORK\24231\02\HASP-B1.TAB

Table B-1. Summary of Substances Detected
Island Chemical Company
St. Croix, U.S. Virgin Islands

Substance Reported	Maximum Concentration Detected (ppm)	
	Soil or Sediment	Groundwater
Lead	466	0.011
Magnesium	11,800	71.6
Manganese	1,430	0.4
Mercury	-	0.0012
Methoxychlor	J	-
Methyl tertiary butyl ether	J	-
1,1-oxybis(Methylene) bis-benzene	8.4	0.4J
Methylene chloride	1,240	-
2-methyl propanol	0.47	-
2-Methyl-1-heptene	0.21	-
4-Methylnaphthalene	0.63	-
Naphthalene	2.1	-
Nickel	49.8J	0.08
Pentachlorophenol	J	-
Pentane	0.01	-
Phenanthrene	2.4	-
Phenols	-	0.161
Phenyl acetate	J	-
Potassium	2,990	-
Pyrene	J	-
Pyridine	3,014	-
Quinidine Gluconate	8,227	-
Quinine Sulfate	2,594	-
Selenium	J	-
Silver	-	0.008

See last page for notes

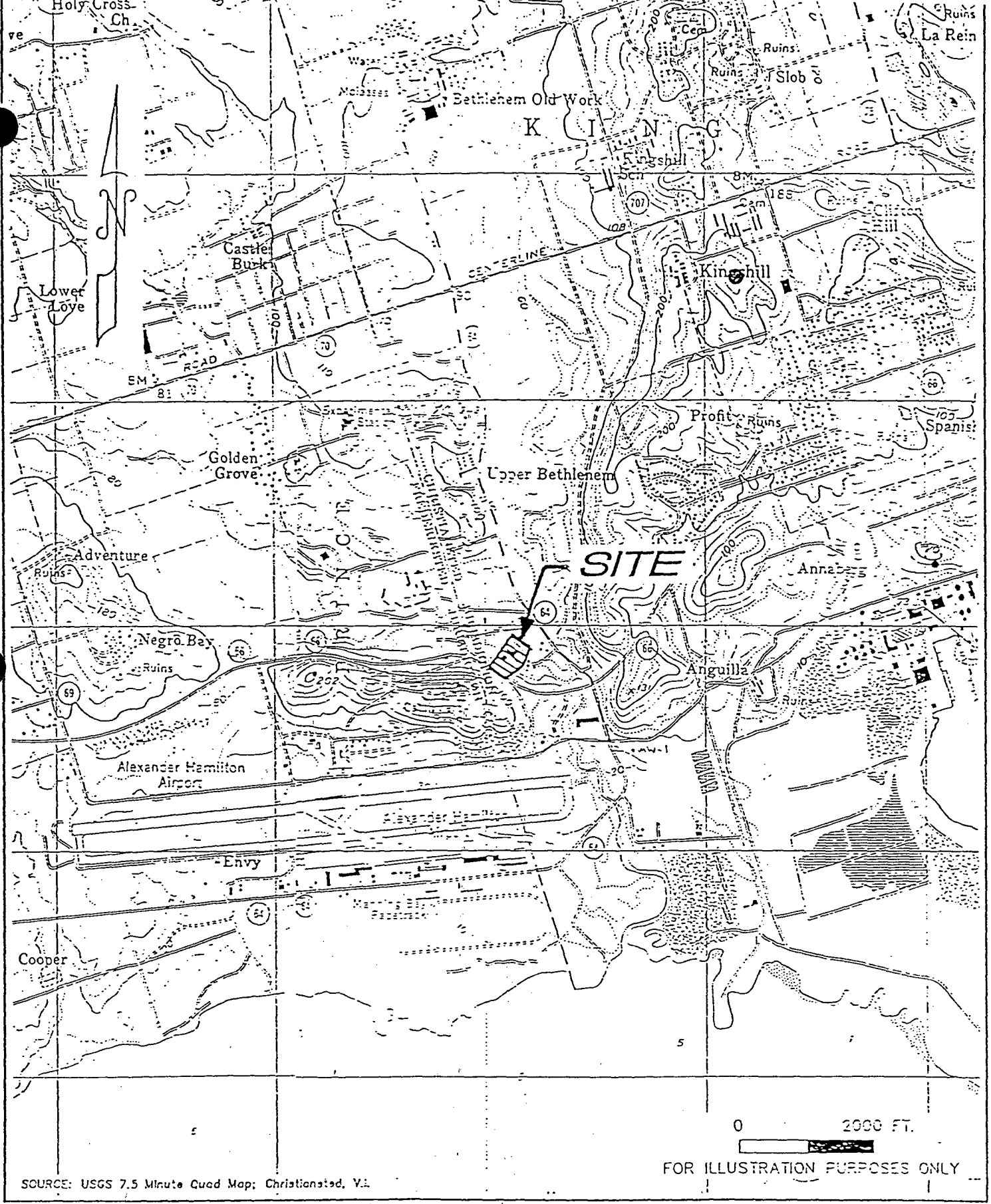
Table B-1. Summary of Substances Detected
Island Chemical Company
St. Croix, U.S. Virgin Islands

Substance Reported	Maximum Concentration Detected (ppm)	
	Soil or Sediment	Groundwater
Sodium	1,840	596
Tetrachloroethene	0.07	-
Thallium	-	0.029
Toluene	13,880	0.38
1,1,1-Trichloroethane	0.011	-
Trichloroethene	0.021[J]	-
Vanadium	97.2	0.0503
Xylenes	32.8	-
Zinc	1,710[J]	4.85

Notes
J Estimated concentration
- Substance not detected

See last page for notes

FIGURES



SOURCE: USGS 7.5 Minute Quad Map; Christiansted, V.I.

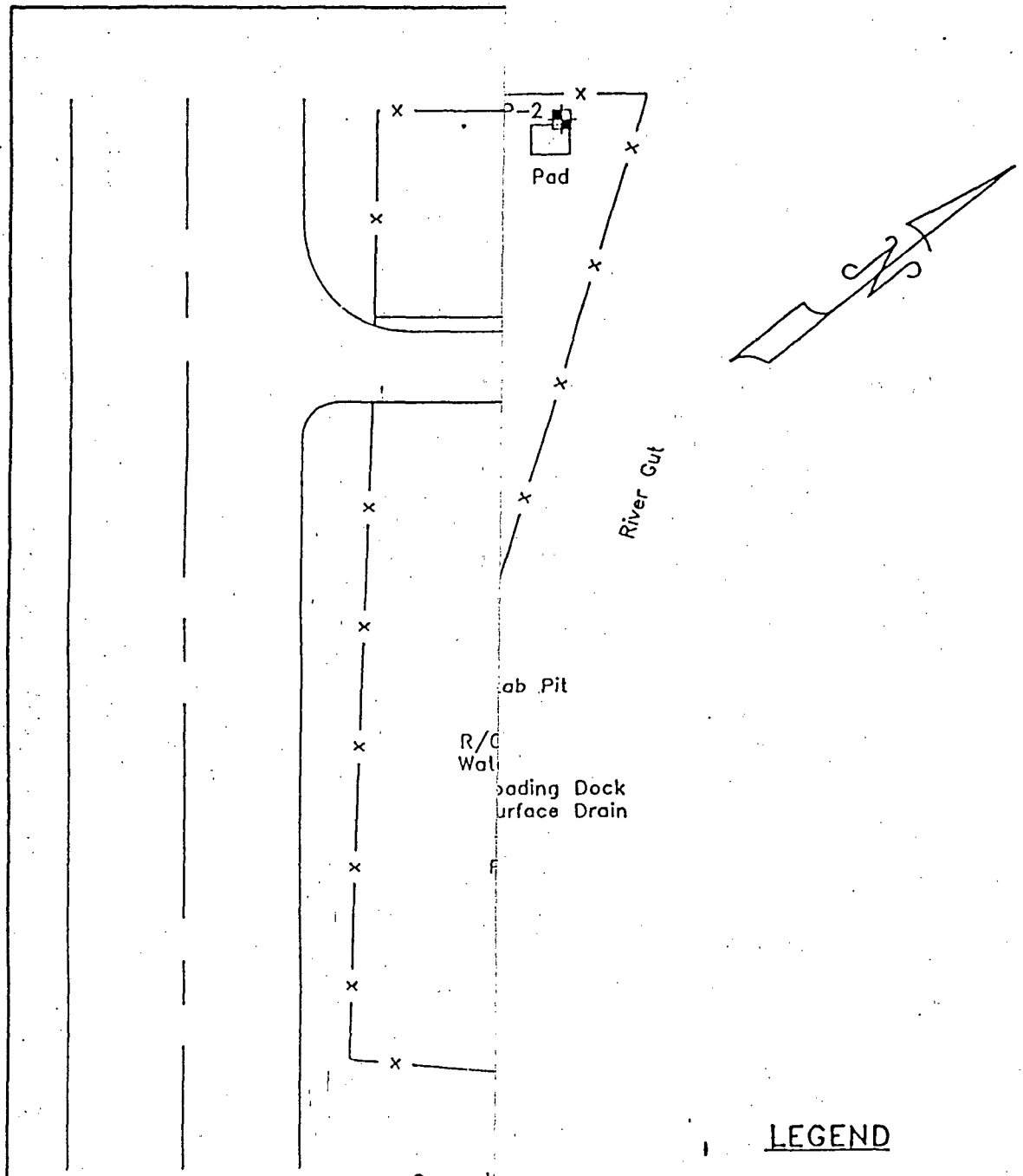
Harding Lawson Associates
Engineering and Environmental Services
131 North Third Street
Philadelphia, PA 19106
215-627-4505

SITE LOCATION MAP

ISLAND CHEMICAL COMPANY
St. Croix, U.S. Virgin Islands

FIGURE
B-1

DRAWN	JOB NUMBER	APPROVED	FILE	DATE	REVISED DATE
JSW	24231.2		24231A01	8/25/93	



LEGEND

- FENCE
- EXISTING PRODUCTION WELL
- EXISTING ABOVE GROUND STORAGE TANK
- TANK PAD–FORMER ABOVE GROUND STORAGE TANK LOCATION

SITE MAP

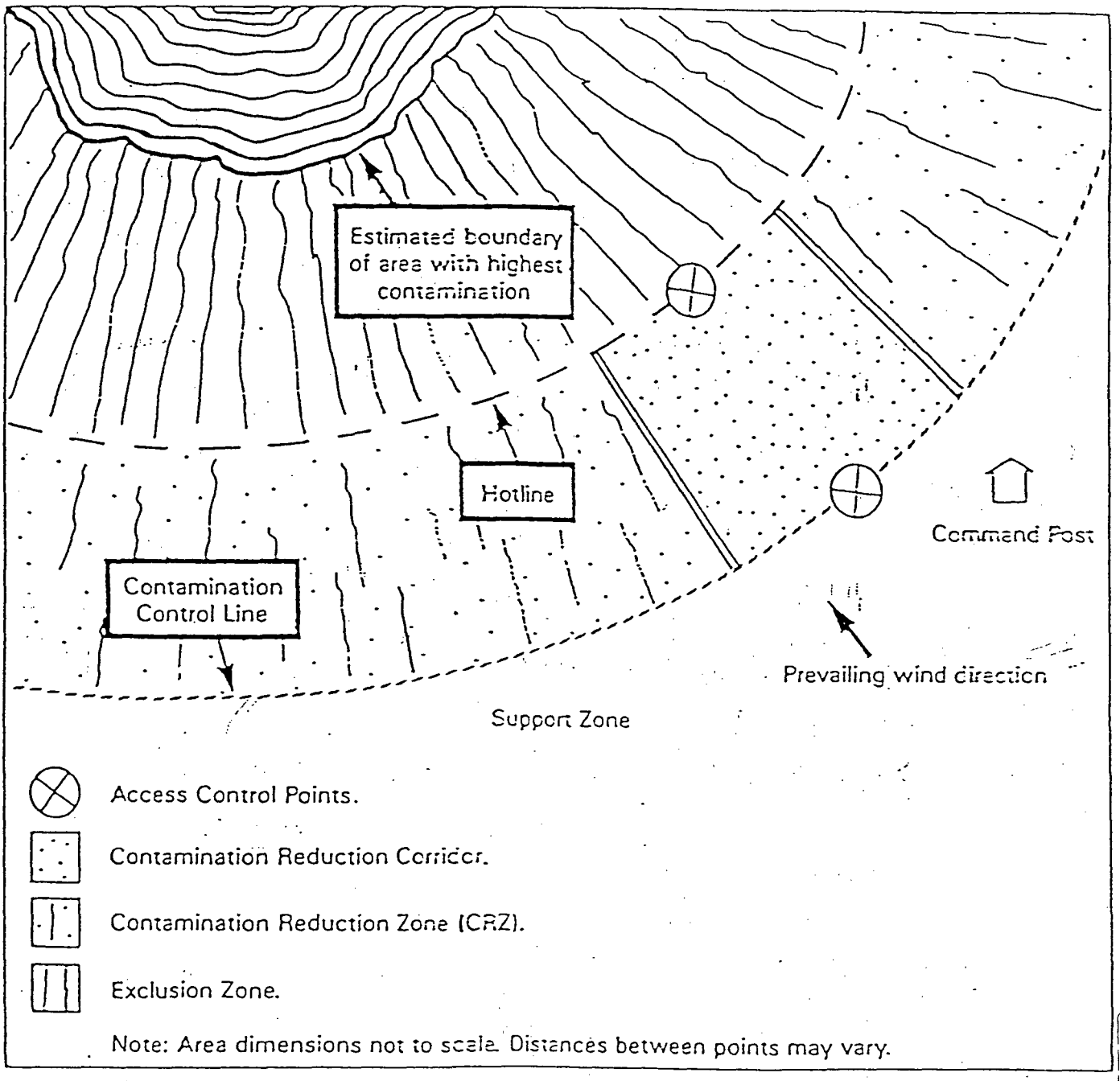
FIGURE **B-2**

ISLAND CHEMICAL COMPANY
St. Croix, U.S. Virgin Islands

APPROVED	FILE	DATE	REVISED DAT
	24231B01	1/31/94	

BASE MAP SOURCE ADAPTED FROM:
PROPOSED ICC SOIL SAMPLING LOCATIONS
SITE MAP, VI CHEMICAL, ST. CROIX, U.S.V.I.

301994



Source: DAS Environmental

301995

Harding Lawson Associates
Engineering and Environmental Services
131 North Third Street
Philadelphia, PA 19106
215-627-4505

TYPICAL WORK ZONE LOCATION MAP

ISLAND CHEMICAL COMPANY
ST. CROIX, U.S. VIRGIN ISLAND

FIGURE
B-3

DRAWN	JOB NUMBER	APPROVED	FILE	DATE	REVISED DATE
JSW	24231.2.C.4		S-BASE	10/12/93	

APPENDIX BA

HAZARDOUS PROPERTY INFORMATION

Table BA1 presents available hazardous property information for the chemical compounds identified as being present onsite. These compounds are indicated by shading. The nonshaded compounds were left in the table to provide information to job site personnel if these compounds are unexpectedly encountered at the site.

APPENDIX BB

PERSONNEL ACKNOWLEDGEMENT RECORDS

PROJECT PERSONNEL LIST AND SAFETY PLAN ACKNOWLEDGEMENT RECORD

HLA Employees

Project staff must sign the master copy of this document, indicating they have read and understand it. The employee's signature indicates acceptance and compliance with the requirements of the HASP. Copies of this document must be made available for their review and readily available at the job site.

LOG OF HLA PROJECT PERSONNEL

Employee Name/Job Title	Date Distributed	Signature

Contractors and Subcontractors

Copies of this document will be provided to contractors and subcontractors who may be affected by activities addressed herein. Contractors and subcontractors must comply with this document (and/or their own HASP if it is equally or more stringent than the HLA HASP), applicable OSHA, USEPA, and local government rules and regulations. The contractors' and subcontractors' signatures acknowledge reading and understanding the HASP and agreeing to comply with the procedures presented therein.

LOG OF CONTRACTOR AND SUBCONTRACTOR PROJECT PERSONNEL

Contractor Name/Company	Signature	Date Distributed

VISITORS: It is HLA's policy that visitors must furnish their own PPE. Visitors are required to sign the Visitor Log and comply with guidelines, rules, and procedures presented herein. If the visitor represents a regulatory agency concerned with site health and safety issues, the SHSO must immediately notify the DHSO.

VISITOR LOG

Name of Visitor	Company Name	Date of Visit	Signature

HEALTH AND SAFETY MEETINGS: Project personnel must receive initial health and safety orientation. Thereafter, a brief tailgate safety meeting is required as deemed necessary by the SHSO. Health and safety meetings will be held at least once every week or when risks and/or hazards change.

HEALTH AND SAFETY MEETING LOG

Date	Topics	Name of Attendee	Company Name

HEALTH AND SAFETY MEETINGS: Project personnel must receive initial health and safety orientation. Thereafter, a brief tailgate safety meeting is required as deemed necessary by the SHSO. Health and safety meetings will be held at least once every week or when risks and/or hazards change.

HEALTH AND SAFETY MEETING LOG

Date	Topics	Name of Attendee	Company Name

HEALTH AND SAFETY MEETINGS: Project personnel must receive initial health and safety orientation. Thereafter, a brief tailgate safety meeting is required as deemed necessary by the SHSO. Health and safety meetings will be held at least once every week or when risks and/or hazards change.

HEALTH AND SAFETY MEETING LOG

Date	Topics	Name of Attendee	Company Name

APPENDIX BC

MATERIAL SAFETY DATA SHEETS

Flinn Scientific, Inc.

MATERIAL SAFETY DATA SHEET

CHEMICAL NAME & SYNONYMS	FLINN CATALOG NUMBER
ACETONE	AX009, AX010, AX081

FORMULA	FORMULA WEIGHT (F.W.)	CAS NO.
CH_3COCH_2	58.08	67-64-1

PHYSICAL DATA (DENSITY, SOLUBILITY, ETC.)

Specific Gravity .785
Miscible with water and most organic solvents

APPEARANCE AND ODOR

Clear liquid, sweetish odor

COMPATIBLE CHEMICAL FAMILY	DOT CLASS	REACTIVITY
Organic #4 Store in a flammables cabinet See Flinn Chemical Catalog/Reference Manual	Flammable Liquid	Stable

CONDITIONS TO AVOID (IF ANY):

Avoid any source of ignition.
Avoid breathing vapor.

HEALTH HAZARDS (IF ANY):	TOLERANCE LIMIT VALUE (TLV) (IF ESTABLISHED)
Irritation to eyes, skin and mucous membranes. Vapor causes weakness, fatigue, nausea and headache.	750 ppm

FIRE HAZARDS (IF ANY):

Use ABC fire extinguisher
Serious fire hazard

SPILLS AND LEAKS:	DISPOSAL NO.
Absorb liquid with vermiculite or other absorbent material and follow suggested disposal procedure at right.	18 See Flinn Chemical Catalog/ Reference Manual

SPECIAL PRECAUTIONS (IF ANY):

Safety glasses
Gloves (rubber)

FIRST AID (IF SUBSTANCE DANGEROUS):

External: Wash affected parts with copious quantities of water.
Internal: Wash mouth; see a physician.
Respiratory: Transport to fresh air.

Consult your copy of the Flinn Chemical Catalog/Reference Manual for even more information about laboratory chemicals.

N/A = NOT APPLICABLE

FLINN SCIENTIFIC, INC. • P.O. BOX 1708 • BATAVIA, ILLINOIS U.S.A. • PHONE: (312) 879-6900

Flinn Scientific, Inc.

MATERIAL SAFETY DATA SHEET

CHEMICAL NAME & SYNONYMS		FLINN CATALOG NUMBER
HEXANES		HX002
FORMULA	**FORMULA WEIGHT (F.W.)**	**CAS NO.**
C_6H_{14} (as Hexane)	86.18 (as Hexane)	As Hexane 110-54-3

PHYSICAL DATA (DENSITY, SOLUBILITY, ETC.)

Sp.Gr. 0.66
Soluble in alcohol and acetone; not water.

APPEARANCE AND ODOR

Colorless liquid.

COMPATIBLE CHEMICAL FAMILY	DOT CLASS	REACTIVITY
Organic #3 See Flinn Chemical Catalog/Reference Manual	Flammable Liquid	Stable

CONDITIONS TO AVOID (IF ANY):

Heat, sparks and open flame.

HEALTH HAZARDS (IF ANY):	TOLERANCE LIMIT VALUE (TLV) (IF ESTABLISHED)
Irritant to body tissues. Vapor toxic.	180 mg/M^3

FIRE HAZARDS (IF ANY):

Fire hazard; store in a dedicated flammables cabinet; use Triclass, dry chemical fire extinguisher.

SPILLS AND LEAKS:	DISPOSAL NO.
Absorb on sand or vermiculite. Place in a suitable container and use suggested disposal method at right.	18 See Flinn Chemical Catalog/ Reference Manual

SPECIAL PRECAUTIONS (IF ANY):

Chemical gloves and goggles.
Fume hood.

FIRST AID (IF SUBSTANCE DANGEROUS):

External: Wash affected parts with copious quantities of water.
Internal: Wash mouth; see a physician.
Respiratory: Transport to fresh air.

Consult your copy of the Flinn Chemical Catalog/Reference Manual for even more information about laboratory chemicals.

N/A = NOT APPLICABLE

FLINN SCIENTIFIC, INC. • P.O. BOX 219 • BATAVIA, ILLINOIS U.S.A. • PHONE: (312) 879-6900

Flinn Scientific, Inc.

MATERIAL SAFETY DATA SHEET

CHEMICAL NAME & SYNONYMS	FLINN CATALOG NUMBER
HYDROCHLORIC ACID (36.5-38.0%)	***

FORMULA	FORMULA WEIGHT (F.W.)	CAS NO.
HCl	36.46	7647-01-0

PHYSICAL DATA (DENSITY, SOLUBILITY, ETC.)

Sp.Gr. 1.2
Soluble in water.

APPEARANCE AND ODOR

Clear liquid; pungent odor; constantly fuming.

COMPATIBLE CHEMICAL FAMILY	DOT CLASS	REACTIVITY
Inorganic #9 See Flinn Chemical Catalog/Reference Manual	Corrosive Liquid	Stable

CONDITIONS TO AVOID (IF ANY):

Strong oxidants.
Avoid breathing vapor.
Avoid body contact.

HEALTH HAZARDS (IF ANY):	TOLERANCE LIMIT VALUE (TLV) (IF ESTABLISHED)
Irritant to body tissues; fumes harmful.	5 ppm in air

FIRE HAZARDS (IF ANY):

Non flammable.

SPILLS AND LEAKS:	DISPOSAL NO.
Absorb on sand or vermiculite. Place in a suitable container and use suggested disposal method at right.	24b See Flinn Chemical Catalog/ Reference Manual

SPECIAL PRECAUTIONS (IF ANY):

Chemical gloves and goggles.
Fume hood.

FIRST AID (IF SUBSTANCE DANGEROUS):

External: Wash affected parts with copious quantities of water.
Internal: Wash mouth; see a physician.
Respiratory: Transport to fresh air.

Consult your copy of the Flinn Chemical Catalog/Reference Manual for even more information about laboratory chemicals.

N/A = NOT APPLICABLE

*** HX031, HX004, HX005, HX006, H0013, H0014, P-2820?, P-2826?, P-2830?

FLINN SCIENTIFIC, INC. • P.O. BOX 219 • BATAVIA, ILLINOIS U.S.A. • PHONE: (312) 879-6900

Flinn Scientific, Inc.

MATERIAL SAFETY DATA SHEET

CHEMICAL NAME & SYNONYMS	FLINN CATALOG NUMBER
METHYL ALCOHOL (Methanol; Wood Alcohol)	MX054, MX055, MX056

FORMULA	FORMULA WEIGHT (F.W.)	CAS NO.
CH_3OH	32.04	67-56-1

PHYSICAL DATA (DENSITY, SOLUBILITY, ETC.)

Sp.Gr. 0.7924
Miscible with water, alcohol and ether.

APPEARANCE AND ODOR

Clear, colorless, mobile, highly polar liquid.

COMPATIBLE CHEMICAL FAMILY	DOT CLASS	REACTIVITY
Organic #2 See Flinn Chemical Catalog/Reference Manual	Flammable Liquid	Stable

CONDITIONS TO AVOID (IF ANY):

Avoid any source of ignition.

HEALTH HAZARDS (IF ANY):	TOLERANCE LIMIT VALUE (TLV) (IF ESTABLISHED)
Toxic by ingestion (causes blindness).	200 ppm in air

FIRE HAZARDS (IF ANY):

Flammable liquid; dangerous fire risk; flash point 54°F. Use Triclass, dry chemical fire extinguisher.

SPILLS AND LEAKS:	DISPOSAL NO.
Absorb spill using sand or chemical absorption pillows or pads. Avoid any source of ignition. Follow suggested disposal procedure at right.	18 See Flinn Chemical Catalog/ Reference Manual

SPECIAL PRECAUTIONS (IF ANY):

Avoid large containers; dispense and use under a hood; store in an approved flammables cabinet.
Chemical gloves and goggles.

FIRST AID (IF SUBSTANCE DANGEROUS):

External: Wash affected parts with copious quantities of water.
Internal: Wash mouth; see a physician.

Consult your copy of the Flinn Chemical Catalog/Reference Manual for even more information about laboratory chemicals.

N/A = NOT APPLICABLE

FLINN SCIENTIFIC, INC. • P.O. BOX 219 • BATAVIA, ILLINOIS U.S.A. • PHONE: (312) 879-6900

Flinn Scientific, Inc.

MATERIAL SAFETY DATA SHEET

CHEMICAL NAME & SYNONYMS	FLINN CATALOG NUMBER
NITRIC ACID , 70.0%	R3800A, R3800B, NX017 NX043, NX016, NX017

FORMULA	FORMULA WEIGHT (F.W.)	CAS NO.
HNO_3	63.01	7697-37-2

PHYSICAL DATA (DENSITY, SOLUBILITY, ETC.)

Sp.Gr. 1.504
Miscible with water.

APPEARANCE AND ODOR

Transparent, colorless or yellowish, fuming, suffocating liquid. Yellow color (if present) results from exposure to light and release of nitrogen dioxide.

COMPATIBLE CHEMICAL FAMILY	DOT CLASS	REACTIVITY
Inorganic #3 See Flinn Chemical Catalog/Reference Manual	Corrosive Oxidizer	Stable

CONDITIONS TO AVOID (IF ANY):

Avoid body contact; avoid breathing fumes; avoid storing near oxidizable materials.

HEALTH HAZARDS (IF ANY):	TOLERANCE LIMIT VALUE (TLV) (IF ESTABLISHED)
Eyes: severe damage; possibly blindness. Skin: causes severe and deep burns. Respiratory: can cause respiratory passage damage. Ingestion: severe tissue damage.	2 ppm in air

FIRE HAZARDS (IF ANY):

Dangerous fire risk in contact with organic materials. Store in a dedicated acid cabinet away from all other chemicals.

SPILLS AND LEAKS:	DISPOSAL NO.
Absorb on sand or vermiculite. Place in a suitable container and use suggested disposal method at right.	24b See Flinn Chemical Catalog/ Reference Manual

SPECIAL PRECAUTIONS (IF ANY):

Chemical gloves and splash goggles. This substance requires utmost concern in handling and storing.

FIRST AID (IF SUBSTANCE DANGEROUS):

External: Wash affected parts with copious quantities of water.
Internal: Wash mouth; see a physician.
Respiratory: Transport to fresh air.

Consult your copy of the Flinn Chemical Catalog/Reference Manual for even more information about laboratory chemicals.

N/A = NOT APPLICABLE

FLINN SCIENTIFIC, INC. • P.O. BOX 219 • BATAVIA, ILLINOIS U.S.A. • PHONE: (312) 879-6900

APPENDIX BD

FIRST AID AND EMERGENCY CARE

APPENDIX BD

FIRST AID AND EMERGENCY CARE

Most accidents occurring at job sites require minimal first aid available through use of the first aid kit(s) at the work site or in the support facility. For more serious medical emergencies that may or may not require professional medical attention, the American National Red Cross (1988) has developed first-aid procedures that can be followed until professional medical attention is obtained. The following sections present a summary of these procedures.

When temperature exceed 70°F, take frequent breaks in shaded area. If working in a heat stress environment, unzip or remove coveralls during breaks. Have cool water or electrolyte replenishment solution available. Drink small amounts frequently to avoid dehydration. Count the pulse rate for 30 seconds as early as possible in the rest period. If the pulse rate exceeds 110 beats per minute at the beginning of the rest period, shorten the work cycle by one-third.

HEAT EMERGENCIES

There are three forms of heat emergencies: heat stroke, heat exhaustion, and heat cramps. Of these three, heat stroke is the most serious because it is life-threatening.

Heat Stroke

Symptoms

- Hot, red skin
- Very small pupils
- Very high body temperature
- Skin may feel dry

First Aid

- Call for medical assistance.
- Move the victim to a cool (not cold) place immediately.
- Cool the victim quickly by immersing him/her in a cool (not cold) bath, wrapping wet sheets around the victim and fanning him/her, or spraying the victim with cool water.
- Monitor the victim for shock until medical assistance arrives.

Heat Exhaustion

Symptoms

- Cool, pale, and moist skin
- Heavy sweating
- Dilated pupils
- Headache
- Nausea
- Dizziness
- Vomiting
- Normal body temperature

First Aid

- Move the victim out of the heat.
- Have the victim lie down with feet elevated.
- Loosen or remove the victim's clothes.
- Cover the victim with wet towels or sheets or apply cold packs wrapped in cloth.
- Fan the victim.
- Have the victim drink one-half glass of water every 15 minutes if they are conscious and able to keep the fluid down.

Heat Cramps

Symptoms

- Muscular pains and spasms

First Aid

- Move the victim out of the heat.
- Have the victim drink one-half glass of water every 15 minutes for one hour.

COLD EMERGENCIES

Cold emergencies are not anticipated during this project. Severe cold exposure can be an immediate danger to life and health. The two most serious forms of cold exposure are hypothermia and frostbite.

Hypothermia

Symptoms

- Shivering
- Dizziness
- Numbness
- Confusion
- Weakness
- Impaired judgement
- Impaired vision
- Drowsiness

Stages

- Shivering
- Apathy
- Loss of consciousness
- Decreasing pulse rate and breathing rate
- Death

First Aid

- Call for medical assistance.
- Move the victim to a warm place.
- Remove the victim's wet clothing, as applicable.

- Cover the victim with a dry blanket.
- Warm the victim slowly.
- Monitor the victim's breathing and heart rate.
- Give the victim warm broth or water - no alcohol or caffeine.

Frostbite

Symptoms

- Area is very cold to the touch and numb
- Slightly flushed skin
- Mild frostbite will appear on the edges of appendages as white or grayish-yellow with hardened skin
- Moderate frostbite will show a larger portion of the appendages as white or grayish-yellow and skin will have blistered
- Severe frostbite is grayish-blue and skin will be hard, cold, and numb. There is a danger of gangrene developing from severe frostbite

First Aid

- Move the victim to a warm place.
- Place the frostbitten ares in warm (not hot) water.
- Handle the frostbitten areas gently.
- Do not rub, massage, or apply unnecessary pressure to the frostbitten area.
- Place dry gauze between frostbitten toes or fingers.
- Bandage frostbitten areas loosely.

ANIMAL BITES

Infection from an animal bite can develop quickly: first aid should be administered immediately.

First Aid

- Control the bleeding.
- Gently wash the wound unless bleeding heavily.
- Cover the bite with a bandage.
- Have the victim see a trained medical person.

RABID ANIMAL BITES

Rabies can be found in the saliva of animals.

First Aid

- Observe the animal for unusual behavior.
- Get the victim to medical care.
- Give a description of the animal and where it was last seen to the police and/or animal control so they can capture the animal for determination of rabies infection.
- Do NOT attempt to capture or restrain the animal yourself.

INSECT BITES AND STINGS

Insert bites and stings may be tolerated by some individuals more so than others. A past history of bite and sting tolerance is not indicative of continued tolerance. All bite and sting victims should be monitored for allergic reactions. The following is a summary of symptoms and first-aid response for an allergic reaction to a bite or sting.

Symptoms

- Pain
- Swelling of the bite or sting area, which may be accompanied by swelling of the throat
- Redness or discoloration of the bite or sting area
- Itching
- Hives
- Decreased awareness
- Breathing noisy or difficult

First Aid

- Remove the stinger with tweezers or scrape with a rigid item without squeezing it (which may release more venom).
- Wash the area of the bite or sting.
- Place a cold pack wrapped in cloth on the area.
- Keep the bite or sting below heart level.
- Get the victim to medical assistance if an allergic reaction is observed.
- Provide over the counter anesthetic if allergic reaction occurs.

SNAKE BITES

Quick response to a snake bite is imperative.

First Aid

- Call for medical assistance.
- Immobilize the bitten area.
- Keep the bitten area below the heart level.
- Keep the victim calm and still.
- Observe victim for symptoms of shock.
- Give a description of the snake to the medical responder.
- Do not cut above the bite and aspirate the poison.
- Do not use a tourniquet.

SEVERE BLEEDING

First Aid

Stop external bleeding by:

- Applying direct pressure to the wound using a clean cloth.
- Apply cloths on top of the first one if bleeding persists; do not remove original cloth.
- If there is no fracture, raise the wound above the level of the heart.

- Apply pressure at the appropriate pressure point (squeezing the main artery against the bone in the forearm or against the pelvis in the groin) while continuing pressure on and elevation of the wound.
- Wrap the wound using subtle pressure to tighten the wrap.
- Check for a pulse on the injured limb to determine that the wrap is not too tight.
- Call for medical assistance.

INTERNAL BLEEDING

Internal bleeding may be as innocuous as a bruise to a condition that threatens life and health.

Symptoms

- Tender, bruised, swollen or rigid abdomen
- Vomiting small to large amounts of blood
- Injuries that have penetrated the body cavity
- Rectal or vaginal bleeding
- Difficulty breathing
- Pulse rate is abnormal
- Cool, moist skin

First Aid

- Treat small bruises by applying a cold pack to the injury.
- Obtain medical help immediately if more severe internal bleeding is suspected.
- Observe the victim's breathing and monitor his/her pulse.
- Keep the victim calm and still.
- Loosen the victim's clothing.
- Place the victim on his/her side if vomiting.
- Monitor the victim for symptoms of shock (below).

SHOCK

Shock can be caused by internal and external bleeding, insect bites or stings, snake bites, electrical shocks, severe injuries or burns, as well as other medical conditions. First aid and medical assistance is imperative for shock victims because shock is caused by a lack of sufficient blood supply to such vital organs as the heart, the lungs, and the brain.

Symptoms

- Confused behavior
- Either very slow or very fast pulse rate
- Either fast, shallow breathing or very slow breathing
- Weak and trembling limbs
- Cool, moist skin
- Pallor or bluish skin
- Pupils are dilated

First Aid

- Improve victims's circulation by laying them down with feet elevated if there are no leg fractures or suspected neck/head injuries. (Lay the victim flat if injuries are suspected.)

- If no injuries are suspected, a semi-reclining position may be used to alleviate breathing problems.
- If the victim is vomiting turn him/her onto their side.
- Cover the victim with a warm blanket.
- Call for medical assistance.
- Monitor the victim's heart rate and breathing.

VICTIM NOT BREATHING AND HAS PULSE

First Aid

- Victim unconscious, tap or gently shake the victim to see if there is a response. Ask, "Are you okay?"
- Roll the victim onto his/her back and toward you.
- Tilt the head back while lifting the chin.
- Check for breathing for 3 to 5 seconds.
- Pinch the nose shut, seal your mouth over the victim's mouth and give two 1- to 1-1/2-second breaths while keeping the head tilted back.
- Call or send someone for help.
- Check victim for a pulse approximately every minute.
- Perform 6 to 10 abdominal thrusts.
- Do finger sweep. Repeat last three steps until the obstruction is cleared or help arrives.
- Continue rescue breathing, if necessary, by breathing into the victim's mouth for 1 to 1-1/2 seconds every 5 seconds.

VICTIM NOT BREATHING AND HAS NO PULSE

First Aid

- Roll the victim onto his/her back and toward you.
- Tilt the head back while lifting the chin.
- Check for breathing for 3 to 5 seconds.
- Pinch the nose shut, seal your mouth over the victim's mouth and give two 1- to 1-1/2-second breaths while keeping the head tilted back.
- Check for a pulse.
- Call or send someone for help.
- Locate the notch at the lower end of the breastbone.
- Place the heel of your hand two fingers-width up from the end of the notch.
- Place your other hand on top keeping the fingers of your hands off the chest.
- Position your shoulders directly over your hands.
- Using a steady, firm force, bending at the waist, compress the breastbone 1-1/2 to 2 inches for 15 counts in 10 seconds.
- Perform rescue breathing (2 quick breaths as above).
- Repeat this for a total of 4 cycles.
- Recheck pulse.
- Continue cardiopulmonary resuscitation (CPR) procedures as described above until medical assistance arrives.

BURNS

There are four types of burns: heat burns, chemical burns, electrical burns, and radiation burns. Each type has three degrees of burns: first degree, second degree, and third degree.

First Degree Burn Symptoms

- Least severe
- Skin will be red or discolored
- Mild swelling
- Pain

Second Degree Burn Symptoms

- Burn extends deeper into the skin
- Skin is red or mottled
- Blistering
- May appear wet from skin fluid loss
- Painful

Third Degree Burn Symptoms

- Deepest burn; extends through all skin layers
- Skin appears white or charred
- Can look like second-degree burns
- Pain may be severe or, if nerve endings are destroyed, may not occur at all
- Can occur in patches with less severe burns

First Aid for Heat Burns

- For first-degree burns and second-degree burns with no open blister, flush with lots of cool running water. Apply moist dressings, and bandage loosely.
- For second-degree burns with open blisters and third-degree burns, apply dry dressings and bandage loosely. Do not use water, as it increases the risk of shock.
- Have the victim lie down.
- Elevate the burned area if doing so does not cause further drain.
- Maintain normal body temperature.

First Aid for Chemical Burns

- Flush the chemicals from the skin with lots of water.
- Continue flushing for 15 to 30 minutes.
- Remove any contaminated clothing or jewelry.
- Cover burns loosely with a dry bandage or dressing.
- Call for medical assistance.

First Aid for Electrical Burns

- Avoid contact with electrical source.
- Shut down the electrical source.
- Cover all burns with a loose dry dressing and bandage.
- Provide care for shock as needed.
- Call for medical assistance.

First Aid for Radiation Burns

- Decontaminate the victim.
- Obtain medical assistance immediately.

EYE INJURIES

Eye injuries should always be treated as a serious injury.

Symptoms

- Visible foreign object
- Redness
- Burning
- Pain
- Headache
- Tearing

First Aid

- Use care and be gentle when touching the eyes.
- Wash hands before caring for an eye injury, if possible.
- If an object is in the eye, lift the upper eyelid, have the victim look down and flush the eye with clean water or eye wash solution.
- If there are chemicals in the eye, flush the eye with clean water or eye wash solution from the nose outward for 15 to 30 minutes.
- For objects in the eye (whether removed through flushing or not) and for chemicals in the eye, wrap a bandage loosely around both eyes.
- If the eye is cut or there is a penetrating object in the eye, place a cup over the injured eye and wrap both eyes loosely with a bandage. Do not attempt to remove the penetrating object.
- Obtain medical assistance for all (even minor) eye injuries.

NOSE INJURIES

Nose injuries can be indicative of more serious injuries to the head, back, or neck. Caution should be used to assess this type of injury. Nosebleeds are typically a less serious injury but can be severe enough to cause shock from loss of blood. Be sure to ask the victim how the nosebleed began.

First Aid

- Have the victim sit down.
- Have him/her lean forward with the chin resting on the chest.
- Pinch the nose.
- Keep the victim calm and quiet until the bleeding has stopped.

Symptoms of a More Serious Nose Injury

- Swelling and pain
- Pupils dilated unevenly
- Bloody or clear fluid draining from either the ears or the nose
- Loss of feeling and movement in appendages

First Aid for a More Serious Nose Injury

- Do not attempt to stop the flow of fluid from the nose.
- Keep the victim's head and neck stable.
- Keep the victim calm and quiet.
- Call for medical assistance.

FRACTURES

There are two types of fractures: simple (one internal fracture) and compound (two or more fractures often breaking the skin). The compound fracture is more serious because of the accompanying open wound. Fractures occurring in the body may be indicative of internal injuries.

Symptoms

- A grating sensation and/or a snapping sound when the appendage is moved
- Deformities
- Pain and tenderness
- Bruising and swelling
- Immobility of the injured part

Note: First aid for fractures, dislocation, sprains, and strains are similar for these injuries. The first aid for these injuries will be discussed after the symptoms.

DISLOCATIONS

Symptoms

- Deformity
- Swelling and tenderness
- Pain in the joint
- Loss of or limited movement

SPRAINS OR STRAINS

Sprains are the result of stretched or torn tendons or ligaments around the joints. Torn muscles are indicative of strains.

Symptoms

- Pain in the joint
- Sharp pain
- Tender to the touch
- Bruising and swelling
- Stiffness

First Aid for Fractures, Dislocations, Sprains, or Strains

- If the injury is to the head, neck, or back, stabilize the head and neck. Do not attempt to move the victim unless absolutely necessary. Obtain medical assistance immediately. Keep the victim calm and quiet.

- Determination of the precise injury is often difficult, so remember this rule of thumb: "When in doubt, splint."
- Splint only if it can be done without causing more pain and discomfort to the victim.
- The injury must be splinted in the position in which it is found. Do not attempt to straighten the injured part.
- Splint the injured area as well as the surrounding joints so that the entire limb is immobilized.
- Check for a pulse before and after splinting.
- Call for medical assistance.

First Aid for Head, Neck, and Back Injuries

If the victim has obvious head injury, suspect the possibility of spinal cord injury also. If the victim is unconscious and your survey of the scene suggests traumatic injury to the head, care for him or her as if there is a spinal injury.

- If you suspect the victim has a head or neck injury, keep him or her lying flat and wait for EMS. Do not move the victim unless there is immediate danger from extreme hazards such as fire, toxic fumes, heavy traffic, electrical wires, or deep or swiftly moving water. If you must move him or her, try not to bend or twist the body. If you have any doubts about the victim's injuries, keep him or her lying flat.
- If you suspect a spinal injury, stabilize the victim's head and neck as you found them by placing your hands along both sides of the head. This keeps the head in line with the spine and prevents movement.
- If you must move the victim, do it carefully, using the clothes drag rescue method.
- Stay with the victim and continue to stabilize the head and neck until EMS arrives. Monitor ABCs.

APPENDIX BE

EQUIPMENT CALIBRATION AND MAINTENANCE

APPENDIX BE

EQUIPMENT CALIBRATION AND MAINTENANCE

This appendix presents Harding Lawson Associates' (HLA's) standard operating procedures for field calibration and maintenance of direct reading instruments, personal sampling pumps, and detector tubes that may be used during field activities. Each equipment item is described and the calibration, operation, and maintenance procedures are detailed to the extent necessary to ensure proper care and use. Detailed procedures are provided in instrument-specific manuals from each manufacturer.

These standard operating procedures are intended to ensure that equipment is properly maintained and operated. These procedures were developed on the basis of the following assumptions:

- Procedures are consistent with the manufacturer's calibration, operation, and maintenance guidelines.
- Equipment calibration, operation, and maintenance procedures will be performed by properly trained HLA personnel.
- Only designated personnel will calibrate, operate, and maintain certain instruments.
- Records will be maintained to allow tracking of the calibration, operation, and maintenance of a given instrument.

PHOTOIONIZATION DETECTOR (HNU PI 101/HNU DL101/PHOTOVAC MICROTIP)

Theory of Operation

The portable photoionization detector (PID) detects the concentration of organic gases as well as a few inorganic gases. The basis for detection is the ionization of gaseous species. Every molecule has a characteristic ionization potential (IP) that is the energy required to remove an electron from the molecule, yielding a positively charged ion and the free electron. The incoming gas molecules are subjected to ultraviolet (UV) radiation, which is energetic enough to ionize many gaseous compounds. Each molecule is transformed into charged ion pairs, creating a current between two electrodes.

Three lamps, each containing a different UV light source, are available for use with most PIDs. Ionizing energies of the lamp are 9.5, 10.2, and 11.7 electron volts (eV). All three detect many aromatic and large molecule hydrocarbons. The 10.2 eV and 11.7 eV probes, in addition, detect some smaller organic molecules and some halogenated hydrocarbons. The 10.2 eV lamp is the most useful for environmental response work because it is more durable than the 11.7 eV lamp and detects more

compounds than the 9.5 eV lamp. The following sections detail the proper calibration and field maintenance methods to be used with these PIDs.

HNU PI 101

The HNU PI 101 PID is designed for trace gas analysis in ambient air. The HNU PI 101 is factory-calibrated with certified standards of benzene, vinyl chloride, and isobutylene, with the reference standard being benzene. Because of the inherent toxicological risks associated with benzene and vinyl chloride, the primary calibration standard to be used should be isobutylene. When calibrating the unit with 100 parts per million (ppm) isobutylene, the SPAN control should be set at 9.8 and the unit should read approximately 70 ppm. This method of calibration converts the response of the unit to isobutylene to yield a direct reading of benzene that is based on the response factor of the unit using a 10.2 eV probe at a span setting of approximately 9.8. More simply stated, the required reading for calibration will be as follows:

$$= \text{Isobutylene ppm} \times \frac{\text{photoionization sensitivity (isobutylene)}}{\text{photoionization sensitivity (benzene)}}$$

$$= 100 \times 7/10$$

$$= 70 \text{ ppm}$$

When using probes with 9.5 eV or 11.7 eV lamps, consult the user's manual for photoionization sensitivities and required SPAN control settings because these units may change for each individual lamp.

In cases where hazardous chemicals have been identified, the HNU PI 101 can also be calibrated to provide direct reading results of these chemicals. Please consult the user's manual and the Designated Health and Safety Officer (DHSO) to select chemicals for concern of appropriate calibration. The steps calibration method for the HNU PI 101 with a 10.2 eV lamp follows:

1. Identify the probe by the lamp label. If a question exists, disassemble the probe and inspect the lamp. The energy of the lamp should be etched into the glass envelope.
2. Connect the probe to the readout assembly, making sure the red interlock switch is depressed by the ring on the connector

3. Set the SPAN control potential to 9.8.

4. Battery check - turn the function switch to BATT. The needle should be in the green region. If it is not, recharge the battery.

5. Zero set - turn the function switch to STANDBY. In this position, the lamp is off and no signal is being generated. Allow the unit to sit for a minute to warm the parts. Set the ZERO point with the ZERO set control.

6. Fill a dedicated tedlar bag with the 100 ppm isobutylene in air SPAN gas.

7. Turn the function switch to the 0 to 200 range position. Attach the sampling bag to the probe inlet. Adjust the SPAN control setting to read approximately 70 ppm at a span setting of 9.8.

8. Record the units achieved at the set SPAN control and the calibration phase used.

9. Lamp cleaning - if calibration cannot be achieved at the desired span potential, the lamp must be cleaned. (See specific instrument manual for instructions)

HNU DL-101-2

The HNU DL-101-2 applies microprocessor capabilities to the basic photoionization detection principles exhibited by the HNU PI 101. The microprocessor provides electronic zeroing, site and time data logging, and the ability to store up to 12 calibrations. The unit provides two basic modes of operation, the first being the survey mode and the second being the hazardous waste mode. Like the PI 101, the DL-101-2 is also factory-calibrated using benzene as the reference standard. The primary method of calibration will also use 100 ppm isobutylene in air (the calibration gas standard) with the unit in the survey mode. If several compounds are suspected, the hazardous waste mode may be utilized to store the needed amount of calibration curves. In either case, it is essential to identify the lamp voltage being used and the photoionization sensitivities of the chemical species of interest.

To calibrate in the survey mode, follow these instructions:

1. Identify the lamp energy. If this information is not available on the outside of the probe, disassemble the probe and inspect the lamp. The energy of the lamp should be etched into the glass envelope.

2. Press the power button to start the unit. Wait one minute to allow the unit to warm up.

3. Fill a dedicated tedlar bag completely with isobutylene calibration standard.

4. Press the CALIBRATE key on the front panel. "Calibrate" should appear on the liquid

crystal display (LCD).

5. Press ENTER. "Zeroing Unit" will appear on the LCD. The unit will display the unit concentration before the electronic zero. The display will then prompt: CE/ENT/EXIT Conc = ___ppm. Enter the concentration of the calibration gas and press enter. "Attach gas to probe and /ENTER/" should appear on the LCD.

6. Attach the tedlar bag to the probe and press ENTER. Allow the sample to be naturally drawn into the unit. Press ENTER when ready. "xxxx ppm" should appear on the LCD. When the readings reach 100 ppm (± 10 percent), press ENTER. The LCD should then display "Calibrating...please wait."

In the survey mode, the unit will save the calibration and then the LCD reverts to the operation screen. When additional calibrations are called for, utilize the hazardous waste mode and cross reference calibration responses with the DL-101-2 user's manual.

Photovac MicroTIP

The MicroTIP must be calibrated to display concentrations in units equivalent to ppm. First, a supply of zero gas (total hydrocarbon concentration <1 ppm) is used to set the zero point. Then Span Gas (100 ppm isobutylene in air) is used to set the sensitivity.

Following these steps for MicroTIP calibration:

1. Turn the MicroTIP on and allow five minutes for warm up.

2. Fill the dedicated zero gas tedlar bag with zero gas calibration standard.

3. Fill the dedicated span gas tedlar bag with 100 ppm isobutylene in air calibration standard.

4. Press SETUP and select the desired Cal Memory (i.e., 100 ppm) with the arrow keys and press ENTER. Press EXIT to leave setup.

5. Press CAL and attach the filled zero gas bag to the MicroTIP probe. Press ENTER and the MicroTIP sets its zero point.

6. MicroTIP then asks for the span gas concentration. Enter 100.0 and then connect the span gas bag to the MicroTIP probe.

7. Press ENTER and MicroTIP sets its sensitivity.

8. When the display reverts to normal, the unit is calibrated and ready for use. Remove the span gas bag from the inlet.

9. Record applicable calibration information.

Organic Vapor Analyzer Foxboro Model 128

Theory of Operation

The Foxboro Model 128 organic vapor analyzer (OVA) is designed to detect and measure hazardous vapors and gases. The instrument utilizes the principle of hydrogen flame ionization for detection and measurement of organic vapors. The instrument measures organic vapor concentration by producing a response to an unknown sample, which can be related to a gas of known composition to which the instrument has been previously calibrated. During normal survey mode operation, a continuous sample is drawn into the probe and transported to the detector chamber by an internal pumping system.

The sample stream is metered and passed through particulate filters before reaching the detector chamber. Inside the detector chamber, the sample is exposed to a hydrogen flame that ionizes the organic vapors. When most organic vapors burn, they leave positively charged carbon-containing ions. An electric field drives the ions to a collecting electrode. As the positive ions are collected, a current corresponding to the collection rate is generated. This current is measured with a linear electrometer preamplifier that has an output signal proportional to the ionization current. A signal conditioning amplifier is used to amplify the signal from the preamp and to condition for display on the probe/readout assembly.

The OVA will primarily be used in the survey mode. In the survey mode, the OVA is internally calibrated to methane by the manufacturer. When the instrument is adjusted to manufacturer's instructions, it indicates the true concentration of methane in air. In response to all other detectable compounds, however, the instrument reading may be higher or lower than the true concentration.

The following procedures detail the operation, calibration, hydrogen refilling, and recharging methods to be used with the OVA:

1. Startup Procedures

   a. Connect the probe/readout assembly to the sidepack assembly by attaching the sample line and electronic jack to the sidepack.

   b. Select the desired sample probe (close area sample or telescoping probe) and connect the probe handle. Before tightening the knurled nut, check that the probe accessory is firmly seated against the flat seals in the probe handle and in the tip of the telescoping probe.

   c. Move the INST/BATT switch to the test position. The meter needle should move to a point beyond the white line, indicating that the integral battery has more than four hours of operating life before recharging is necessary.

   d. Move the INST/BATT switch to the "ON" position and allow a five-minute warm up.

   e. Turn the PUMP switch on.

   f. Use the Calibrate Adjust knob to set the meter needle to the level desired for activating the audible alarm. If this alarm level is other than zero, the CALIBRATE switch must be set to a appropriate range.

   g. Turn the Volume knob fully clockwise (optional).

   h. Using the Alarm Level Adjust knob, turn the knob until the audible alarm is activated (optional).

   i. Move the Calibrate Switch to x1 and adjust the meter reading to zero using the Calibrate Adjust (zero knob).

   j. Open the hydrogen Tank Valve one or two turns and observe the reading on the Hydrogen Tank Pressure Indicator. (Approximately 150 pounds per square inch [psi] of pressure is required for each hour of operation.)

   k. Open the Hydrogen Supply Valve one or two turns and observe the reading on the Hydrogen Supply Pressure Indicator. The reading should be between 8 and 12 psi.

   l. After approximately one minute, depress the IGNITER BUTTON until the hydrogen flame lights. The meter needle will travel upscale and begin to read "Total Organic Vapors." Caution: Do not depress igniter for more than six seconds. If flame does not ignite, wait one minute and try again.

   m. The instrument is ready for use. NOTE: If the ambient background organic vapors are "zeroed out" using the Calibrate Adjust knob, the meter needle may move off-scale in the negative direction when the OVA is moved in a location with lower background. If the OVA is to be used in the 0 to 10 ppm range, it should "zeroed" in an area with very low background. A charcoal filter (Part No. 510095-1) can be used to generate the clean background sample.

2. Calibration Using Known Samples for Each Range

The accuracy is obtained when the instrument is calibrated with known concentrations for

each range. Prepare separate samples of methane-in-air in these concentration ranges: 7 to 10 ppm, 90 to 100 ppm, and 900 to 1000 ppm. Calibrate the instrument as follows:

a. Place the instrument in normal operation and allow a minimum of 15 minutes for warm-up and stabilization.

b. Set the Gas Select control to 300.

c. Set the Calibrate switch to x1.

d. Set the Calibrate Adjust (Zero) knob so that the meter reads zero.

e. Check that the meter reads zero on the x10 and x100 ranges.

f. Set the Calibrate switch to x1 and introduce the sample with known concentration in the 7 to 10 ppm range.

g. Adjust R31 so the meter reading corresponds to the sample concentration.

h. Set the Calibrate switch to x10 and introduce the sample with known concentration in the 90 to 100 ppm range.

i. Adjust R32 so that the meter reading corresponds to the sample concentration.

j. Set the Calibrate switch to x100 and introduce the sample with known concentration in the 900 to 1000 ppm range.

k. Adjust R33 so that the meter reading corresponds to the sample concentration.

l. The instrument is now calibrated for methane and ready for service.

If the flame-out alarm is actuated, check that the pump is running, then press the IGNITER button. Under normal conditions, flame-out results from sampling a gas mixture that is above the lower explosive level, which causes the hydrogen flame to extinguish. If this is the case, reignition is all that is required to resume monitoring. Another possible cause for flame-out is restriction of the sample flow line, which would not allow sufficient air into the chamber to support combustion. The normal cause for such restriction is a clogged particle filter.

It should be noted that the chamber exhaust port is on the bottom of the case and blocking this port with the hand will cause fluctuations and/or flame-out.

3. Shut Down Procedure

a. Close HYDROGEN TANK valve

b. Close HYDROGEN SUPPLY valve

c. Move INSTRUMENT switch to OFF

d. Wait five seconds and move PUMP switch to OFF. The instrument is now in a shut down configuration.

4. Fuel Refilling

Note: Use Prepurified or Zero grade hydrogen (certified total hydrocarbons as methane <0.5 ppm is recommended).

a. The instrument and the charger should be completely shut down during hydrogen tank refilling operations. Refilling should be performed in a ventilated area. There should be no potential igniters or flame in the area.

b. If you are making the first filling on the instrument or if the filling hose has been allowed to fill with air, the filling hose should be purged with hydrogen before filling the instrument tank. This purging is not required for subsequent fillings.

c. The filling hose assembly should be left attached to the hydrogen supply tank when possible. Ensure that the FILL/BLEED valve on the instrument end of the hose is in the OFF position. Connect the hose to the refill connection on the Side Pack Assembly.

d. Open the hydrogen supply bottle valve on the instrument panel and place the FILL/BLEED valve on the filling hose assembly in the FILL position. The pressure in the instrument tank will be indicated on the Hydrogen Tank Pressure indicator.

e. After the instrument fuel tank is filled, close the REFILL valve on the panel, the FILL/BLEED valve on the filling hose assembly and the hydrogen supply bottle valve.

f. The hydrogen trapped in the hose should not be bled off to atmospheric pressure. Caution should be used in this operation as described in Step (g) below because the hose will contain a significant amount of hydrogen at high pressure.

g. The hose is bled by turning the FILL/BLEED valve on the filling hose assembly to the Bleed position. After the hose is bled down to atmospheric pressure, the FILL/BLEED valve should be turned to the FILL position to allow the hydrogen trapped in the connection fittings to go into the hose assembly. Then, again, turn the FILL/BLEED valve to the Bleed position and exhaust the trapped hydrogen. Then turn the FILL/BLEED valve to OFF to keep the hydrogen at one atmosphere in the hose so that at the time of the next filling there will be no air trapped in the filling line.

h. Close the HYDROGEN TANK valve.

i. With the HYDROGEN TANK valve and the HYDROGEN SUPPLY valve closed, a small amount of Hydrogen at high pressure will be present in the regulators and plumbing. As a leak check, observe the Hydrogen Tank Pressure indicator while the remainder of the system is shut down and ensure that the pressure reading does not decrease rapidly (more than 350 psi/hour), which would indicate a significant leak in the supply system.

5. Battery Charging

Warning: Never charge in a hazardous environment.

a. Plug charger connector into mating connector on battery cover and insert alternating current (AC) plug into 115V AC wall outlet.

b. Move the battery charger switch to the ON position. The lamp above the switch button

should illuminate.

c. Battery charge condition is indicated by the meter on the front panel of the charger; meter will deflect to the left when charging. When fully charged, the pointer will be in line with the "charged" marker above the scale.

d. Approximately one hour of charging time is required for each hour of operation. However, an overnight charge is recommended. The charger can be left on indefinitely without damaging the batteries. When finished, move the battery charger switch to OFF and disconnect from the Side Pack Assembly.

It has been established that these battery charging procedures may not be effective when the battery has completely discharged. When this happens and the above procedures fail to charge the battery, perform the following additional steps:

e. Remove the battery from the instrument case.

f. Connect to any variable direct current (DC) power supply.

g. Apply 40 volts at 1/2 ampere (A) maximum.

h. Observe the power supply meter. As soon as the battery begins to draw current, gradually reduce the power maintaining 1/2 A maximum until the meter reads approximately 15 volts.

Note: The time required to reach the 15-volt reading will depend on degree of discharge.

i. Repeat steps (a), (b), (c), and (d) above to complete the charging cycle.

SAMPLING PUMPS (SKC, MSA, or Gillian)

Sampling pumps utilized to collect personal and area samples will be calibrated before and after sampling. In each case, the sampling pumps will be calibrated in accordance with parameters established in National Institute of Occupational Safety and Health (NIOSH) Manual of Analytical Methods (1984). Calibration will be performed onsite using a primary standard (i.e., electronic bubble meter or 1-liter glass buret). Calibrations of sampling trains will be conducted with the collection media (i.e., charcoal tubes, XAD-2 tubes, tenax, cyclone separators, impingers, etc.) in line with the primary standard to ensure quality data.

The following calibration procedures should be followed when calibrating sampling trains:

1. Electronic Bubble Meter Method

a. Allow the pump to run five minutes before voltage check and calibration.

b. Connect the collection media to the bottom of the calibration meter by Tygon tubing. Then connect the pump and the tubing to be used to the top of the meter. This will allow the sampling train to be calibrated as it is to be used.

c. Visually inspect all Tygon tubing connections.

d. Wet the inside of the electronic flow cell with the supplied soap solution by pushing on the button several times.

e. Turn on the pump and adjust the pump rotameter, if available, to the appropriate flow rate setting.

f. Press the button on the electronic bubble meter. Visually capture a single bubble and electronically time the bubble. The accompanying printer will automatically record the calibration reading in liters per minute.

g. Repeat step f until two readings are within 5 percent.

h. While the pump is still running, adjust the pump, if necessary.

i. Repeat the procedure for all pumps to be used for sampling. The same cassette and filter may be used for all calibrations involving the same sampling method.

Bubble-meter Method

Perform calibration using the bubble-meter method as follows:

1. Allow sampling pumps to run for five minutes before calibration. Check voltage after five minutes. If the voltage is below the level specified by the manufacturer, the pump needs to be recharged. Check the manufacturer's instructions for proper charging procedures.

2. Wet the inside of the burette with the soap solution before setup.

3. Assemble the bubble meter and connect the sampling pump and the type of collection device intended for the field sampling.

4. Momentarily submerge the opening of the burette to capture a film of soap.

5. Draw two or three bubbles up the burette to ensure that they will reach the top.

6. Visually capture a single bubble and time (with a stopwatch) the bubble from 0 to 1000 milliliter (ml) or 0 to 100 ml, depending on the pump being calibrated.

7. Adjust the pump flow rate until the desired flow rate is achieved. For example, for a flow rate of 2 liters per minute, the bubble must travel from 0 to 1000 ml in 30 seconds. Verify the flow rate at least twice.

8. For pumps with rotameters, mark or record the position of the float (ball) when the pump is running at the desired flow rate. This will allow the industrial hygienists to adjust the

pump flow rate back to the correct rotameter position if the float moves off the marked setting during sampling.

DETECTOR TUBES/PUMPS (Sensidyne/Gastech, Drager, MSA)

Principle/Description

1. Detector tubes/pumps, when used with a variety of commercially available detector tubes, are capable of measuring the concentrations of a wide variety of compounds in industrial atmospheres.

2. Operation consists of using the pump to draw a known volume of air through a detector tube designed to measure the concentration of the substance of interest. The concentration is determined by a colorimetric change of an indicator that is present in the tube contents.

Applications/Limitations

1. Detector tubes/pumps can measure more than 200 organic and inorganic gases and vapors or for leak detection. Some aerosols can also be measured.

2. Detector tubes of a given brand are to be used only with a pump of the same brand. The tubes are calibrated specifically for the same brand of pump and may give erroneous results if used with a pump of another brand.

3. A limitation of many detector tubes is the lack of specificity. Many indicators are not highly selective and can cross-react with other compounds. Manufacturer's manuals describe the effects of interfering contaminants.

4. Another important consideration is sampling time. Detector tubes give only an instantaneous interpretation of environmental hazards. This may be beneficial in potentially dangerous situations or when ceiling exposure determinations are sufficient. When long-term assessment of occupational environments is necessary, short-term detector tube measurements may not reflect time-weighted average levels of the hazardous substances present.

5. Detector tubes normally have a shelf-life at 25 degrees Celsius (°C) of one to two years. Refrigeration during storage lengthens the shelf-life. Outdated detector tubes (i.e., beyond the printed expiration date) should never be used.

Performance Data

1. The specific tubes are designed to cover a concentration range that is near the Permissible Exposure Limit (PEL). Concentration ranges are tube-dependent and can be anywhere from one one-hundredth to several thousand ppm. The limits of detection depend on the particular detector tube.

2. Accuracy ranges vary with each detector tube (± 25 percent).

3. The pump may be handled during operation (weighing from 8 to 11 ounces) or it may be an

automatic type (weighing about 4 pounds) that collects a sample using a preset number of pump strokes. A full pump stroke of either type of short-term pump has a volume of about 100 cubic centimeters (cm^3).

4. In most cases where only one pump stroke is required, sampling time is about on minute. Determinations for which more pump strokes are required take proportionately longer.

Leakage Test

1. Each day before use, perform a pump leakage test by inserting an unopened detector tube into the pump and attempt to draw in 100 ml of air. After a few minutes, check for pump leakage by examining pump compression for bellows-type pumps or return to resting position for piston-type pumps. Automatic pumps should be tested according to the manufacturer's instructions.

2. In the event of leakage that cannot be repaired in the field, notify the DHSO to expedite repairs.

3. Record leakage test on the HLA Air Monitoring Calibration Form.

Calibration Test

1. Calibrate the detector tube for proper volume measurement at least quarterly.

2. Simply connect the pump directly to the bubble meter with a detector tube in-line. Use a detector tube and pump from the same manufacturer.

3. Wet the inside of the 100 cm^3 bubble meter with soap solution.

4. For volume calibration, experiment to get the soap bubble even with the zero mark of the buret.

   a. For piston-type pumps, pull the pump handle all the way out (full pump stroke) and note where the soap bubble stops; for bellows-type pumps, compress the bellows fully; for automatic pumps, program the pump to take a full pump stroke. For either type pump, the bubble should stop between the 95 cm^3 and 105 cm^3 marks. Allow four minutes for the pump to draw the full amount of air (This time interval varies with the type of detector tube being used in-line with the calibration setup).

   b. Also check the volume of 50 cm^3 (1/2 pump stroke) and 25 cm^3 (1/4 pump stroke) if pertinent. As in Section 1 above, a ± 5 percent error is permissible. If error is greater that ± 5 percent, send the pump for repair and recalibration.

5. Record the calibration information required on the Calibration Log.

6. It may be necessary to clean or replace the rubber bung or tube holder if a large number of tubes have been taken with the pump.

Additional Information

1. Draeger, Model 31 (bellows)

   When checking the pump for leaks with an unopened tube, the bellows should not be completely expanded after 10 minutes.

2. Draeger, Quantimeter 1000, Model 1 (automatic)

   A battery pack is an integral part of this pump. The pack must be charged before initial use. One charge is good for 1000 pump strokes. During heavy use, it should be recharged daily. If a "U" (undervoltage) message is continuously displayed in the readout window of this pump, the battery pack should be immediately recharged.

3. Mine Safety Appliances, Samplair Pump, Model A, Part No. 463998 (piston)

   The pump contains a flow rate control orifice protected by a plastic filter that periodically needs to be cleaned or replaced. To check the flow rate, the pump is connected to a buret and the piston is withdrawn to the 100-ml position with no tube in the tube holder. After 24 to 26 seconds, 80 ml of air should be admitted to the pump. Every six months, the piston should be relubricated with the oil provided.

4. Sensidyne-Gastec, Model 800, Part No. 7010657-1 (piston)

   This pump can be checked for leaks as mentioned for the Kitagawa pump; however, the handle should be released after one minute. Periodic relubrication of the pump head, the piston gasket, and the piston check valve is needed and is use-dependent.

Special Considerations

1. Detector tubes should be refrigerated when not in use to prolong shelf life.

2. Detector tubes should not be used when cold. They should be kept at room temperature or in a shirt pocket for one hour before use.

3. Lubrication of the piston pump may be required if volume error is greater than 5 percent.

COMBUSTIBLE GAS INDICATOR (Model 361 or equivalent)

Theory of Operation

The Model 361 Hydrogen Sulfide combustible gas and oxygen sensors operate simultaneously. Each sensing circuit is equipped with an individual, visual alarm descriptor. There is a common, pulsating audible alarm. One position of the FUNCTION switch enables the audible alarm to be turned off, if so desired. The alarm descriptors will remain on until the concentration returns to within the alarm setpoints and the reset button is depressed.

A low-battery alarm will activate the BATT descriptor on the display and a continuous, steady-

sounding audible alarm. This steady sound indicates that the Model 361 must be removed from service and charged in a nonhazardous area.

> WARNING: Exposure of the combustible gas sensor to a concentration high enough to cause the readout to indicate a reading higher that 100 percent Lower Explosive Limit (LEL) will cause the readout to latch. When latched, the LEL readout will be blank and the descriptors for OVER and LEL ALARM will appear. This latching circuit is a warning that the gas concentration has exceeded the LEL and that all personnel must evacuate the area.

This latching circuit can be reset by removing the Model 361 to an area known to be free of combustible gas (fresh air) and turning off the instrument. The Model 361 can then be turned on and rezeroed in fresh air. This latch circuit does not operate during the first 30 seconds after turning on the instrument, thus providing sufficient time for sensor warm-up and rezeroing.

Toxic Gas Sensor

The toxic gas sensor used in the Model 361 is a membrane-sealed electrochemical cell. The cell requires an external voltage source to function and produces a current output that is proportional to the amount of H_2S present. The H_2S diffuses through the front membrane of the cell and is oxidized at the working electrode. Current flows through the liquid electrolyte (acid solution) to the counter/reference electrode where oxygen reduction occurs. The amount of current produced for a concentration of H_2S is dependent on the voltage across the working reference electrodes as well as the electrode materials and the electrolyte. The choice of the particular noble metal electrodes and the setting of the cell voltage optimizes the sensor for the detection of H_2S.

The current from the cell is fed to a current-to-voltage converter. This voltage signal is applied to an amplifier that drives the toxic gas readout and provides and input for an alarm comparator circuit.

Combustible Gas Sensor

The flammable properties of combustible gases are used as the basis of detection. The sensor consists of a pair of pelletized filaments called Pelements™ arranged in an electrically balanced bridge

circuit. The detector pelement is treated with a catalyst that causes the combustible gases to combine with oxygen at much lower temperatures than would be required for normal burning. The inactive compensator pelement is also exposed to the sample flow and acts to offset any electrical changes caused by flow conditions, sample temperature, pressure, and/or humidity.

Combustible gases in the sample combine with oxygen in the air at the surface of the catalyzed detector pelement. Heat is liberated by this chemical reaction, thus increasing the temperature of the pelement and causing an associated increase in the pelement electrical resistance.

Increased resistance of the detector pelement unbalances the bridge circuit, causing a voltage change at the mid-point connection between the detector pelement and the compensating pelement. This voltage signal is applied to an amplifier that drives the combustible gas readout and provides an input for an alarm comparator circuit.

Oxygen Sensor

The oxygen sensor is a galvanic type cell containing gold and lead electrodes in a potassium hydroxide solution. The cell is sealed with a membrane that allows oxygen to diffuse into the active area. The current generated by the cell is proportional to the oxygen partial pressure in the atmospheric sample passing over the face of the membrane. The generated current passes through a resistance to provide a voltage input signal for an amplifier. The output of the amplifier drives the oxygen readout and also serves as an input to the alarm comparator circuit.

The following instructions detail the procedures for operation and calibration of the MSA Model 361 Combustible Gas Indicator.

Operating Instructions

The Model 361 oxygen calibration and toxic and combustible zero checks must be made in fresh air or with the inlet end of the sampling line in fresh air.

1. Turn the FUNCTION control to the HORN OFF position; the HORN OFF indicator will light and the descriptor percent LEL will show in the readout.
2. Set the readout to zero (00) by adjusting the LEL ZERO control (NOTE: this must be done

within 30 seconds of turning ON to prevent the possibility of activating the off-scale LEL latching alarm).

3. Press the SELECT button firmly to obtain percent OXY on the readout; then set the readout to 20.8 percent by adjusting the OXY CALIBRATE control.

4. Press the SELECT button firmly to obtain PPM TOX on the readout; then set the readout to zero (00) by adjusting the TOX ZERO control.

5. Press the RESET button.

6. Turn the FUNCTION control to MANUAL for continuous readout of any one gas or to SCAN for automatic scanning of the three gas readings. (NOTE: All alarm functions operate in either position.)

7. Momentarily place a finger over the sample inlet fitting or the end of the sample line, if one is used. Observe that the FLOW indicator float drops, indicating no flow. If it does not, check the flow system and sample line for leaks.

8. The instrument is ready for calibration.

WARNING: If an alarm is indicated by an ALARM or OVER sign in the readout or a pulsing horn, evacuate personnel from the area and notify the safety officer.

A low battery condition is indicated by a BATT sign in the readout or by a steady horn; remove the Model 360 or 361 and recharge in a nonhazardous area to prevent potential ignition of combustible atmospheres.

Model 361 Calibration

1. Attach the flow control to the 0.75 percent pentane/15 percent oxygen calibration gas tank.

2. Connect the adapter-hose to the flow control.

3. Open the flow control valve.

4. Connect the adapter-hose fitting to the inlet of the instrument; within 30 seconds, the LEL meter should stabilize and indicate between 47 and 55 percent. If the indicator is not in the correct range, remove the right end of the indicator and adjust the LEL SPAN control to obtain 50 percent.

5. Verify the oxygen reading; it should be between 13 and 17 percent.

6. Disconnect the adapter-hose fitting from the instrument.

7. Close the flow control valve.

8. Remove the flow control from the calibration gas tank.

9. Attach the flow control to the 10 ppm hydrogen sulfide calibration gas tank (40 ppm gas may be used; the choice of H_2S calibration will depend on concentrations anticipated in the

work place).

10. Open the flow control valve.

11. Connect the adapter-hose fitting to the inlet of the instrument; after approximately one minute, the TOX readout should stabilize and indicate between 7 to 13 ppm (35 to 45 ppm for 40 ppm H_2S). If the indication is not in the correct range, remove the right end of the indicator and adjust the TOX SPAN control to obtain 10 ppm (40 ppm for 40 ppm H_2S).

12. Disconnect the adapter-hose fitting from the instrument.

13. Close the flow control valve.

14. Remove the adapter-hose from the flow control.

15. Remove the flow control from the calibration gas tank.

CAUTION: Calibration gas tank contents are under pressure. Do not use oil, grease, or flammable solvents on the flow control or the calibration gas tank. Do not store calibration gas tank near heat or fire, nor in rooms used for habitation. Do not throw in fire, incinerate, or puncture. Keep out of the reach of children. It is illegal and hazardous to refill this tank. Do not attach any gas tank other than MSA calibration tanks to the flow control.

APPENDIX BF

ACCIDENT INVESTIGATION

Harding Lawson Associates requires that an Accident Investigation form be completed for accidents occurring during working hours. The form, which is included in this appendix, can be obtained from the DHSO. This form must completed as soon as possible (limit - within three working days) after occurrence of any injury that results in medical treatment or property damage. After completion, the form must be returned to the DHSO for processing.

ACCIDENT INVESTIGATION

COMPLETED FORM MUST BE FORWARDED TO CORPORATE HEALTH AND SAFETY WITHIN 10 WORKING DAYS

Revision 1

GENERAL DATA

Case No.

ployee name | Social Security No. | Sex | Date of injury

Age | Time of injury

ice | OT last week /hrs | Immediate Supervisor | Date injury reported

ation of injury (address; description of job site) | Date of Hire

MEDICAL DATA

A. Class of injury (check one only)

Fatality ___ Lost workday ___ No lost time ___ First aid only ___ Other

B. Nature of injury (check all that apply)

- Amputation
- Asphyxiation
- Burn, scald
- Burn (chemical)
- Concussion
- Contagious, infectious disease
- ___ Contusion, bruise
- ___ Cut, laceration, bruise
- ___ Dermatitis
- ___ Dislocation
- ___ Electric shock, electrocution
- ___ Flesh burn
- ___ Foreign body in eye
- ___ Fracture
- ___ Freezing, frostbite
- ___ Hearing loss or impairment
- ___ Heat stroke, sunstroke
- ___ Hernia rupture
- ___ Poisoning–systemic
- ___ Pneumoconiosis
- ___ Radiation effects
- ___ Scratches, abrasions
- ___ Strains, sprains
- ___ Occupational disease
- ___ Other_____
- ___ Unclassified, not determined

C. Part of Body Affected (check all that apply)

- Trunk (abdomen, back, chest, hips, pelvis, shoulder, other)
- ___ Head and neck (ear, eye, face, mouth, scalp, skull, neck, other)
- ___ Lower extremities (ankle, foot, knee, lower leg, thigh, toe, other)
- ___ Upper extremities (upper arm, elbow, forearm, finger, hand, wrist, other)
- ___ Body system (circulatory, digestive, genitourinary, hemato-logic, integumental, musculo-skeletal, nervous, respiratory, other)

ACCIDENT ANALYSIS

A. Accident Type (check one only)

- [redacted] by
- [redacted] against
- [redacted] from elevation
- [redacted] all to foot level
- ___ Motor vehicle accident
- ___ Public transportation
- ___ Rubbed or abraded
- ___ Bodily reaction
- ___ Overexertion
- ___ Contact with electric current
- ___ Contact with temperature extremes
- ___ Contact with chemical or toxic substance
- ___ Exposure to physical hazards (noise, UV radiation)
- ___ Inhalation of toxic substance
- ___ Other_____
- ___ Caught in, under, or between

B. Source of Injury (check all that apply)

- Air pressure
- Animals, insects, birds, reptiles
- Animal products (not food)
- Body motion
- Boilers, heating equipment, pressure vessels
- Boxes, barrels, containers, packages
- Building and structures
- Ceramic items
- Chemicals (liquids, solids, gases, vapors, fumes, etc.)
- ___ Clothing, apparel, shoes
- ___ Coal and petroleum products
- ___ Cold (atmospheric, environmental)
- ___ Conveyors, unpowered (chutes, rollers, etc.)
- ___ Dollies, hand trucks
- ___ Drugs and medicines
- ___ Electrical apparatus
- ___ Excavations, trenches, tunnels
- ___ Flame, fires, smoke
- ___ Floors, level surface
- ___ Furniture, fixtures, furnishings
- ___ Glass items
- ___ Hand tools, not powered
- ___ Heat (atmospheric, environmental)
- ___ Hoisting apparatus
- ___ Infectious, parasitic agents
- ___ Ladders, scaffolds
- ___ Liquids
- ___ Machines
- ___ Mechanical power transmission apparatus
- ___ Metal (plate, sheet, coil)
- ___ Noise, vibration
- ___ Paper, plastic, foil
- ___ Particulate (undefined)
- ___ Plants, trees, vegetation
- ___ Plastic items
- ___ Pumps, prime movers
- ___ Radiating substances, equipment
- ___ Soaps, detergents, cleaning compounds
- ___ Silicates
- ___ Scrap, wastes, debris
- ___ Steam
- ___ Textile items
- ___ Tooling and fixtures
- ___ Vehicles, powered
- ___ Wood items (pulp, lumber, slabs, chips)
- ___ Working surfaces
- ___ Work area environments
- ___ Other_____

C. Unsafe Act (check all that apply)

- Horseplay
- Failure to secure, warn, lockout, or assure clearance
- Improper lifting or carrying
- Improper task selection
- ___ Working on energized, pressurized equipment
- ___ Misuse of equipment, tools, materials, vehicles
- ___ Driver/operator error
- ___ Failure to use equipment provided
- ___ Failure to follow instructions
- ___ Failure to use proper personal protective
- ___ Improper use of hands or body parts
- ___ Unsafe placing, mixing, loading
- ___ Operating or acting without authorization or in unauthorized location
- ___ Taking an unsafe bodily position or posture (climbing, reaching, stretching)
- ___ Failure to wear safe personal attire
- ___ Inattention to footing or surroundings
- ___ Using unsafe equipment
- ___ Removing or making safety devices inoperative
- ___ Other_____

D. Unsafe Condition (check all that apply)

- [redacted] housekeeping
- [redacted] ing not provided
- [redacted] quate traffic control, traffic [redacted] ds
- [redacted] fects of machines, equipment, [redacted] ols, materials, vehicles
- ___ Inadequate illumination
- ___ Inadequate or improperly designed ventilation
- ___ Unsuitable design construction, layout of prescribed work method
- ___ Natural hazards (terrain, elements, etc.)
- ___ Hazardous conditions
- ___ Inadequate or improper guarding
- ___ Other_____
- ___ Unavailability of required equipment or devices
- ___ No hazardous condition
- ___ Improper stackings, palletizing, and banding

E. Supervisory Conditions (check all that apply)

- Failure to enforce safety rules, standards, or procedures
- ___ Failure to follow instructions
- Incorrect job assign-
- ___ Inadequate training or instruction provided
- Failure to provide
- ___ Other_____
- ___ Ineffective immediate supervision
- ___ Failure to provide correct or safe tools

302043

A. Names of witnesses

B. How did accident happen? (Give a brief description)

C. Why did accident occur? (Explain more fully any unsafe acts/conditions which contributed to this accident.)

D. Was the person(s) involved in the accident aware of the safe procedures to complete the job? Describe.

E. What corrective action is to be, or has been, taken to prevent a reoccurrence. Who is responsible for corrective action and when is the expected completion date?

[redacted]ated by: Date: Reviewed by DHSO: Date:

Reviewed by Project Manager: Date: Reviewed by Office Manager: Date:

Reviewed by Manager H/S: Date: Office Manager Review with CEO: Date:
(required for all lost time injuries)

302044

Appendix C
Quality Assurance Project Plan

Appendix C
Quality Assurance Project Plan

Prepared for

Island Chemical Company
St. Croix, U.S. Virgin Island

24231 2.C.3

James L. Collins
Staff Geologist

Jason M. Schindler
Senior Geologist

August 5, 1994

Harding Lawson Associates
Engineering and Environmental Services
131 North Third Street
Philadelphia, PA 19106 – (215) 627-4505

Quality Assurance Project Plan Approval Form

The undersigned have read and approved this Quality Assurance Project Plan for Island Chemical Company St. Croix, U.S. Virgin Islands.

Santo Guillermain, ICC Project Officer	(201) 305-5408	
Edward A. Nemecek, HLA Project Manager	(609) 936-0700	Date _____
Jason M. Schindler, Deputy Project Manager	(215) 627-4505	Date _____
Bharat Patel, HLA Quality Assurance Manager	(609) 936-0700	Date _____
Sherrel Henry, U.S. EPA RI Project Manager	(212) 264-8675	Date _____
Elaine Wild, ETC Laboratory QA Officer	(504) 283-4223	Date _____

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

TABLES

APPENDICES

C1.0 QUALITY ASSURANCE OBJECTIVES

The overall Quality Assurance (QA) objective for this project is to develop and implement standard United States Environmental Protection Agency (USEPA) procedures for field sampling, chain-of-custody, laboratory analyses and reporting that will provide results that are technically usable and legally defensible in a court of law. The objectives of the analytical program are to generate data of sufficient quality:

1. To be compared to ARARs identified;

2. To be used in development of a baseline human health and/or ecological risk assessment, if necessary; and

3. To be used to develop a feasibility study, if necessary.

Table C1-1 presents a summary of tasks covered by this Quality Assurance Project Plan (QAPP). Specific QA procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analyses, data reporting, internal quality control (QC), laboratory audits, preventive maintenance of field equipment and corrective action are described in other sections of this QAPP. The purpose of this section is to address the specific objectives for precision, accuracy, representativeness, completeness and comparability (PARCC). Definitions for PARCC follow (USEPA, 1986a):

- Precision - a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions, usually expressed in terms of the relative percent difference.
- Accuracy - the degree of agreement of a measurement with an accepted reference or true value.
- Representativeness - the selection of analytical methods, sampling protocols and sample locations such that results are representative of the media being sampled and the conditions being measured.
- Completeness - the amount of valid data obtained from a measurement system compared to the amount that was expected and needed to be obtained to meet the project data goals.
- Comparability - the confidence with which one data set can be compared to another.

C1.1 Level of Quality Control Effort

Project QC checks will be accomplished by submitting controlled samples to the laboratory from the field. Three types of QC samples will be used: field duplicates, blanks (rinse blanks and trip blanks) and matrix spike samples. These QC samples will be analyzed to assess the data quality resulting from the field sampling program. Field duplicate samples will be submitted to the laboratory as blind samples. Any samples submitted as blind will be noted in the field log and given a sample number that does not indicate to the laboratory that the sample is a QC check.

QC samples will be collected and submitted to the laboratory to ensure that the data generated are representative of the study area environmental conditions. Soil and groundwater samples, including QC samples to be collected during this project, are summarized on Tables C1-2 and C1-3, respectively. Each type of QC sample to be collected is discussed separately below.

C1.1.1 Field Duplicate Samples

Field duplicates will be co-located, independent samples collected in such a manner that they are equally representative of the parameter(s) of interest at a given point in space and time. Co-located samples, when collected, processed and analyzed by the same organization, provide intra-laboratory precision information for the entire measurement system, including sample acquisition, homogeneity, handling, shipping, storage, preparation and analysis. Field duplicate samples can also be used to estimate the overall precision of a data collection activity and to check sampling and analytical reproducibility.

At least one field duplicate sample will be collected for every 20 investigative samples per sample matrix. Field QC samples will be handled identically to environmental samples.

C1.1.2 Rinse Blank Samples

Rinse blank samples will be obtained by running analyte-free distilled water through sample collection equipment after decontamination and collecting the rinsate in the appropriate sample containers for analysis. These samples will be used to evaluate the overall accuracy of the data by assessing whether decontamination procedures have been sufficient to minimize sample contamination. Rinse blank samples will be collected at a frequency of once each day a decontamination event takes place for each type of equipment used, not to exceed one per day. Field documentation will clearly indicate which field blank corresponds to which samples so that the data validator will compare the correct samples.

The water used for rinse blanks will be demonstrated analyte-free water. The water will be analyzed prior to use in the field and found to be contaminant-free to the levels required for the project. The water will be evaluated in accordance with the criteria specified in the USEPA Region II QA manual (p.59) as follows.

Purgeable Organics	< 10 parts per billion (ppb);
Semi-volatile Organics	< Contract Required Quantitation Limit (CRQL) (Table C1-5)
Pesticides and PCBs	< CRQL, see Table C1-6;
Inorganics	< Contract Required Detection Limit (CRDL) (Table C1-7)
Methylene Chloride[1]	< 6 ppb
Acetone[1]	< 15 ppb
Toluene[1]	< 3 ppb
2-Butanone[1]	< 15 ppb
Dimethylphthalate[1]	< 15 ppb
Diethylphthalate[1]	< 15 ppb
di-n-Butylphthalate[1]	< 15 ppb
Butylbenzylphthalate[1]	< 15 ppb
bis(2-ethylhexyl)phthalate[1]	< 15 ppb
di-n-Octyl phthalate[1]	< 15 ppb

[1] For common laboratory contaminants listed, allowable limits are three times the respective CRQLs.

The rinse blank samples will be collected, preserved and handled in the same manner as the aqueous samples for the associated analysis.

C1.1.3 Trip Blank Samples

Trip blank samples will be prepared by the analytical laboratory before the sampling event by filling 40-milliliter vials with reagent-grade water demonstrated free of volatile organic compounds (VOC). The trip blanks are preserved in the same manner as the groundwater samples. Trip blank samples are kept with field sample containers throughout the sampling event, then packaged for shipment with the other samples and sent to the laboratory for VOC analysis. One trip blank sample will be included in each cooler that contains samples to be analyzed for VOCs, each day aqueous volatile organic samples are collected. At no time after their preparation will the trip blank sample containers be opened before they are returned to the laboratory. Trip blank samples will be collected to assess the potential for VOC contamination introduced by sample bottles or sample handling during field operations and shipping.

C1.1.4 Matrix Spike Samples

Matrix spike samples will be created in the laboratory by adding known amounts and concentrations of target analytes to a prepared portion of a sample immediately before extraction or analysis. Matrix spike samples provide information on matrix effects encountered during extraction, digestion and analysis (i.e., suppression or enhancement of instrument signal levels). Matrix spike sample results are principally used to evaluate accuracy, but, when combined with MSD sample data, they also yield information on analytical precision.

During the field activities, additional sample material will be collected from field-selected locations to provide sufficient sample volume for the laboratory to prepare matrix spike samples. The matrix spike water samples each require three additional sample container volumes for aqueous samples to be analzyed for TCL extractable organics. Soil matrix spike samples do not require additional sample volume. At least one set of matrix spike samples will be collected for every 20 investigative samples per sample matrix.

C1.2 Precision, Accuracy and Sensitivity

The fundamental QA objective with respect to precision, accuracy and sensitivity of laboratory analytical data is to achieve the QC acceptance criteria of the analytical protocols.

The precision of the data will be evaluated by examining results obtained from the analysis of sample blanks, field and laboratory duplicate samples, laboratory matrix spike samples and Contract Laboratory Procedure (CLP)-required laboratory QA/QC samples.

The accuracy of the data will be evaluated for CLP methods by comparing the QC criteria stipulated in these methods to the results from laboratory matrix spike samples. Analytical accuracy for non-CLP methods will be evaluated in relationship to method validation/start-up QC control criteria.

Instrument sensitivity will be monitored by analyzing method blanks, calibration check samples (organic analyses), by laboratory control samples (organic samples analyzed by Superfund Analytical

Method - Low Concentration Water for Organic Analysis [SAMLCWOA]) and by detection limit standards. The achievement of the method detection limits depends on instrument sensitivity and possible matrix effects. Therefore, it is important to monitor instrument sensitivity by regular instrument checks.

Accuracy and precision goals for the study area will be adopted from the appropriate CLP statement of work (SOW) as available for the matrix spike results. Data will be qualified in accordance with the appropriate USEPA functional guidelines if either external (field) QC blanks or internal (laboratory) QC blanks indicate that the precision or accuracy of analytical results is compromised. Duplicate sample agreement goals will be compared with method QC criteria. The use of the method validation/startup QC criteria will also be used to evaluate matrix spike results for non-CLP methods when specific matrix spike control criteria are unavailable. If control criteria are unavailable for a targeted parameter, the laboratory-specific method control criteria will be adopted. Methods for calculating QA/QC sample precision and accuracy are provided in Section C10.0 of this document. The sensitivities required for these analyses will be the method reporting limits shown in Tables C1-4 through C1-7.

Standard operating procedures (SOP) for selected laboratory analyses will be reviewed prior to selection. These SOPs include the required precision, accuracy and sensitivity of the analyses. SOPs for the field equipment to measure pH, conductivity and temperature are outlined in the Sampling and Analysis Plan (SAP) presented as Appendix A of this Work Plan.

C1.3 Representativeness, Completeness and Comparability

This section describes the QA objectives with respect to representativeness, completeness and comparability.

C1.3.1 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling location, a process condition or an environmental condition. Representativeness is a qualitative parameter most concerned with the proper design of the sampling program, proper sampling locations, implementing proper sampling protocols and collecting a sufficient number of investigative samples.

Representativeness is addressed in detail in the Workplan and SAP by describing the rationale used to select sampling locations and proper sampling techniques. Representativeness will be satisfied by ensuring that the SAP is followed, proper sampling techniques are used, proper analytical procedures are followed and technical holding times of the samples are not exceeded. Representativeness will be assessed by analysis of field duplicate samples. Furthermore, representativeness will be assessed by the analysis and interpretation of the results of an appropriately defined number of internal (laboratory) and external (field) QC samples. Precision and accuracy information developed from the evaluation of QC samples will be used to qualitatively evaluate representativeness. A representativeness evaluation will be performed through a careful comparison of results from the study area. The chemical constituent type, breakdown characteristics and concentration will be used to qualitatively evaluate the representativeness of the reported results.

C1.3.2 Completeness

This QA program is designed to achieve a goal of 100 percent data completeness. Realizing that under normal conditions this goal may not be achievable, the completeness goal for this program, on the basis of HLA's experience, is 90 to 95 percent. This completeness goal is considered adequate to meet the intended data uses for this site on the basis of prior consideration of PARCC parameters, the sampling design plans and data collection activities proposed for the remedial action. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$\text{Completenes}(\%) = \frac{\text{Number of valid samples}}{\text{(Number of samples collected for each parameter analyzed)}} \times 100$$

C1.3.3 Comparability

Comparability of the data collection activities must consider field conditions as well as sampling and analytical techniques. Comparability of the data will be enhanced through the use of standard sampling and analytical methods or analytical methods that are equivalent in method performance criteria and reported units. For the purposes of the remedial action, the analytical methods, the quality of the data and the sampling design will be evaluated for data comparability. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in the QAPP, are expected to provide comparable data. If data do not appear comparable after the initial evaluation, HLA will attempt to identify other components possibly affecting comparability, including, but not limited to, field conditions, sampling protocols and the occurrence of true data anomalies.

Table C1-1. Summary of Tasks Covered in Project Work Plan
Island Chemical Company Site
St. Croix, U.S. Virgin Islands

Data Collection Activity	Rationale/Objective(s)	Covered in QAPP[1]
Review existing data	Understanding previous work and site conditions as known.	No
Validate existing sampling data	Evaluate quality of existing data.	Yes
Clear the site of vegetation and perform a reconnaissance	Facilitate access to site; confirm areas of concern and sampling locations	No
Repair and re-sample existing wells	Confirm existing data regarding groundwater quality	Yes
Install and sample new monitoring wells	Evaluate whether affected groundwater is present; Assess groundwater flow	Yes
Acquire access approvals and permits	Ensure compliance with local rules and regulations	No
Install soil borings	Evaluate local geology; determine if clay layer reported by ESI is present; determine if affected soils are present	Yes
Collect surface soil samples	Evaluate whether affected sediments are present	Yes
Survey wells and borings	Measure exact locations of sampling points; ensure accuracy and consistency	No

[1] See Work Plan and Sampling and Analysis Plan for additional details on items not specifically covered in this QAPP.

Table C1-2. Groundwater Sampling Summary

Island Chemical Company Site
St. Croix, U.S. Virgin Islands

Analytical Parameter	Investigative Samples			Quality Control Samples									Total
				Rinse Blank			Field Duplicate			Trip Blank			
	No.	Freq.	Tot.	No.	Freq.[1]	Tot.	No.	Freq.	Tot.	No.	Freq.	Tot.	
VOCs	5	4	20	1	4	4	1	4	4	1	4	4	32
SVOs	5	4	20	1	4	4	1	4	4	0	0	0	28
Pyridine	5	4	20	1	4	4	1	4	4	0	0	0	28
Pest/PCBs	5	4	20	1	4	4	1	4	4	0	0	0	28
Inorganics	5	4	20	1	4	4	1	4	4	0	0	0	28

[1] Rinse blanks to be collected at a frequency of once each day a decontamination event takes place for each type of equipment. The scope of work assumes four quarterly groundwater sampling events, each of which is expected to take one day.

VOCs — Target Compound List (TCL) Volatile Organic Compounds using SAMLCWOA (10/92)
SVOs — TCL Semi-volatile Organic Compounds using using SAMLCWOA (10/92)
Pyridine — SW-846 Method 8270
Pest/PCBs — TCL pesticides and PCBs using SAMLCWOA (10/92)
Inorganics — Target analyte list inorganics by CLP SOW ILMO3.0 (May 1993); antimony, beryllium and thallium will be analyzed using the atomic absorption furnace technique given in the CLP SOW ILMO2.0, Part B, pages D-28 through D-40)

Table C1-3. Soil Sampling Summary

Island Chemical Company Site
St. Croix, U.S. Virgin Islands

Analytical Parameter	Investigative Samples			Quality Control Samples									Total
				Rinse Blank			Field Duplicate			Trip Blank			
	No.	Freq.	Tot.	No.	Freq.[1]	Tot.	No.	Freq.	Tot.	No.	Freq.	Tot.	
VOCs	20	1	20	1	5	5	1	1	1	0	0	0	26
SVOs	20	1	20	1	5	5	1	1	1	0	0	0	26
Pest/PCBs	20	1	20	1	5	5	1	1	1	0	0	0	26
Inorganics	20	1	20	1	5	5	1	1	1	0	0	0	26

[1] Rinse blanks to be collected at a frequency of once each day a decontamination event takes place for each type of equipment. The scope of work assumes soil samples will be collected during five (5) days of drilling activities.

VOCs — Target Compound List (TCL) Volatile Organic Compounds using CLP SOW OLMO1.9
SVOs — TCL Semi-volatile Organic Compounds and pyridine using CLP SOW OLMO1.9
Pest/PCBs — TCL pesticides and PCBs using CLP SOW OLMO1.9
Inorganics — Target analyte list inorganics using CLP SOW ILMO3.0

Table C1-4. Target Compound List Volatile Organic Compounds
Contract Required Quantitation Limits
Island Chemical Company Site
St. Croix, U.S. Virgin Islands

CAS Number	Parameter	Contract Required Quantitation Limits[1]	
		Water Analyses (µg/l)[2]	Soil Analyses (µg/kg)[2]
74-87-3	Chloromethane	1	10
74-83-9	Bromomethane	1	10
75-01-4	Vinyl chloride	1	10
75-00-3	Chloroethane	1	10
75-09-2	Methylene chloride	2	10
67-64-1	Acetone	5	10
75-15-0	Carbon disulfide	1	10
75-35-4	1,1-Dichloroethene	1	10
75-35-3	1,1-Dichloroethane	1	10
156-59-4	cis-1,2-Dichloroethene	1	NA
156-60-5	trans-1,2-Dichloroethane	1	NA
540-59-0	Total 1,2-Dichloroethane	NA	10
67-66-3	Chloroform	1	10
107-06-2	1,2-Dichloroethane	1	10
73-93-3	2-Butanone	5	10
74-97-5	Bromochloromethane	1	???
71-55-6	1,1,1-Trichloroethane	1	10
56-23-5	Carbon tetrachloride	1	10
75-27-4	Bromodichloromethane	1	10
78-87-5	1,2-Dichloropropane	1	10
10061-01-5	cis-1,3-Dichloropropene	1	10
71-01-6	Trichloroethene	1	10
124-48-1	Dibromochloromethane	1	10
79-00-5	1,1,2-Trichloroethane	1	10
71-43-2	Benzene	1	10
10061-02-6	trans-1,3-Dichloropropene	1	10

Table C1-4. Target Compound List Volatile Organic Compounds
Contract Required Quantitation Limits
Island Chemical Company Site
St. Croix, U.S. Virgin Islands

CAS Number	Parameter	Contract Required Quantitation Limits[1]	
		Water Analyses (µg/l)[2]	Soil Analyses (µg/kg)[2]
75-25-2	Bromoform	1	10
108-10-1	4-Methyl-2-pentanone	5	10
591-78-6	2-Hexanone	5	10
127-18-4	Tetrachloroethene	1	10
79-34-5	1,1,2,2-Tetrachloroethane	1	10
106-93-4	1,2-Dibromomethane	1	NA
108-88-3	Toluene	1	10
108-90-7	Chlorobenzene	1	10
100-41-4	Ethylbenzene	1	10
108-42-5	Styrene	1	10
1330-20-7	Total xylenes	1	10
541-73-1	1,3-Dichlorobenzene	1	NA
106-46-7	1,4-Dichlorobenzene	1	NA
95-50-1	1,2-Dichlorobenzene	1	NA
96-12-8	1,2-Dibromo-3-chloropropane	1	NA

Source: U.S. Environmental Protection Agency, 1991b.

µg/l Micrograms per liter
µg/kg Micrograms per kilogram
CAS Chemical Abstract Service
CLP Contract Laboratory Program
NA Not analyzed
SOW Statement of Work
USEPA United States Environmental Protection Agency

1. Quantitation limits are matrix-dependent, and listed quantitation limits may not always be achievable. Actual quantitation limits attained will be reported by the laboratory.

2. Quantitation limits from 10/92 SAMLCWOA for water and CLP SOW OLMO1.9 (7/93) for soil.

Table C1-5. Target Compound List Semi-Volatile Organic Compounds
Contract Required Quantitation Limits
Island Chemical Company Site
St. Croix, U.S. Virgin Islands

CAS Number	Parameter	Contract Required Quantitation Limits[1]	
		Water Analyses (µg/l)[2]	Soil Analyses (µg/kg)[2]
108-95-2	Phenol	5	330
111-44-4	bis(2-Chloroethyl)ether	5	330
95-57-8	2-Chlorophenol	5	330
108-60-1	2,2'-oxybis(1-Chloropropane)	5	330
95-48-7	2-Methylphenol	5	330
106-44-5	4-Methylphenol	5	330
621-64-7	N-nitroso-di-n-propylamine	5	330
67-72-1	Hexachloroethane	5	330
98-95-3	Nitrobenzene	5	330
78-59-1	Isophorone	5	330
88-75-5	2-Nitrophenol	5	330
105-67-9	2,4-Dimethylphenol	5	330
111-91-1	bis(2-Chloroethoxy)methane	5	330
120-83-2	2,4-Dichlorophenol	5	330
120-82-1	1,2,4-Trichlorobenzene	5	330
91-20-3	Naphthalene	5	330
106-47-8	4-Chloroaniline	20	330
87-68-3	Hexachlorobutadiene	5	330
59-50-7	4-Chloro-3-methylphenol	20	330
91-57-6	2-Methylnaphthalene	5	330
77-47-4	Hexachlorocyclopentadiene	5	330
88-06-2	2,4,6-Trichlorophenol	5	330
95-95-4	2,4,5-Trichlorophenol	20	800
91-58-7	2-Chloroanaphthalene	5	330
88-74-4	2-Nitroaniline	20	800
131-11-3	Dimethylphthalate	5	330
208-96-8	Acenaphthylene	5	330

Table C1-5. Target Compound List Semi-Volatile Organic Compounds
Contract Required Quantitation Limits
Island Chemical Company Site
St. Croix, U.S. Virgin Islands

CAS Number	Parameter	Contract Required Quantitation Limits[1]	
		Water Analyses (µg/l)[2]	Soil Analyses (µg/kg)[2]
606-20-2	2,6-Dinitrotoluene	5	330
99-09-2	3-Nitroaniline	20	800
83-32-9	Acenaphthene	5	330
51-28-5	2,4-Dinitrophenol	20	800
100-02-7	4-Nitrophenol	20	800
132-64-9	Dibenzofuran	5	330
121-14-2	2,4-Dinitrotoluene	5	330
84-66-2	Diethylphthalate	5	330
541-73-1	1,3-Dichlorobenzene	NA	330
106-46-7	1,4-Dichlorobenzene	NA	330
95-50-1	1,2-Dichlorobenzene	NA	330
7005-72-3	4-Chlorophenyl-phenyl ether	5	330
86-73-7	Fluorene	5	330
100-01-6	4-Nitroaniline	20	800
534-52-1	4,6-Dinitro-2-methylphenol	20	800
86-30-6	N-nitrosodiphenylamine	5	330
101-55-3	4-Bromophenyl-phenylether	5	330
118-74-1	Hexachlorobenzene	5	330
87-86-5	Pentachlorophenol	20	800
85-01-8	Phenanthrene	5	330
120-12-7	Anthracene	5	330
84-74-2	di-n-Butylphthalate	5	330
206-44-0	Fluoranthene	5	330
129-00-0	Pyrene	5	330
85-68-7	Butylbenzylphthalate	5	330
91-94-1	3,3-Dichlorobenzidine	5	330
56-55-3	Benzo(a)anthracene	5	330

Table C1-5. Target Compound List Semi-Volatile Organic Compounds
Contract Required Quantitation Limits
Island Chemical Company Site
St. Croix, U.S. Virgin Islands

CAS Number	Parameter	Contract Required Quantitation Limits[1]	
		Water Analyses (µg/l)[2]	Soil Analyses (µg/kg)[2]
218-01-9	Chrysene	5	330
117-81-7	bis(2-Ethylhexyl)phthalate	5	330
117-84-0	di-n-Octyl phthalate	5	330
205-99-2	Benzo(b)fluoranthene	5	330
207-08-9	Benzo(k)fluoranthene	5	330
50-32-8	Benzo(a)pyrene	5	330
193-39-5	Indeno(1,2,3-cd)pyrene	5	330
53-70-3	Dibenzo(a,h)anthracene	5	330
191-24-2	Benzo(g,h,i)perylene	5	330
110-86-1	Pyridine[3]	10[3]	333[3]

Source: U.S. Environmental Protection Agency, 1991b.

µg/l Micrograms per liter
µg/kg Micrograms per kilogram
CAS Chemical Abstract Service
CLP Contract Laboratory Program
NA Not analyzed
SOW Statement of Work
USEPA United States Environmental Protection Agency

1. Quantitation limits are matrix-dependent, and listed quantitation limits may not always be achievable. Actual quantitation limits attained will be reported by the laboratory.
2. Quantitation limits from USEPA 10/92 SAMLC for water and CLP 3/90 SOW for soil.
3. Pyridine in groundwater to be analyzed by SW-846 methodology, pyridine will be added to soil analysis as an additional target compound

Table C1-6. Target Compound List Pesticides and PCBs

Contract Required Quantitation Limits
Island Chemical Company Site
St. Croix, U.S. Virgin Islands

CAS Number	Parameter	Contract Required Quantitation Limits[1]	
		Water Analyses (µg/l)[2]	Soil Analyses (µg/l)[2]
319-84-6	alpha-BHC	0.01	1.7
319-85-7	beta-BHC	0.01	1.7
319-86-8	delta-BHC	0.01	1.7
58-89-9	gamma-BHC (Lindane)	0.01	1.7
76-44-8	Heptachlor	0.01	1.7
309-00-2	Aldrin	0.01	1.7
1024-57-3	Heptachlor epoxide	0.01	1.7
959-98-8	Endosulfan I	0.01	1.7
60-57-1	Dieldrin	0.02	3.3
72-55-9	4,4'-DDE	0.02	3.3
72-20-8	Endrin	0.02	3.3
33213-65-9	Endosulfan II	0.02	3.3
72-54-8	4,4'-DDD	0.02	3.3
1031-07-8	Endosulfan sulfate	0.02	3.3
50-29-3	4,4'-DDT	0.02	3.3
72-43-5	Methoxychlor	0.10	17
53494-70-5	Endrin ketone	0.02	3.3
7421-36-3	Endrin aldehyde	0.02	3.3
5103-71-9	alpha-Chlordane	0.01	1.7
5103-74-2	gamma-Chlordane	0.01	1.7
8001-35-2	Toxaphene	1.0	170
12674-11-2	Arochlor 1016	0.20	33
11104-28-2	Arochlor 1221	0.40	67
11141-16-5	Arochlor 1232	0.20	33
53469-21-9	Arochlor 1242	0.20	33
12672-29-6	Arochlor 1248	0.20	33
11097-69-1	Arochlor 1254	0.20	33
11096-82-5	Arochlor 1260	0.20	33

µg/l	Micrograms per liter	µg/kg	Micrograms per kilogram
CAS	Chemical Abstract Service	CLP	Contract Laboratory Program
SOW	Statement of Work	USEPA	United States Environmental Protection Agency

1. Quantitation limits are matrix-dependent, and listed quantitation limits may not always be achievable. Actual quantitation limits attained will be reported by the laboratory.
2. Quantitation limits from USEPA 10/92 SAMLCWOA for water and CLP SOW OLMO1.9 (7/93) for soil.

Table C1-7. Target Analyte List Inorganics

Contract Required Detection Limits
Island Chemical Company Site
St. Croix, U.S. Virgin Islands

CAS Number	Parameter	Contract Required Detection Limits[1]	
		Water Analyses[2] (mg/l)	Soil Analyses[2] (mg/kg)
7429-90-5	Aluminum	0.2	40
7440-36-0	Antimony	0.003[3]	3
7440-38-2	Arsenic	0.01	2
7440-39-3	Barium	0.2	40
7440-41-7	Beryllium	0.0002[3]	1
7440-43-9	Cadmium	0.005	1
7440-70-2	Calcium	5.0	1,000
7440-47-3	Chromium	0.01	2
7440-48-4	Cobalt	0.05	10
7440-50-8	Copper	0.025	5
7439-89-6	Iron	0.1	20
7439-92-1	Lead	0.003	0.6
7439-95-4	Magnesium	5.0	1,000
7439-96-5	Manganese	0.015	3
7439-97-6	Mercury	0.0002	0.04
7440-02-0	Nickel	0.04	8
7440-09-7	Potassium	5.0	1,000
7782-49-2	Selenium	0.005	1
7440-22-4	Silver	0.01	2
7440-23-5	Sodium	5.0	1,000
7440-28-0	Thallium	0.001[3]	2
7440-62-2	Vanadium	0.05	10
7440-66-6	Zinc	0.02	4
57-12-5	Cyanide	0.01	2

mg/l - Milligrams per liter
mg/kg - Milligrams per kilogram
CAS - Chemical Abstract Service
CLP - Contract Laboratory Program
USEPA - United States Environmental Protection Agency

1 Detection limits are matrix-dependent and listed detection limits may not always be achievable. Actual quantitation limits attained will be reported by the laboratory.
2 Except as noted in [3] below, quantitation limits from CLP SOW ILMO3.0 for groundwater and soil samples.
3 Approximate detection limits are listed based on using the furnace technique.

C2.0 INTENDED DATA USES AND SUPERFUND DATA CATEGORIES

Intended uses for data gathered during the field activities include identifying contaminated media, establishing baseline data, performing treatability studies (if necessary) and, eventually, designing a remedial action. The Data Quality Objective (DQO) process (USEPA, 1993) provides a logical basis for linking QA/QC procedures to the intended use of the data. To assist in the interpretation of data, the Superfund program has developed the following two descriptive categories:

- Screening data with definitive confirmation
- Definitive data

These two data categories are associated with specific QA and QC elements, and may be generated using a wide range of analytical methods. The particular type of data to be generated depends on the qualitative and quantitative DQOs developed during application of the DQO Process. The decision on the type of data to be collected should not be made prior to completion o f the entire DQO Process.

Screening Data with Definitive Confirmation

Screening data are generated by rapid, less precise methods of analysis with less rigorous sample preparation. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data provide analyte identification and quantification, although the quantification my be relatively imprecise. At least ten percent of the screening data are confirmed using analytical methods and QA/QC procedures and criteria associated with definitive data. Screening data without associated confirmation data are not considered to be data of known quality.

QA/QC elements for screening data are as follows:

- Sample documentation (location, date and time collected and batch);
- Chain of custody (when appropriate);
- Sampling designation approach (systematic, simple or stratified random, judgmental, etc.);
- Initial and continuing calibration;
- Determination and documentation of detection limits;
- Analyte(s) identification;
- Analyte(s) quantification;
- Analytical error determination. An appropriate number of replicate aliquots, as specified in the QAPP, are taken from at least one thoroughly homogenized sample, the replicate aliquots are analyzed, and the standard laboratory QC parameters (such as variance, mean, and coefficient of variation) are calculated and compared to method-specific performance requirements specified in the QAPP;
- Definitive confirmation: at least ten percent of the screening data must be confirmed with definitive data as described below. As a minimum, at least three screening samples reported above the action level (if any) and three screening samples reported below the action level (or as non-detects) should be randomly selected from the appropriate group and confirmed.

Definitive Data

Definitive data are generated using rigorous analytical methods, such as approved USEPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce tangible raw data (e.g. chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files. Data may be generated at the site or at an offsite location, as long as the QA/QC requirements are satisfied. For the data to be definitive, either analytical or total measurement error must be determined.

QA/QC elements for definitive data are as follows:

- Sample documentation (location, date and time collected, and batch);
- Chain of custody (when appropriate);
- Sampling designation approach (systematic, simple or stratified random, judgmental, etc.);
- Initial and continuing calibration;
- Determination and documentation of detection limits;
- Analyte(s) identification;
- Analyte(s) quantification;
- QC blanks (trip, method, rinsate);
- Matrix spike recoveries;
- Performance Evaluation (PE) samples (when specified);
- Analytical error determination (measures precision of analytical method): An appropriate number of replicate aliquots, as specified in the QAPP, are taken from at least one thoroughly homogenized sample, the replicate aliquots are analyzed, and the standard laboratory QC parameters (such as variance, mean, and coefficient of variation) are calculated and compared to method-specific performance requirements specified in the QAPP;
- Total measurement error determination (measures overall precision of measurement system from sample acquisition through analysis): An appropriate number of co-located samples as determined by the QAPP are independently collected from the same location and analyzed following standard operating procedures. Based on these analytical results, standard laboratory QC parameters such as variance, mean and coefficient of variation should be calculated and compared to established measurement error goals. This procedure may be required for each matrix under investigation and may be repeated for a given matrix at more than one location at the site.

The Project DQOs have been developed to integrate the sampling activities with the intended data uses. The purpose of this project is to evaluate whether historical activities at the site have affected soil and/or groundwater quality.

Because of the intended multiple uses of the data to be collected, the data categories are discussed separately according to data type. Details of the analytical methods to be used for the investigation are presented in Section C8.0 of this QAPP.

Analyses of soil and groundwater samples collected as part of the field activities will provide DQO Definitive Confirmation type data for use in characterization of soil and groundwater at the site. Data collected during groundwater treatability test field activities will include both Screening With Definitive Confirmation and Definitive Data DQOs. Field measurements such as water levels,

surveying organic vapor measurements, geophysical logging and geotechnical analyses (ASTM specifications) will be Screening Data with Definitive Confirmation. Other activities such as data validation, access and permitting require no sampling. These activities will be conducted consistent with state of the industry practices.

C3.0 SAMPLE CUSTODY

This section describes SOPs for sample custody. Final custody procedures will be followed through sample collection, transfer, analysis and disposal. The purpose of these procedures is to ensure that (1) sample integrity is maintained during sample collection, transportation and storage before analysis and (2) post-analysis sample material is properly disposed. Sample custody is divided into field procedures and laboratory procedures as described below. Originals of laboratory reports and purge files will be maintained under document control in a secure area. A file is considered under custody if the documents are in:

- The custodian's possession or view.
- A designated secure area.

C3.1 Field Custody Procedures

The sample packaging and shipment procedures summarized in this section are intended to ensure that the samples collected will arrive at the laboratory with the chain of custody intact.

C3.1.1 Field Procedures

The HLA field sampler is personally responsible for custody of the collected samples until they are properly shipped or transferred to the laboratory. Samples will be handled by as few people as possible. Each sample will be properly labeled and sealed immediately after collection. The HLA field supervisor will review field activities to evaluate whether proper custody procedures were followed during the field work and decide if additional samples are required.

C3.1.2 Field Documentation

Sample identification documents will be carefully prepared to maintain identification and chain-of-custody records and to control sample disposition. Forms will be completed in water-proof ink. The following sample identification documents will be used for all sampling activities:

- Sample labels
- Sampling data sheets
- Field logbook
- Chain-of-custody forms

C3.1.2.1 Sample Labels

Sample labels are permanently affixed to sample bottles to provide sample identification. Where necessary, the label will be protected from water and solvents with clear label-protection tape. At a minimum, sample labels will contain the following information:

- HLA office address and telephone number
- Sequential label identification number
- Sample identification number
- Project code: an assigned HLA project number

- Name and initials of sample collector
- Date: a six-digit number indicating the day, month and year of collection
- Time: a four-digit number indicating the 24-hour clock time of collection
- Media type: the type of sample
- Sample location and depth
- Sample container type
- Sampling technique
- Preservative: the label will indicate whether a preservative was used and the type of preservative
- Analysis: the type of analysis requested (if no analyses are to be performed, this will be indicated)
- Remarks

C3.1.2.2 Groundwater Sampling Data Sheets

During groundwater sampling activities, information pertinent to field measurements and/or sampling will be recorded on groundwater sampling data sheets. The following entries will be contained in these sheets:

- Name and title of author, date and time of entry
- Weather conditions during field activity
- Location of sampling or measurement activity
- Name(s) and title(s) of field crew
- Type of sampled or measured media (e.g., groundwater)
- Sample collection or measurement method(s)
- Number and volume of sample(s) collected
- Description of sampling points
- Description of measuring reference points
- Date and time of collection or measurement
- Sample identification number(s)
- Sample preservative (if necessary)
- Sample distribution (e.g., laboratory)
- Field observations/comments
- Field measurement data (pH, conductivity and temperature)
- References for maps and photographs of sampling area(s)
- Sample documentation including dates and methods of sample shipment and bottle lot numbers

An example of a groundwater sampling data sheet is provided in the SAP.

C3.1.2.3 Field Logbook

The field logbook will provide the means of recording data collection activities. As such, entries will be described in detail so that persons going to the site may reconstruct a particular situation without relying on memory.

- Logbooks will be assigned to field personnel, but will be stored in the project file when not in use. Each logbook will be identified by a project-specific number.
- The title page of each logbook will contain the following information:
  - Person to whom the logbook is assigned
  - Logbook number
  - Project name
  - Project start date
  - Project end date

Information pertinent to a field survey, measurements and/or sampling will be recorded in a bound logbook. The following entries will be contained in the logbook:

- Name and title of author, date and time of entry and physical/environmental conditions during field activity
- Location of sampling or measurement activity
- Name(s) and title(s) of field crew
- Name(s) and title(s) of site visitors and purpose of visit
- Type of sampled or measured media (e.g., soil, sediment or groundwater)
- Sample collection or measurement method(s)
- Number and volume of sample(s) and sample containers collected
- Description of sampling point(s)
- Description of measuring reference points
- Date and time of sample collection or field measurement
- Description of sample collection equipment
- Description of deviations from the SAP and the rationale for the deviations.
- Sample identification number(s)
- Sample preservative (if necessary)
- Sample distribution (e.g., laboratory)
- Field observations/comments
- Calculations
- Description of field measurement instruments
- Field measurement data (pH, conductivity), including calibration data
- References for all maps and photographs of sampling site(s)
- Sample documentation including dates and methods of sample shipment and bottle lot numbers
- Level of personal protective equipment being used
- The signature of the person making the entry

A line will be drawn across the remainder of each incomplete page and initialed to indicate the end of an entry.

C3.1.2.4 Chain-of-Custody Record

The chain-of-custody record for each sample will originate in the field where the sample is prepared for shipment to the laboratory. HLA will be responsible for completing the chain-of-custody record throughout the sampling program until the samples have been shipped or delivered to the laboratory. The chain-of-custody record will accompany the sample through sample collection, shipment and analysis by the laboratory. This record will be completed to establish the documentation necessary to trace sample custody from sample collection through sample analysis.

The chain-of-custody form will contain, at a minimum, the following information:

- Project name
- Sample identification number(s)
- Laboratory identification
- Site identification
- Signature of sampler
- Date and time of sample collection
- Sample location and depth
- Sampling technique
- Sample type (media sampled)
- Sample preservation
- Requested analysis
- Container type
- Signatures of persons involved in the chain of possession (inclusive dates and times of custody)
- Preservatives/remarks
- Designation of sample as grab or composite

The laboratory portion of the form should be completed by the designated laboratory sample custodian and will contain the following information:

- Name of person receiving the samples
- Date and time of sample receipt by the laboratory
- Sample condition and temperature (recorded in Remarks section)

This form will be returned to HLA as part of the final project file upon successful completion of analysis. A copy of an example chain-of-custody form is provided in the SAP.

C3.1.3 Sample Custody Transfer and Shipment Procedures

During shipment, samples will always be accompanied by a chain-of-custody form. When transferring samples, the individuals relinquishing and receiving the samples will sign, date and note the time on the chain-of-custody form. The method of shipment, courier name(s) and other pertinent information will be entered in the chain-of-custody record. This record documents transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory or to/from a secure storage area.

Samples will be properly packaged within 24 hours of collection for shipment via an overnight courier and dispatched to the appropriate laboratory for analysis with a separate signed chain-of-custody form enclosed in each sample cooler. Shipping containers will be secured with strapping tape and custody seals will be attached to the front right and back left of the cooler for shipment to the laboratory. The custody seals will be covered with clear plastic tape. A copy of a custody seal (evidence tape) is provided in the SAP. The cooler will be strapped shut with strapping tape in at least two locations. Each cooler will be marked "Box _ of_" (with appropriate numbers in the blanks) so that the recipient will know when the entire shipment has been received.

Whenever samples are split with a recipient or government agency, a separate sample receipt will be prepared for those samples and marked to indicate with whom the samples are being split. The person relinquishing the samples to the facility or agency should request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses to sign, this will be noted in the "received by" space.

All shipments will be accompanied by the chain-of-custody form identifying the contents. The original record will accompany the shipment and copies will be retained by the sampler for return to the HLA files.

If the samples are sent by common carrier, a bill of lading should be used. Receipts of bills of lading will be retained as part of the permanent documentation. If sent by U.S. Postal Service, the package will be registered with return receipt requested. Neither commercial carriers nor the U.S. Postal Service are required to sign the chain-of-custody forms as long as the forms are sealed inside the sample cooler and the custody seals remain intact.

C3.2 Laboratory Custody Procedures

The laboratory contractor will follow the sample custody procedures specified in the CLP SOW for organic and inorganic analyses. A sample custodian will be designated by the laboratory to receive the sample shipment from the field. The custodian will accept custody of the samples shipped to the laboratory and will verify that the information on the sample label matches the information on the chain-of-custody form(s). Pertinent information relating to shipment, pickup and courier will also be verified on the chain-of-custody form(s). The custodian will enter the appropriate data from the chain-of-custody form into the laboratory sample tracking system, using the sample number from the sample label or assigning a unique laboratory number to each sample. The custodian will store the sample(s) in the defined secure area.

The laboratory sample custodian will notify the HLA QA Manager of any discrepancies noted on the chain-of-custody form or sample labels. Samples will not be analyzed until the HLA QA Manager resolves the discrepancy. Any changes made will be documented by the laboratory personnel and the HLA QA Manager. The name and telephone number of the HLA QA Manager are noted on the Approval Form at the beginning of this QAPP.

Laboratory personnel are responsible for custody of samples from the time they are received until sample analysis is complete. Any unused portions of samples remaining after completion of analysis by the laboratory will be disposed in accordance with procedures developed by the laboratory and consistent with existing laws and regulations governing sample disposal. If for any reason unused

sample portions cannot be disposed by the laboratory, these sample portions will be returned to the site to await final disposition.

C3.3 Corrections to Documentation

Original data recorded in field logbooks, chain-of-custody records and other forms will be written in waterproof ink. None of these documents will be altered, destroyed or discarded even if they are illegible or contain inaccuracies that require a replacement document.

If an error is made on a document assigned to one individual, that individual will make the correction by drawing a single line through the error, entering the correct information and initialing and dating the change. The erroneous information will not be obliterated. Any additional error(s) discovered on a document will be corrected by the person who made the entry. All corrections will be initialed and dated by the author.

C3.4 Final Evidence File Custody Procedures

HLA is the custodian of the final project file and maintains the contents of project files. HLA will maintain the study area files along with relevant records, reports, logs, field logbooks, photographs, subcontractor reports and the data and data reviews of the laboratory data in a limited access secure area and under custody of the QA Manager. The final study area file will contain, but not be limited to, the following project data:

- Planning documents
- Field data records
- Field logbooks
- Sample tags
- Chain-of-custody forms
- Sample tracking records
- Copies of analytical logbook pages
- Bench sheets
- Instrument readout records
- Computer printouts
- Graphs
- Calculations
- Raw data summaries
- Data purge files
- Correspondence
- Data validation files and reports
- Progress reports
- Report notes
- Photographs, maps and drawings
- Final report

C4.0 Calibration Procedures and Frequency

This section describes procedures for maintaining the accuracy of the instruments and measuring equipment that are used for conducting field tests and laboratory analyses. A variety of instruments, equipment and sampling tools will be used to collect data and samples and to monitor site conditions. Proper calibration, maintenance and use of instruments and equipment are imperative to ensure the quality of the data collected. A record of calibration and maintenance activities is important to provide legally defensible data. The Site Manager is responsible for proper calibration, maintenance and operation of field equipment. The laboratory QA officer is responsible for calibration and maintenance of laboratory instruments.

C4.1 Inspection of Field Equipment

Instruments and equipment purchased or used will be inspected to ensure that they conform to manufacturer's specifications. Equipment to be used during the field sampling activities will be examined to certify that it is in satisfactory operating condition. This examination includes checking the manufacturer's operating manual and instructions for each instrument to ensure that maintenance requirements are observed. Field notes from previous sampling activities will be reviewed so that the notes regarding previous equipment problems, if any, are not overlooked and necessary repairs to equipment have been performed. Instruments meeting these requirements will be given a serialized number and made available for project use. Instruments and equipment not meeting project requirements are labeled as such and are withheld from project use until they are modified or repaired to meet project requirements.

C4.2 Field Equipment Calibration

Instruments and equipment used to gather, generate or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications.

Each item of equipment used in field activities will be calibrated at a frequency specified by the owner/operator manuals provided by the manufacturer. The operating instructions for each piece of equipment contains, at a minimum, the following information:

- Equipment identification number and serial number
- HLA inventory number
- Calibration schedule and frequency
- Equipment specifications
- Specification verification (where applicable)
- Equipment necessary to accomplish calibration
- Procedure for calibration

Equipment calibration is recorded daily or as required by the calibration schedule by HLA field personnel in bound field logbooks. Information to be recorded includes the following:

- Date of calibration
- Data pertaining to the calibration procedures

- Initials of analyst performing calibration
- Adjustments made to the equipment before and after calibration
- Record of equipment failure or inability to meet specifications

If the calibration schedule is not adequately maintained or if accuracy as reported in the operations manual cannot be attained, that instrument will be unavailable for use until it is repaired so that specifications are attained.

The calibration, maintenance and operating procedures for instruments, equipment and sampling tools are documented in the owner/operator manuals supplied by the manufacturer. These manuals provide manufacturers' instructions and include specifications and criteria for calibration, maintenance and operation. A copy of the owners' manuals supplied by the manufacturer will be kept with each instrument.

General calibration requirements consistent with the manufacturers' owner/operator manuals for field equipment to be used for field activities follow.

C4.2.1 Organic Vapor Analysis

The portable gas analyzers currently identified as being available for onsite use during field operations are Thermo Environmental Instruments, Inc. OVM Model 580B photoionization detectors (PID). Equivalent instruments may also be used during the investigation. External standard calibration procedures specified in the factory-supplied instruction manual will be followed daily prior to the initiation of each day's field activities. These procedures include calibrating the instrument with an appropriate calibration gas (e.g., isobutylene) in the concentration range expected to be used. The calibration will be performed at ambient temperature and pressure. The instrument calibration will be checked daily by using the internal calibration mechanism. Specific procedures for instrument calibration are presented in the HASP for this project (Appendix BD).

C4.2.2 Water-level Measurements

The sounder will be checked against a steel surveyor's tape at the site. The graduated steel tape will have the manufacturer-supplied temperature correction applied if field conditions warrant.

Pressure transducers used for water level measurements will be factory-calibrated once, calibrated in-house with water columns before aquifer tests, checked weekly in the field against steel tape and against a sounder during use.

C4.2.3 Water Temperature

Temperature data are measured with a mercury thermometer. The thermometers will be inspected before use to ensure there is no mercury separation. The thermometers will be rechecked in the field before and after each use to see if the readings are logical and the mercury is still intact. The thermometers will be checked biannually for calibration, by immersing them in a water bath of known temperature until equilibrium is reached. Thermometers will be properly discarded if found to have more than 10 percent error. The reference thermometer used for the water bath calibration will

be traceable to National Bureau of Standards (NBS) calibration thermometers. All temperature meters are calibrated weekly with a mercury thermometer.

C4.2.4 pH Measurements

The digital pH meter (Beckman Model 021 or equivalent) will be calibrated daily with two standard buffer solutions before field measurements. Calibration procedures and frequency will be recorded in the field logbook along with the lot number of the buffer solutions. General procedures for calibrating the digital pH meter are described below:

1. Connect pH electrode to pH meter and turn on the pH meter.
2. Measure temperature of buffer solution.
3. Adjust the temperature setting on the basis of the buffer temperature, then place the electrode in the first buffer solution.
4. Set the span or slope adjustment to display correct value after the reading has been stabilized.
5. Rinse electrode in distilled water and repeat this procedure for the second buffer solution.
6. Place pH electrode in the sample and record the pH measurement displayed.
7. Remove pH electrode from sample and rinse with distilled water.
8. Re-calibrate the pH meter every time it is turned off and turned back on or if it exhibits erratic results.

The calibrations performed, standards used and sample pH values measured are recorded in the field logbook and sampling forms, as appropriate. New batteries will be purchased and kept with the meters to facilitate immediate replacement in the field as necessary.

C4.2.5 Specific Conductance

The conductivity cells of the specific conductivity meter (YSI Inc. Model 33 S-C-T or equivalent) will be cleaned and checked daily against known conductivity standards before use. The calibration procedure follows:

1. Place the probe in conductivity calibration standard solution.
2. Set temperature knob to the temperature of the standard solution.
3. Turn to the appropriate scale and set the instrument for the calibration standard value including zeroing and red-lining the instrument as described in the manufacturer's set-up and operations procedures.
4. Rinse the conductivity electrode with distilled water.
5. Measure the conductivity of distilled water, ensuring the temperature is set correctly for the temperature of the sample to be measured.

Sample readings and calibrations will be recorded in the field logbook and sampling forms as appropriate.

C4.3 Laboratory Instrument Calibration

Calibration of laboratory equipment will be performed on the basis of method-specific procedures. Records of calibration, repairs or replacement will be filed and maintained by the designated

laboratory personnel performing QC activities. These records will be filed at the location where the work is performed and may be subject to a QA audit. For instruments, the laboratory will maintain a factory-trained repair staff with in-house spare parts or will maintain service contracts with equipment vendors.

The calibration records will be maintained as follows:

- If possible, each instrument will have a calibration record permanently affixed to it with an assigned record number.
- A label will be affixed to each instrument showing description, manufacturer, model numbers, date of last calibration, calibrator's signature and due date of next calibration. Reports and compensation or correction figures will be maintained with the instrument.
- Written step-wise calibration procedures will be available for each measurement instrument.
- Any instrument that is not calibrated to the manufacturer's original specifications will display a warning tag to alert the analyst that the instrument has only a limited calibration.

The calibration procedures and frequency of calibration for laboratory equipment used for sample analysis will be consistent with CLP SOW protocols as specified in the current CLP SOWs for organic and inorganic analyses. Calibration procedures and frequency of calibration for laboratory equipment used for non-CLP sample analyses are discussed in appropriate laboratory method SOPs.

C4.3.1 Organic Analyses

Before calibration, the instrument(s) used for gas chromatography/mass spectrometry (GC/MS) analyses are tuned by analysis of p-bromofluorobenzene for VOC analyses and decafluorotriphenyl phosphine for semi-volatile organic compound (SVO) analyses. The instrument tune will be verified every 12 hours of operation.

Once the tuning criteria for these reference compounds are met, the instrument is initially calibrated by using a five-point calibration curve. Continuing calibration is verified every 12 hours of operation. The calibration standards will be traceable to USEPA or NBS standards and are spiked with internal standards and surrogate compounds. Calibration and continuing calibration verification of instruments will be performed at approved intervals as specified by the manufacturer or the analytical method (whichever is more frequent).

C4.3.2 Inorganics Analyses

The Atomic Absorption Spectrophotometer and Inductively Coupled Plasma (ICP) Emission Spectrophotometer instruments are initially calibrated by use of a minimum of three calibration standards prepared by dilution of certified standard stock solutions. An analysis blank is prepared with one calibration standard at the quantitation limit for the metal. The other standards bracket the concentration range of the samples. Calibration standards will contain acids at the same concentration as the digested samples.

A continuing calibration standard, prepared from a different stock solution that is used for preparation of the initial calibration standards, is prepared and analyzed after every 10 samples or every 2 hours of continuous instrument operation. The continuing calibration standard concentrations must agree

within 10 percent of the initial calibration value or the appropriate corrective action is taken. Corrective action may include re-calibrating the instrument and reanalyzing the previous 10 samples. For the ICP, linearity near the lower quantitation limit will be verified with a blank. This blank must be run at the beginning and end of each sample analysis sequence or a minimum of twice per 8-hour period of instrument operation.

C4.3.3 Non-Contract Laboratory Program Analyses

Currently, the only non-CLP analyses to be performed will be analysis of water and soil samples for pyridine. Pyridine in water will be analyzed in accordance with SW-846 method 8270. On January 11, 1993, ETC performed a detection limit study for semi volatile organic compounds including pyridine, in water. A copy of ETC's method detection limits for this analysis is included in Appendix CA.

If possible, pyridine in soil will be analyzed by extending the CLP analysis. ETC is currently working to confirm that this procedure is practicable.

The laboratory will develop a specific methodology for these analyses prior to project startup. Analytical accuracy for pyridine will be evaluated in relation to method validation/startup QC control criteria.

Table C4-1. Summary of Laboratory Data to be Collected
During Remedial Investigation Activities
Island Chemical Company Site
St. Croix, U.S. Virgin Islands

Sample Matrix	VOCs	Semi-VOCs	Inorganics	Pyridine
Groundwater sample collection and analysis	CLP	CLP	CLP	SW-846 8270
Soil sample collection and analysis	CLP	CLP	CLP	CLP[1]

CLP Contract Laboratory Program
[1] CLP analysis for semi-volatile organic compounds in soil will be modified to include pyridine

C5.0 ANALYTICAL METHODS AND PROCEDURES

The analytical methods and procedures include a description of field and analytical parameters, method reporting limit requirements, QA/QC procedures for laboratory and field analyses and laboratory deliverables. Samples will be analyzed by USEPA-CLP laboratories as noted in the SAP. HLA currently plans to contract laboratory services through ETC Laboratory of Edison, New Jersey. The intent is to have measurements required for plume definition be performed at a CLP laboratory using CLP protocol. Other analyses conducted for treatability, permitting and/or geotechnical purposes not requiring CLP protocol will also be performed at CLP laboratories, when feasible.

C5.1 Non-Contract Laboratory Program Analytical Methods

Pyridine is currently the only substance proposed for analysis that is not included in the CLP program. This substance will be analyzed and reported with the TCL semi-volatile organic compounds.

C5.2 Field Screening Analytical Procedures

The procedures for field measurement of pH, specific conductivity, temperature and relative VOC concentration are provided in the SAP.

C5.3 Quality Assurance/Quality Control Procedures for Field Analyses

HLA's Site Manager will be responsible for QA/QC procedures for field analyses. Field QA/QC analyses will include calibrating field measurement instruments and equipment and comparing data to previous measurements obtained at the specific location. Variations in field data measurements, greater than those specified by the manufacturer of the equipment, at a specific location will be examined to evaluate whether general trends may be developing. Variations in data that cannot be explained will be assigned a lower level of confidence and will be used for limited purposes.

A variety of instruments, equipment and sampling tools will be used to collect data and samples and to monitor site conditions. Proper calibration, maintenance and use of instruments and equipment are required to ensure the quality of data collected in the field. Equipment and instrument calibration, maintenance and operational procedures are described in detail in Section C4.0 of this QAPP.

The QC objective of these data collection activities is to obtain reproducible and comparable measurements to a degree of accuracy consistent with the intended use of the data. The QC objectives will be accomplished through the use of documented standard procedures. The procedures for performing these activities and the standardized formats for documenting them are presented in the SAP.

C5.4 Laboratory Analytical Parameters and Methods

Laboratory analytical parameters and methods to be used during this project are as follows:

Groundwater	
VOCs, SVOCs and pesticides/PCBs	Superfund Analytical Methods for Low Concentration Waters for Organic Analysis (SAMLCWOA), Rev. 10/92
Pyridine	SW-846 Method 8270
Inorganics	CLP SOW ILMO3.0 (May 1993); antimony, beryllium and thallium will be analyzed using the atomic absorption furnace technique given in the CLP SOW ILMO2.0, Part B, pages D-28 through D-40)
Soil	
VOCs, SVOCs including pyridine and pesticides/PCBs	Statement of Work for Organics Analysis, OLMO1.9 (July 1993) modified for pyridine analysis
Inorganics	Statement of Work for Inorganic Analysis ILMO3.0

C5.5 Method Reporting Limit Requirements

Method reporting limits (MRL) for analytical data will be consistent with the objective of the investigation and the intended use of the data. The MRLs are reported in Tables C1-4 through C1-7 (see Section C1.0).

Contract required quantitation limits and MRLs for target analytes may be sample-specific for samples with complex matrices (i.e., samples containing one or more analytes at widely varying concentrations). In this case, detection limits for certain samples will increase when a sample has to be diluted to provide on-scale instrument response for high-concentration analytes. However, target analytes not requiring dilution will be analyzed accordingly and analytical results will be included in the laboratory deliverables. For samples requiring lower detection limits, the diluted samples will be reanalyzed by the laboratory upon approval of HLA's QA review officer. Samples that require lower detection limits, if any, will be identified before analyses, if possible, and the laboratory will be notified in this event.

C5.6 Laboratory Quality Assurance/Quality Control Procedures

Analytical QA/QC for laboratory testing will be based on (1) CLP SOW requirements as stated in the current CLP SOW and (2) the laboratory's specific QA/QC procedures. Laboratory precision and accuracy will be evaluated on the basis of CLP-required system checks and results of required laboratory QA/QC samples introduced into the sample analysis stream. The types and frequency of required system checks and laboratory QA/QC samples are provided in the CLP SOWs and SOPs. As listed in the SOW requirements, any non-CLP laboratories if used, will be amenable to analysis of performance evaluation samples submitted by USEPA for QA purposes.

In addition to the laboratory QA/QC described above, project QA/QC checks will be used to quantitatively and qualitatively evaluate the analytical performance of the laboratory. QA/QC samples will also be used qualitatively to assess external effects on the accuracy and comparability of the reported results. Project QA/QC checks will consist of controlled samples from the field. Project QA/QC samples will consist of rinse and trip blanks, field duplicates and matrix spikes. Field duplicates and matrix spikes will be designated in the field before analysis by the laboratory.

C6.0 INTERNAL QUALITY CONTROL PROCEDURES

QC procedures are designed to ensure and document data quality. Field and laboratory QC checks will be used to evaluate the laboratory's analytical procedures. Key project QA/QC personnel are identified on the Approval Form located at the beginning of this QAPP. Resumes of key QA/QC personnel are included in Appendix CB.

C6.1 Field Quality Control Sample Collection

QC samples will be collected in the field and submitted to the laboratory with the investigative samples. Three types of QC samples will be collected: blanks (rinse blanks and trip blanks), matrix spikes and field duplicates. The QC samples will be used to assess the field sampling program data quality and the laboratory analytical data quality and are described in Section C1.0 of this QAPP. Field blanks will be collected at a rate of 10 percent for non-aqueous samples and one field blank per day for aqueous samples. Duplicates will be collected at a frequency of 1 per 20 investigative samples of each matrix.

The levels and types of project QC check samples that will be introduced into the analytical program are described below.

C6.1.1 Water and Soil Samples

The following project QC check samples will be submitted for analysis to ensure and document water and soil data quality for samples collected from borings and monitoring wells:

- Rinse blank for Target Compound List (TCL) organics, Target Analyte List (TAL) inorganics and pyridine
- Trip blank for VOCs only
- Field duplicate for TCL organics, TAL inorganics and pyridine

Rinse blanks will not be collected if the sample is collected directly into the container. The frequency of QC sample collection was previously presented in Tables C1-2 and C1-3 (see Section C1.0).

C6.2 Field Measurement Quality Control Procedures

Field measurement QC procedures for pH, conductivity and temperature measurements are limited to checking the reproducibility of the measurement (1) by obtaining multiple readings on a single sample or standard and (2) by calibrating the instruments. Field measurement procedures are described in the SAP (Appendix B).

C6.3 Laboratory Quality Control Procedures

Laboratory QC checks (for CLP procedures) represent internal system checks and controlled samples introduced by the laboratory into the sample analysis stream. These procedures are used to validate the data and calculate the accuracy and precision of the chemical analysis program. The level of QC effort provided by the laboratory will be equivalent to the level of QC effort specified in the CLP SOW methods. The level of QC effort for inorganics testing (metals and cyanide) will conform to the

protocols of the SOW (5/93 ILMO3.0). The levels of QC effort for TCL organics testing (VOCs, SVOCs, Pesticides and PCBs) will conform to the protocols of the SOW (7/93 OLMO1.9) or the Superfund Analytical Method Low Concentration Water for Organic Analysis (SAMLCWOA, 10/92), as appropriate.

The QC level will meet the criteria in the CLP SOWs or appropriate SOPs or the SAMLCWOA. These specifications include the types of QC checks required (method blanks, reagent/preparation blanks, matrix spikes, calibration standards, internal standards, surrogate standards, the frequency of each QC analysis, specific calibration check standards and laboratory duplicate/replicate analysis), compounds and concentrations to be used and the QC acceptance criteria. Laboratory system checks and QA/QC samples are required by the current CLP SOWs and are defined below.

C6.3.1 Laboratory Quality Assurance Program

The selected laboratory will have a written QA/QC program that provides rules and guidelines to ensure the reliability and validity of work conducted at the laboratory. Compliance with the QA/QC program is coordinated and monitored by the laboratory Quality Assurance Unit (QAU), which is independent of the operating departments.

The stated objectives of the laboratory QA/QC are intended to:

- Ensure that procedures are documented, including any changes in administrative and or technical procedures.
- Ensure that analytical procedures are conducted according to sound scientific principles and have been validated.
- Monitor the performance of the laboratory by a systematic inspection program and provide for corrective action, as necessary.
- Collaborate with other laboratories in establishing quality levels, as appropriate.
- Ensure that data are properly recorded and archived.

Laboratory procedures are documented in writing as either SOPs or Method Procedures, which are edited and controlled by the laboratory QAU. Internal QC procedures for analytical services will be conducted by the laboratory in accordance with their SOPs.

Laboratory QC checks will be performed and samples will be analyzed at a frequency established by the appropriate CLP SOWs (or SAMLCWOA) for organics and inorganics and by the SOPs for non-CLP samples.

C6.3.2 Organic Analysis

The following QC samples are analyzed along with samples that are analyzed for organic compounds:

- Initial Calibration - analysis of analytical standards for a series of different specified concentrations; used to define the linearity and dynamic range of the response of the GC or GC/MS to the target compounds.

- Continuing Calibration - analytical standard run frequently to verify the calibration of the GC or GC/MS system.

- Method Blank - an analytical control consisting of all applicable reagents, internal standards and surrogate standards carried through the entire analytical procedure. The method blank is used to define the level of laboratory background contamination.

- Internal Standards - compounds added to every standard, blank, duplicate, matrix spike sample (for volatile organic analysis) and sample extract (for SVOs), at a known concentration, before analysis. Internal standards are used as the basis for quantitation of the organic target compounds.

- Surrogates - organic compounds added to every blank, sample, duplicate, matrix spike and standard; used to evaluate analytical efficiency by measuring recovery. Surrogates are brominated, fluorinated or isotopically labeled compounds not expected to be detected in environmental media.

- Storage Blank - (SAMLCWOA only) Upon receipt of the first samples from a Sample Delivery Group (SDG), two 40-mL VOA vials with a Teflon™-faced silicon septum are filled with reagent water. The vials are stored under the same conditions as the samples in the SDG. A 25.0 mL aliqot of this reagent water is spiked with a 10.0 μL internal standard and 10.0 μL of surrogate solution and analyzed after all samples in the SDG have been analyzed. The storage blank indicates whether contamination may have occurred during sample storage.

- Instrument Blank - (SAMLCWOA only) 25.0 mL of reagent water spiked with a 10.0 μL internal and 10.0 μL of surrogate solution carried through the entire analytical scheme. Instrument blanks are analyzed after a sample/dilution which contains a target compound at a concentration greater than 25 μg/L (ketones 125 μg/L) or a non-target compound at a concentration greater than 100 μg/L or saturated ions from a compound (excluding the compound peaks in the solvent front). The results from instrument blank analysis indicate whether there is contamination from a previous sample.

- Laboratory Control Sample (LCS) - The LCS is an internal laboratory QC sample designed ot assess (on an SDG-by-SDG basis) the capability of the contractor to perform the analytical method.

C6.3.3 Inorganic Analysis

The following QC samples are analyzed along with samples that are analyzed for inorganic arameters:

- Calibration Blank - a volume of acidified deicnized and/or distilled water.

- Continuing Calibration - analytical standard run every 10 analytical samples or every two hours, whichever is more frequent, to verify the calibration of the analytical system.

- Instrument Calibration - analysis of analytical standards for a series of different specified concentrations; used to define the quantitative response, linearity and dynamic range of the instrument to target compounds.

- Preparation Blank - an analytical control that contains distilled and/or deionized water and reagents, carried through the entire analytical procedure (digested and analyzed). An aqueous method blank is treated with the same reagents as a sample with a water matrix; a solid method blank is treated with the same reagents as a soil sample.

- Laboratory Duplicate - a second aliquot of a sample, which is prepared and analyzed using the same procedures as the original sample, to evaluate method precision.

- Interference Check Sample - consists of two solutions: Solution A and Solution AB. Solution A consists of the interferer and Solution AB consists of the analytes mixed with the interferer. The solutions are analyzed consecutively to verify inter-element and background correction factors.

- Inter-element Correction Factors - values determined to correct for spectral interference caused by aluminum, calcium, iron and magnesium for ICP instruments at wavelengths used for each analyte.

C6.3.4 Miscellaneous Analyses

The following QC samples are analyzed, where appropriate, with samples for miscellaneous analyses.

- Calibration Blank - a volume of distilled water containing the same reagents as the other calibration standards.
- Continuing Calibration - analytical standard run every 10 analytical samples to verify the calibration of the analytical system.
- Instrument Calibration - analysis of analytical standards for a series of different specified concentrations; used to define the quantitative response, linearity and dynamic range of the instrument to target compounds.
- Preparation Blank - an analytical control that contains distilled and/or deionized water and reagents, carried through the entire analytical procedure (digested and analyzed). An aqueous method blank is treated with the same reagents as a sample with a water matrix; a solid method blank is treated with the same reagents as a soil sample.
- Laboratory Duplicate - a second aliquot of a sample that is prepared and analyzed using the same procedures as the original sample to evaluate method precision.

C7.0 DATA VALIDATION, REDUCTION AND REPORTING

Data collected during implementation of the Work Plan will be managed, distributed and preserved to substantiate and document that data are of known quality and are properly maintained. Laboratory sample analyses will be tracked and validated to monitor performance.

C7.1 Data Validation

C7.1.1 Field Measurement Data Validation Procedures

Field measurement data validation procedures include reviewing the raw data and supportive documentation generated from field investigations and will include, but not be limited to, the following:

- Field logbooks
- Field investigation daily reports
- Field instrument readings and calibration data sheets
- Field well completion data
- Field boring logs
- Well test data
- Groundwater sampling forms
- Sample tags
- Chain-of-custody forms
- Sample tracking records
- Elevation survey information
- Maps

Validation of field data will be performed by HLA's QA Manager or designated representative. Data validation will be performed to meet the project's intended data uses by checking the procedures used in the field and comparing the data to previous measurements. The following areas will be addressed during validation:

- Sampling methodology
- Sample technical holding times and preservation
- Instrument selection and use
- Instrument calibration and standardization
- Instrument preventative maintenance
- Field deviations
- Sampling limitations

Field measurements that could affect the quality of the data (such as temperature, pH, conductivity, water level) will also be validated.

Additional evaluations of data integrity, including those for non-CLP procedures, will be performed on 10 percent of the data, including the following:

- Review chain-of-custody forms.
- Review the appropriateness of field methodologies.

- Review data for transcription, calculation, completeness and accuracy.
- Analyze field notes to evaluate possible bias.

C7.1.2 Analytical Data Validation

For parameters noted in the SAP, a CLP laboratory will be selected to perform chemical analyses to ensure that laboratory QC and data packages comply with CLP guidelines and are completed within reasonable turnaround times.

Laboratory validation of samples analyzed by methods under the CLP SOW will be performed in a manner consistent with the following guidelines:

- CLP Organic Data Review, SOP No. HW-6 (Rev. 8, 1/92);
- Evaluation of Metals Data for the CLP based on SOW 3/90, SOP No. HW-2 (Rev. 11, 1/92);
- SAMLCWOA, SOP No. HW-13 (Rev. 1, 10/92).

Validation of samples analyzed by non-CLP methods will be consistent with USEPA functional guidelines and/or method-specific SOPs. Pyridine data will be validated following SOP No. HW-6, noted above.

C7.1.2.1 Laboratory Data Validation Procedures

Under the direction of the Laboratory QA Officer, the laboratory will review analytical data to ensure that results for investigative and QC samples meet CLP-specified criteria and USEPA Region II SOP Nos. Hazardous Waste Division memoranda 2 and 6 (January 1992). The following analytical data will be checked during the laboratory validation process:

- Sample technical holding times
- GC/MS tuning
- Calibration
- Initial
- Continuing
- Blank results
- Surrogate recovery
- matrix spike results
- Internal standards performance
- TCL compound identification
- Compound quantitation and reported detection limits
- Tentatively identified compound identification
- System performance
- Overall data assessment

The laboratory will perform analytical data reduction and in-house validation under the direction of the Laboratory QA Officer. The Laboratory QA Officer will be responsible for assessing data quality and advising appropriate laboratory Section Supervisors and HLA's QA Manager of any data that are

rated "unacceptable" or have notations that would caution the data user to possible unreliability. Data reduction, validation and reporting by the laboratory will be conducted as follows:

1. Raw data produced by the analyst will be turned over to the respective Section Supervisor.
2. The Section Supervisor will review the data to ensure it has met QC criteria as outlined in CLP protocol and established USEPA methods.
3. Upon acceptance of the raw data by the Section Supervisor, a computerized report will be generated and sent to the Laboratory QA Officer.
4. The Laboratory QA Officer will complete a thorough audit of the computerized reports at a frequency of 1 in 10 and audit every report for consistency.
5. The Laboratory QA Officer and Section Supervisor will decide whether any sample re-analysis is required.
6. Upon acceptance of the preliminary reports by the Laboratory QA Officer, final reports will be generated and signed by the Laboratory Director. The laboratory package will be presented to HLA in the sequence in which the samples were analyzed.

The Laboratory QA Officer will evaluate the laboratory report package. These evaluations will consider the finished data sheets, calculation sheets, document control forms, blank data, duplicate data and recovery data for matrix and surrogate spikes. The material will be checked for legibility, completeness, correctness and the presence of necessary dates, initials and signatures. The results of these checks will be assessed and reported to the HLA Project Manager and HLA QA Manager, noting any discrepancies and their effect on acceptability of the data.

C7.1.2.2 Harding Lawson Associates Data Validation Procedures

A description of the validation steps that will be used by HLA's QA Manager or representative to independently validate the laboratory data is provided in this section. Consistent with USEPA Functional Guidelines, all sample cases will be validated. The validation steps follow:

1. Compile a list of investigative samples.

2. Compile a list of QC samples, including the following:

   - Rinse blanks
   - Trip blanks
   - Laboratory blanks
   - Blind field duplicate samples (replicated or co-located samples)
   - Laboratory replicates
   - matrix spikes

3. Review laboratory analytical procedures and instrument performance criteria as follows for organic and inorganic analyses:

   Organic Analysis
   - Sample technical holding time
   - GC/MS instrument calibration and performance
   - GC/MS tuning and performance

- Blanks
- Surrogate recovery
- matrix spike recovery
- Compound identification and quantitation
- System performance
- Overall data assessment

Inorganic Analysis

- Sample technical holding time
- Instrument calibration
- Blanks
- Interference check sample analysis
- Laboratory control sample analysis
- Matrix spike recovery
- Laboratory replicates
- Quarterly verification of instrument parameter report
- Overall data assessment

4. Evaluate the integrity of the data as follows:

- Review chain-of-custody forms for completeness and correctness.
- Review data for transcription, calculation, completeness and accuracy.
- Review laboratory analytical procedures, appropriateness and instrument performance criteria.

5. Prepare a data summary that includes the following:

- Results
- Sample media identification
- Sample location and descriptions
- Appropriate concentration units
- Appropriate significant figures
- Data qualifiers
- Definitions

6. Review the data summary for potential data quality problems, including the following:

- Unexpected results
- Common laboratory contaminants
- Field-induced contaminants
- Unusual spatial concentration/identification relationships
- Unexpected compound or parameter relationships
- Samples in which dilution was necessary
- Samples that may have been contaminated with carryover from the previous sample analyzed
- Missed technical holding times

Laboratory records and data package requirements will be checked to assess completeness of the data package. The validation effort will be performed by personnel qualified and experienced in laboratory data validation. The laboratory data validation and QA review summary will be provided as an appendix to the final report.

Despite all efforts to achieve the objectives of the project, the potential for error exists in the laboratory chemical analyses and the data reporting process. Every reasonable effort will be made to compare and double-check data reported from the laboratory and data managed during the process.

C7.1.3 Data Qualifiers

Data qualifiers and definitions, consistent with CLP SOWs, method-specific SOPs and/or USEPA functional guidelines, will be used where appropriate in validation. Data qualifiers will be attached to the tabulated data to indicate the data quality according to intended data use. The qualifiers will be attached to the data whenever they appear in hard copy or computerized form to ensure that data users are aware of limitations and quality of the data. Upon completion of data validation, summary reports will be placed in the file along with qualified analytical result summary forms.

C7.2 Data Reduction

Reduction of analytical data will be performed in accordance with validation procedures described above. These procedures specify the documentation needed and the technical criteria required to validate the data. Data quality and utility depends on many factors, including sampling methods, sampling preparation, analytical methods, QC and documentation.

7.2.1 Field Measurement Data Reduction Procedures

Reduction of field measurement data will be performed in accordance with validation procedures described previously in Section C7.1. Validity of data will be evaluated by checking calibration procedures used in the field and by comparing the data to previous measurements obtained at the site. The Site Manager will summarize the data obtained from field measurements and will include this information in the field activities documentation report, which will be submitted to the QA Manager and the Project Manager for review. Independent data entry checks will be performed and computerized data storage will be routinely checked to verify accurate retrieval of data.

To evaluate the field measurement data supporting the analytical data, the following items will be documented:

- Sampling date and time
- Sampling team, sampling observer and recorder and sampling crew leader
- Sampling location
- Physical description of sampling location
- Sample collection technique
- Field preparation techniques (e.g., sample filtration)
- Visual classification of sample using an accepted classification system (if applicable)
- A thorough description of the methodology used and a rationale for the use of that methodology

- Complete documentation of record keeping practices
- Field logbooks and all custody documents stored in a secure repository or under the control of a document custodian
- All forms completed in indelible ink without alterations, except as initialed

C7.2.2 Laboratory Analytical Data Reduction Procedures

The selected laboratory will perform in-house analytical data reduction under the direction of the Laboratory QA Officer. The Laboratory QA Officer is responsible for assessing data quality and advising of any data that were rated "preliminary" or "unacceptable" or other notations that would caution the data user of possible unreliability. Data reduction will be conducted as follows:

1. Raw data produced by the analyst is submitted to the respective area supervisor.
2. The area supervisor reviews the data (1) for attainment of QC criteria as outlined in CLP protocols and/or established USEPA methods and (2) for overall reasonableness.
3. Upon acceptance of the raw data by the area supervisor, a computerized report is generated and sent to the Laboratory QA Officer.
4. The Laboratory QA Officer will complete (1) a thorough audit of reports at a frequency of 1 in 10 and (2) an audit of every report for consistency.
5. The QA Officer and area supervisors will decide whether any sample re-analysis is required.
6. Upon acceptance of the preliminary reports by the QA Officer, final reports will be generated and signed by the Laboratory Project Manager. The laboratory package shall be presented in the same order in which the samples were analyzed.

Data reduction reporting procedures will be those specified in the CLP SOWs for inorganic and organic analyses. The laboratory will prepare and retain full analytical and QC documentation similar to that required by the CLP. Such retained documentation need not be hard (paper) copy but may be in other storage media (e.g., magnetic tape). As needed, the laboratory will supply the hard copy of the retained information.

Data reduction procedures for non-CLP methods will be performed in accordance with method-specific SOPs.

7.2.3 Harding Lawson Associates Analytical Data Reduction Procedures

When field measurements and chemical data are validated and assembled, these data are further evaluated with respect to PARCC parameters. The definitions of these parameters were presented in Section C1.0 and are repeated here for convenience.

- Precision - a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions, usually expressed in terms of the relative percent difference.
- Accuracy - the degree of agreement of a measurement with an accepted reference or true value.
- Representative - the selection of analytical methods, sampling protocols and saple locations such that results are representative of the media being sampled and the conditions being measured.

- Completeness - the amount of valid data obtained from a measurement system compared to the amount that was expected and needed to be obtained to meet the project data goals.
- Comparability - expresses the confidence with which one data set can be compared to another.

Satisfaction of these criteria will be documented as follows. Chemical data must meet criteria of (1) quantitative statistical significance in relationship to the standard analytical methods employed and (2) satisfactory custody and document control. Field measurement criteria include (1) complete documentation of sampling location, time and personnel; (2) satisfactory documentation of field activities; and (3) correct sampling methodologies.

To determine the quantitative statistical significance of chemical data, the following items will be documented, as appropriate:

- Laboratory/field instrumentation, including calibration data, standard methods and references
- Laboratory analysis methods, including reference methods
- Laboratory method detection limits
- Analysis of laboratory (reagent) blanks at a frequency of at least 1 per 20 samples
- Analysis of laboratory matrix spikes at a frequency of at least 1 per 20 samples if the analyte is amenable to spiking.
- Analysis of field duplicates at a frequency of at least 1 per 20 samples for each matrix
- Analysis of laboratory replicates (duplicates or splits) at a frequency of at least 1 per 20 samples for inorganic analyses
- Presentation of tabulated QC data or QC charts and acceptance criteria
- QA/QC certification of the laboratory and/or participation in round-robin testing by USEPA-accredited agencies
- QC limits consistent with USEPA's CLP limits

To evaluate the custody and document control for samples and results, the following items will be documented:

- Field custody noted in field logbook or chain-of-custody form
- Samples hand-delivered to the laboratory with a chain-of-custody form
- Laboratory custody documented by chain-of-custody form from either field personnel or shipper to the designated laboratory sample custodian
- Sample designation number(s) traceable through entire field monitoring system
- Field logbooks and all custody documents stored in a secure repository or under the control of a document custodian
- All forms completed in indelible ink without alterations except as initialed
- Identity of sampler
- Date of sample collection and shipping

To determine sample representativeness, the following items must be checked:

- Comparability between field and laboratory measurements or suitable explanation of discrepancy
- Analysis within time limits suitable for the preservation and analysis methods used
- Sample storage within suitable temperature, light and moisture conditions

- Proper sample containers used
- Proper sample collection equipment used
- Proper decontamination procedures used for sample collection equipment
- Proper sample preservation techniques used
- Proper laboratory preparation techniques used
- Factors to determine bias screening evaluated
- Sample site selection criteria must provide representativeness

C7.3 Information Transfer

Data structures for the project database will be implemented using electronic media compatible with commercially available computer software.

C7.4 Reporting Requirements and Document Control

Appropriate documents will be prepared and distributed to summarize both field activities performed and the results of all data collected. These reports, to the extent possible, will include the following:

- Presentation of results
- Summaries of data from field measurements
- Field location of sampling points

In addition, USEPA will be provided copies of the following documents for each sampling event within 180 calendar days of the last sample shipment to the laboratory of that event:

- Field measurements and logbooks
- Laboratory purge files, including, but not limited, to sample tags, chain-of-custody records, copies of sample tracking records, analysts' logbook pages, instrument logbook pages (including instrument conditions), bench sheets, instrument readout records, computer printouts, chromatographic charts, raw data summaries, correspondence and memoranda and document inventory
- Data validation reports summarizing the validation process used and specific comments pertaining to a sample or group of samples

C7.4.1 Laboratory Deliverables

The laboratory will provide data deliverables consistent with that required by the CLP SOW for organics SAMLCWOA (Rev. 10/92), CLP SOW ILM03.0 (May 1993), and CLP SOW OLMO1.9 (July 1993). Laboratories performing analysis of non-CLP target parameters will provide raw data deliverables appropriate to the method-specific SOPs. The deliverables will include, but not be limited to, the following, where appropriate:

- QC summary packages
- Sample data package
- Standards data package
- Initial and continuing calibration raw data
- Raw QC data

- Blank data
- matrix spike data
- Additional performance criteria specific to analytical methods (e.g., pesticide evaluation standards individual standards and quantitation standards)

In addition, the following information will be included with the data deliverables, where appropriate:

- Case narrative
- Chain of custody or similar documentation
- Copies of sample tracking records
- Analysis logbook pages
- Instrument logbook pages
- Bench sheets
- Instrument readout records
- Computer printouts
- Chromatographic charts
- Raw data summaries
- Correspondence or memoranda
- All raw sample data including sample preparation logs, instrument logs, data system printouts, chromatograms and spectra necessary to validate the data according to Region II SOPs.

Pyridine data will be printed on modified CLP forms.

C8.0 PERFORMANCE AND SYSTEMS AUDITS

Field and laboratory audits are used to quantitatively evaluate the accuracy of the total measurement system. These audits will also verify that sampling and analysis activities are performed in accordance with the procedures established in the SAP and this QAPP. HLA's QA Manager will monitor and audit the performance of the field and laboratory activities. Information produced or obtained during the course of this investigation is subject to audit. As such, the information must be reliable, gathered with appropriate attention to detail and maintained with integrity. The documentation may take any of several forms, including a field notebook, photographs, computer tape or a sample identification tag.

C8.1 Field Audits

The HLA QA Manager or designated representative will audit field activities to evaluate sample identification, sample control, chain-of-custody procedures, field documentation sampling operations, handling and packaging procedures. Persons conducting the audits in addition to the QA Manager will be senior technical reviewers who are familiar with the technical and procedural requirements of field sampling.

The field audits will not be announced to the field team before they occur. If problems are encountered during the audits, the frequency of the audits will be increased. The audits will include performance audits for each measurement parameter, including performance audits for all measurement systems. Follow-up audits will be conducted to correct deficiencies and to verify that QA procedures are maintained throughout the project. Following the audit, preliminary results will be reviewed with the person in charge of the sampling. The field audit will provide information to allow examination of the following field documents: sample labels, chain-of-custody records and field logbooks. In addition, external field audits may be conducted by USEPA Region II.

C8.1.1 Sample Labels

The auditor will examine a selected number of sample labels for completeness and accuracy and will determine whether the information identified in Section C3.1.2.1 of this QAPP is included on the label. The auditor will also determine whether the sampling methods used were as described in the USEPA-approved SAP.

8.1.2 Chain-of-Custody Records

The auditor will select a predetermined number of the chain-of-custody records to be audited in the field. The records will be reviewed to determine whether (1) the station number, station description, date and time correspond to the sample label, (2) the parameters to be analyzed have been properly identified and (3) custody transfers have been documented and the date and time of transfer have been recorded. The auditor will also determine whether samples have been kept in custody at all times and have been properly and securely stored.

C8.1.3 Field Logbooks

Field logbooks will be reviewed during the field audit to determine whether each is signed and whether entries are dated. During field activities, notebooks will be kept in the possession of the

sampling team leader. The project number, site name, date of receipt and name of the person using the book will be recorded on each page.

In situ measurements and field observations will be recorded in the notebooks with pertinent information necessary to explain and reconstruct sampling operations. Each page will be dated and signed by the individuals making entries on that page. The Site Manager and the field team on duty will be responsible for ensuring that the notebooks are available during monitoring activities and that they are safely stored at the end of each day's sampling activities and after the final day of field activities to maintain security. Any lost, damaged or voided notebooks will be reported to the Site Manager.

Notebook entries must be legible, written in ink and contain accurate and inclusive documentation of project activities. Language should be factual, objective and free of speculation and inappropriate terminology. Entries made by individuals other than the person to whom the notebook was assigned must be signed and dated by the individual making the entry.

Photographs may be taken and must also be controlled. The auditor will review the field notebook to determine whether the photographs are properly documented. When slides or photographs are taken that show sampling sites or provide other documentation, they will be numbered to correspond to the notebook entries. The name of the photographer, date, time, site location and site description will be entered sequentially in the notebook as photographs are taken.

The Site Manager's logbook will document the transfer of notebooks to the individuals who have been designated to perform specific field activities. Pertinent information will be recorded in these logbooks from the time each individual is assigned to the project until the project is completed. The auditor will review field notebooks for adherence to these procedures.

C8.1.4 Sampling Operations

The auditor will review sampling operations to determine whether they are performed as stated in the SAP or as directed by the Site Manager. The auditor will determine that the proper number of samples were collected at the assigned locations and that the samples were placed in proper containers and properly preserved. The auditor will also determine whether the required field measurements and QA checks have been performed and documented.

C8.2 Laboratory Audits

Laboratory audits may be performed by USEPA Region II (external audits) or HLA (internal audits) at their discretion. Laboratory audits are performed to verify continuity of personnel, instrumentation and QC requirements. A laboratory audit typically consist of random data audits and review of continuous trend analysis of laboratory QC data.

The internal audits of the subcontractor laboratory will be conducted by the HLA QA Manager or designated representative. The laboratory system audits will include the examination of laboratory documentation on sample receipt, sample log-in, sample storage, chain-of-custody procedures, sample preparation, sample analysis and instrument operating records.

As part of the laboratory audit procedures, provisions may be made to provide USEPA or other regulatory agencies split or duplicate samples collected by HLA field representatives upon request by USEPA. USEPA will provide HLA with such requests at least 3 work days in advance of the day that the samples are to be collected. Procedures for collecting split or duplicate samples are set forth in the SAP.

C8.3 Document Control

The document control audit will consist of checking each document for accountability. Documents used for field activities will be checked against the list of field documents issued to the Site Manager or designated representative. Written explanations will be provided for any unaccounted documents.

The documents will be examined to determine whether required items such as signatures, dates and project codes are included. The auditor will examine controlled documents and will evaluate whether they have been handled and stored in the proper manner.

After a project has been completed, the individual files will be either assembled, organized and securely stored or returned to the client.

C9.0 PREVENTIVE MAINTENANCE PROCEDURES AND SCHEDULES

Preventive maintenance will be performed on both field equipment and laboratory instruments.

C9.1 Field Equipment

The field equipment includes thermometers, pH meters, conductivity meters, water level meters, pumps and air sampling equipment. Specific preventative maintenance procedures are those recommended by the manufacturer.

Field instruments will be checked before they are brought to the site. These instruments will be checked and calibrated daily before use. Calibration checks will be performed regularly and will be documented in the field logbooks.

Critical spare parts such as tape, pH probes, electrodes and batteries will be kept onsite to minimize instrument downtime. Backup instruments and equipment should be available onsite or within one-day shipment to avoid delays in the field schedule.

Each piece of equipment used for field activities will be maintained to specifications recommended by the manufacturer. The Site Manager will be responsible for performing routine maintenance and will have tools and spare parts available to conduct routine maintenance. Repairs that cannot be performed by the Site Manager will be performed by a person certified or trained to repair the instrument. Procedures set forth in the QAPP for maintaining instruments are consistent with manufacturers' operations manuals. Instruments will be calibrated to proper specifications following maintenance to ensure proper completion of the maintenance procedure.

A record of maintenance, including a description of specific activities performed, will be made in the field logbook. Data recorded in the logbook will be similar to the data recorded for calibration.

If the equipment or instrument cannot be maintained to the manufacturer's specifications or if it cannot be properly calibrated, it will be returned to the manufacturer or other repair facility for proper maintenance and repair. When it is returned from the manufacturer, the instrument will be checked for compliance to project specifications before being returned to routine field use.

C9.2 Laboratory Instruments

As part of their QA/QC program, a routine preventative maintenance program will be conducted by the laboratory to minimize the occurrence of instrument failure and other system malfunctions. Laboratory instruments will be maintained in accordance with manufacturer's specifications and the requirements of the specific method employed. This maintenance is performed on a regular, scheduled basis and is documented in the laboratory instrument service logbook for each instrument. Emergency repair or scheduled manufacturer's maintenance is provided under a repair and maintenance contract with factory representatives.

C10.0 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES FOR DATA ASSESSMENT

This section summarizes QA/QC procedures for assessing the quality of the field and chemical data generated and the format for presenting the results of the QA/QC evaluations in the appropriate progress reports.

C10.1 Procedures for Assessing Field Data Precision and Accuracy

The precision and accuracy of the field data measurements will be assessed by the HLA QA Manager or designated representative. The field measurements will be reviewed for compliance with the QC criteria outlined in the SAP. The precision of the field measurements will be assessed by checking the results of duplicate instrument readings for a single sample. Field measurement accuracy will be assessed by reviewing daily instrument calibrations, calibration checks and blank sample analyses. Field measurement completeness will be calculated as follows:

$$C(\%) = \frac{V}{T} \times 100\%$$

where:

C = Completeness of field measurements in percent
V = Amount of valid data obtained
T = Amount of valid data expected to be obtained under normal conditions

C10.2 Procedures for Assessing Laboratory Data Precision, Accuracy, Completeness, Representativeness and Comparability

Chemical data will be assessed for precision, accuracy and completeness for both the laboratory analytical program and field sample collection activities. The primary goal of the program is to ensure that the data generated are consistent with the DQOs presented in Section C2.0. To meet this goal, a combination of quantitative procedures and qualitative evaluations will be used to check the data quality. However, the quantitative procedure results will not be used to eliminate data from the database. A quantitative assessment of precision, accuracy and completeness along with a qualitative assessment of representativeness will be documented in progress reports. The goals of this assessment will be (1) to establish site-specific PARCC parameters, (2) to use these parameters to develop a database with known limitations of data usability and (3) to evaluate these limitations in achieving the program-intended data uses.

The QA/QC assessment program will evaluate data on the basis of the types of project and laboratory QC check samples described in Section C1.0. External QC samples used to quantitatively and qualitatively evaluate the accuracy of liquid sample analyses will not be applied to evaluate the accuracy of soil samples because of the inherent differences in the sampling and analytical protocols.

Because the QA/QC samples are generated for analysis both in the field and internally by the laboratories, a system of cross-checking has been established that provides independent evaluations of the chemical data on project and laboratory levels. This system of cross-checking is described under

validation procedures in Section C7.1 of this document. Completeness will be assessed before preparing each appropriate report.

The procedures for evaluating both the project and laboratory QA/QC data are the same and are presented below for QA/QC duplicate (co-located or replicate), blank and matrix spike samples.

C10.2.1 Precision Evaluation

Precision for sample data will be calculated by evaluating data from duplicate and matrix spike QC samples. Procedures for calculating precision are described below.

C10.2.1.1 Duplicate Samples

The procedure for assessing field and laboratory duplicate samples follows:

Tabulate duplicate data and calculate the relative percent difference (RPD) as shown below for each duplicate pair:

$$RPD(\%) = \frac{[X1 - X2]}{(X1 + X2)/2} \times 100$$

where:

X1 = duplicate sample 1 concentration
X2 = duplicate sample 2 concentration

C10.2.1.2 Matrix Spike Samples

The procedure for assessing and tabulating matrix spike sample data and calculating the spiked sample recovery (SSR) percent for each sample is shown below:

$$SSR(\%) = \frac{[T - X]}{A} \times 100$$

where:

T = Total concentration in spiked sample
X = Original concentration in sample before spiking
A = Actual spike concentration added to sample

C10.2.2 Accuracy Evaluation

Accuracy for sample data will be calculated by evaluating data from blanks and matrix spike QC samples. Procedures for calculating accuracy are described below for each QC sample type.

C10.2.2.1 Blank Samples

The blank evaluation procedure is a qualitative review of the chemical analysis data reported by the laboratories. The procedure for assessing blank samples follows:

1. Tabulate the blank sample data.
2. Identify any blank samples exhibiting detectable concentrations of target analytes in the sample.
3. If no target analytes are detected in any blank samples, the tables are ready for entry into the appropriate report.
4. If any chemicals are detected in blank samples, the compound(s) and concentration(s) will be reported and the field data for that period of time will be assessed for potential problems with data interpretation. No data will be removed from the database on the basis of target analytes being detected in blank samples. Appropriate notations, however, will be made in the database reports.
5. Chemicals detected in blank samples will be flagged with the appropriate notation as described in USEPA's Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses (USEPA, 1988b) and Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses (USEPA, 1988c).

C10.2.2.2 Matrix Spike Samples

The procedure for assessing and tabulating matrix spike sample data and calculating the SSR percent for each sample is shown below:

$$SSR(\%) = \frac{[T - X]}{A} \times 100$$

where:

T = Total concentration in spiked sample
X = Original concentration in sample before spiking
A = Actual spike concentration added to sample

C10.2.3 Representativeness Evaluation

Representativeness will be assessed by the analysis and interpretation of the results of an appropriately defined number of internal (laboratory) and external (field) QC samples. Precision and accuracy information developed from the evaluation of QC samples will be used to evaluate representativeness qualitatively.

C10.2.4 Completeness Evaluation

The completeness of the data represents the amount of validated data obtained from the field programs versus the amount of data expected under normal conditions. Overall completeness for the sample data collected will be calculated according to the following equation:

$$C(\%) = \frac{V}{T} \times 100\%$$

where:

C	=	Completeness of analytical effort in percent
V	=	Amount of valid data obtained
T	=	Amount of valid data expected to be obtained under normal conditions

Completeness will be based on validation as described in Section C7.0 of this QAPP.

C10.2.5 Comparability Evaluation

The comparability evaluation will include a qualitative assessment of analytical techniques. The comparability evaluation will include rounds of analytical results previously collected by other parties, as available.

The comparability of the analytical techniques will be assessed by referencing the analytical data reports submitted by the laboratory. Specific items to be evaluated include analytical method equivalency, detection limits, reporting units, equivalent laboratory facilities and personnel and laboratory QA procedures. The comparability evaluation will be included in the report.

C10.2.6 Sensitivity Evaluation

The achievement of the method detection limits depends on instrument sensitivity and possible matrix effects. Therefore, it is important to monitor instrument sensitivity by regular instrument checks. Instrument sensitivity will be monitored by analyzing method blanks and calibration check samples (organic and inorganic analyses) and laboratory control samples (inorganic analyses).

C11.0 CORRECTIVE ACTION PROCEDURES

This section describes the field and laboratory corrective action procedures. It also addresses (1) predetermined limits for data acceptability beyond which corrective action is required, (2) project personnel responsible for initiating the corrective action and (3) individuals responsible for approving corrective action, if necessary.

C11.1 Field Situations

The need for corrective action will be identified as a result of the field audits previously described. If problems become apparent that are identified as originating in the field, immediate corrective action will take place. If the sampling methodology needs to be modified to complete a task successfully, the modification will be documented in the log book. If immediate corrective action does not resolve the problem, appropriate personnel will be assigned to investigate and evaluate the cause of the problem. When a corrective action is implemented, the effectiveness of the action will be verified such that the end result is elimination of the problem. Field nonconformances and subsequent corrective action will be documented on the form provided in Appendix CC, noted in the field logbook and reported to the Project Manager. Copies of the forms will be included in reports and kept onsite for reference purposes.

C11.2 Laboratory Situations

The laboratories participating in the CLP are required to have a written SOPs specifying corrective actions to be taken when an analytical error is discovered or the analytical system is determined to be out of control. The SOP requires documentation of the correction action and notification to the analyst of the error and correction procedures.

The need for corrective action resulting from QA audits or HLA validation activities will be initiated by the Laboratory QA Officer in consultation with HLA's QA Manager. Corrective actions may include, but are not limited to:

- Re-analyzing the samples, if holding time criteria permit.
- Evaluating and amending sampling and analytical procedures.
- Accepting data with an acknowledged level of uncertainty.
- Re-sampling and analyzing, if the completeness of the data set or intended use of the data is recognized during a preliminary review to be insufficient to meet program DQOs.

If the above corrective actions are deemed unacceptable, a backup laboratory will be selected to perform necessary or appropriate verification analyses.

C11.3 Immediate Corrective Action

Any laboratory or field equipment malfunctions will require immediate corrective actions. The laboratory QC charts are working tools that identify appropriate immediate corrective actions to be taken when a control limit has been exceeded. They provide the framework for uniform actions as part of normal operating procedures. The actions taken should be noted in field or laboratory logbooks, but no other formal documentation is required unless further corrective action is necessary.

These on-the-spot corrective actions will be applied daily, as necessary. A detailed description of method-specific laboratory corrective action limits is provided in the appropriate CLP SOW. Any deviation from the prescribed CLP corrective action protocols or control limits must be approved in writing by HLA's QA Manager. Exceedance of control limits specified in CLP SOWs or appropriate method-specific SOPs will trigger corrective actions. The exceedances and corrective actions will be reported to the Laboratory QA Officer.

C11.4 Long-Term Corrective Action

The need for long-term corrective action may be identified by standard QC procedures, control charts and/or field or laboratory audits. Any procedural or data quality problem that cannot be solved by immediate corrective action falls into the long-term category. The essential steps in a corrective action system follow:

- Identification and definition of the problem
- Investigation and determination of the cause of the problem
- Determination and implementation of a corrective action to eliminate the problem
- Verification that the corrective action has eliminated the problem

Documentation of the problem is important in corrective action. The responsible person may be an analyst, Site Manager, Laboratory QA Officer, sampler, HLA's QA Manager or the Project Manager. In general, the respective QA Manager will investigate the situation and determine who will be responsible for implementing the corrective action. HLA's QA Manager will verify that the corrective action has been taken, appears effective and, at appropriate later dates, verify that the problem has been resolved.

The required corrective action will be documented by the HLA's QA Manager and the Site Manager for field activities. The corrective action will be discussed with the Project Manager, Island Chemical Company and USEPA before implementation.

Any changes proposed for amending sampling and analytical procedures will be approved by USEPA before implementation. These changes will be documented in progress reports and addenda to this QAPP.

C12.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Copies of analytical results from samples analyzed will be submitted to HLA's Project Manager and provided to the USEPA Remedial Project Manager following QA/QC review, in the progress reports and in report deliverables. The results will include a tabulation of the analytical data and an explanation of any field conditions or laboratory QA/QC problems and their possible effects on data quality. The monthly progress reports will also include the results of periodic assessment of measurement data accuracy and precision or proposed changes to the QAPP. Results of field audits and laboratory audits will also be included, as appropriate. Corrective actions will be recommended if QA problems are identified during the review of data quality or results of field or laboratory audits.

HLA's QA Manager or designated representative will review aspects of the implementation of this QAPP on a monthly basis, as necessary and submit a summary report to HLA's Project Manager for inclusion in the progress reports. These results will include an assessment of data quality and results of laboratory and/or field audits, as appropriate. If significant QA problems are identified as a result of these assessments and audits, corrective actions will be recommended and included in the progress reports.

C13.0 ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or relevent and appropriate requirement
CLP	Contract Laboratory Program
DQO	Data quality objective
SAP	Sampling and Analysis Plan
GC/MS	Gas chromatography/mass spectrometry
HLA	Harding Lawson Associates
ICP	Inductively coupled plasma
LCS	Laboratory Control Sample
MRL	Method Reporting Limit
NBS	National Bureau of Standards
PARCC	Precision, accuracy, representativeness, completeness and comparability
PID	Photoionization detector
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QAU	Quality assurance unit
QC	Quality control
RPD	Relative percent difference
SAMLCWOA	Superfund Analytical Method-Low Concentration Waters for Organic Analyses, Rev. 10/92
SDG	Sample delivery group
Site	Island Chemical Company, St. Croix, U.S. Virgin Islands
SOP	Standard Operating Procedures
SOW	Statement of Work
SSP	Site Safety Plan
SSR	Spiked sample recovery
SVO	Semi-volatile organic compound
TAL	Target Analyte List
TCL	Target Compound List
TIC	Tentatively identified compound
USEPA	U.S. Environmental Protection Agency
VOC	Volatile organic compound

C14.0 BIBLIOGRAPHY

Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA): Public Law 96-510, 42 USC 9601 et.seq.

Superfund Amendments and Reauthorization Act of 1986 (SARA): Public Law 99-499.

U.S. Environmental Protection Agency, 1981, *Process Design Manual for Land Treatment of Municipal Wastewater*

U.S. Environmental Protection Agency, 1983, *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans: QAMS-005/80; Office of Monitoring Systems and Quality Assurance, ORD, Washington, D.C.*, February.

U.S. Environmental Protection Agency, 1984, *Guidelines Establishing Test Procedures for the Analysis - Final Rule and Proposed Rule, 40 CFR Part 136*, October.

U.S. Environmental Protection Agency, 1986, *National Enforcement Investigations Center Policies and Procedures Manual.*

U.S. Environmental Protection Agency, 1986a, *Data Quality Objectives for Remedial Response Activities*, March.

U.S. Environmental Protection Agency, 1986b, *Draft Supplement to Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans: QAMS-005/80, Office of Monitoring Systems and Quality Assurance, ORD, Washington, D.C.*, December.

U.S. Environmental Protection Agency, 1986c, *Test Methods for Evaluating Solid Waste: Office of Solid Waste and Emergency Response (OSWER) Directive SW-846, Vol. 1B.*

U.S. Environmental Protection Agency, 1986d, *User's Guide to the Contract Laboratory Program: Office of Emergency and Remedial Response, Sample Management Office*, December.

U.S. Environmental Protection Agency, 1988a, *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Atmospheric Research and Exposure Assessment Laboratory*, June.

U.S. Environmental Protection Agency, 1988b, *Laboratory Data Validation - Functional Guidelines for Evaluating Inorganics Analyses, Hazardous Site Evaluation Division*, July.

U.S. Environmental Protection Agency, 1988c, *Laboratory Data Validation - Functional Guidelines for Evaluating Organics Analyses: TDD Doc. No. HQ-8401-01, Hazardous Site Evaluation Division*, February.

U.S. Environmental Protection Agency, 1989, *Region II CERCLA Quality Assurance Manual, Revision I.*

U.S. Environmental Protection Agency, 1989, *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A, Interim Final, Office of Emergency and Remedial Response*, December.

U.S. Environmental Protection Agency, 1990a, *Contract Laboratory Program Statement of Work for Inorganic Analysis, ILM01.0*, March.

U.S. Environmental Protection Agency, 1990b, *Contract Laboratory Program Statement of Work for Organic Analysis - Multi-Media Multi-Concentration, OLM01.0*, April.

U.S. Environmental Protection Agency, 1990c, *Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions; Final Rule, 40 CFR Part 261*, Thursday, March 29.

U.S. Environmental Protection Agency, 1991b, *Contract Laboratory Program Statement of Work for Low Concentration Organic Analysis*, June.

U.S. Environmental Protection Agency, 1991c, *Model Quality Assurance Project Plan: Office of Superfund, Region V*, May.

U.S. Environmental Protection Agency, 1992, *Region II SOP #W-2 Evaluation of Metals Data for the CLP* Revision II, January.

U.S. Environmental Protection Agency, 1992, *Region II SOP HW-6, CLP Organic Data Review and Preliminary Review, Revision 8*, January.

U.S. Environmental Protection Agency, 1993, *Data Quality Objectives for Superfund, Interim Final Guidance: USEPA/540-R-93/071, Office of Emergency and Remedial Response, Washington, D.C.*

Appendic CA
Results of ETC Semi-Volatile Organic Compound Detection Limit Study

GULF SOUTH ENVIRONMENTAL LABORATORY INCORPORATED

METHOD DETECTION LIMITS

MATRIX: WATER

LIST. B 01/11/93

ANALYST: JS

COMPOUND NAME	MDL
N-NITROSODIMETHYLAMINE	2.33
BIS(2 CHLOROETHYL)ETHE	2.11
2-CHLOROPHENOL	1.91
PHENOL*	2.62
1,3-DICHLOROBENZENE	2.89
1,4DICHLOROBENZENE*	2.97
1,2-DICHLOROBENZENE	2.87
BIS(2-CHLOROISOPROPYL)	2.77
HEXACHLOROETHANE	2.86
NITROSOPROPYLAMINE**	1.50
NITROBENZENE	2.53
ISOPHORONE	2.00
2-NITROPHENOL*	1.78
2,4-DIMETHYLPHENOL	3.09
BIS(2-CHLOROETHOXY)METH	2.36
2,4-DICHLOROPHENOL*	1.52
1,2,4-TRICHLOROBENZENE	2.32
NAPHTHALENE	2.17
CLASSTADIENE*	3.11
4CHLORO3METHYLPHENOL*	1.29
* CLASCYCLOPENTADIENE**	8.90
246TRICHLOROPHENOL*	3.21
2-CHLORONAPHTHALENE	1.88
ACENAPHTHYLENE	1.83
* DIMETHYL PHTHALATE	1.72
2,6-DINITROTOLUENE	1.53
ACENAPHTHENE*	1.43
24DINITROPHENOL**	3.40
2,4-DINITROTOLUENE	0.76
4NITROPHENOL**	4.04
FLUORENE	1.53
4-CHLOROPHENYL PHENYL	1.43
* DIETHYL PHTHALATE	1.66
4,6-DINITRO-2-METHYLPH	2.86
DIPHENYLAMINE*	2.15
1,2-DIPHENYLHYDRAZINE	1.12

COMPOUND NAME	MDL
4-BROMOPHENYL PHENYL E	0.98
HEXACHLOROBENZENE	1.44
PENTACHLOROPHENOL*	2.22
PHENANTHRENE	1.56
ANTHRACENE	1.03
DI-N-BUTYL PHTHALATE	3.56
FLUORANTHENE*	2.05
PYRENE	1.61
BUTYL BENZYL PHTHALATE	3.38
BENZO(A)ANTHRACENE	1.27
CHRYSENE	1.22
3,3'-DICHLOROBENZIDINE	2.04
α BIS(2-ETHYLHEXYL)PHTHA	18.63
DI-N-OCTYLPHTHALATE*	1.93
BENZO(B)FLUORANTHENE	2.97
BENZO(K)FLUORANTHENE	4.01
BENZO(A)PYRENE*	1.23
INDENO(1,2,3-CD)PYRENE	1.55
DIBENZO(A,H)ANTHRACENE	0.90
BENZO(G,H,I)PERYLENE	1.46
ANILINE	3.78
BENZOIC ACID	9.15
BENZYL ALCOHOL	2.32
4-CHLOROANILINE	5.83
DIBENZOFURAN	1.05
2-METHYLNAPHTHALENE	2.04
2-METHYLPHENOL	1.51
4-METHYLPHENOL	2.18
4-NITROANILINE	4.55
3-NITROANILINE	6.88
2-NITROANILINE	2.46
2,4,5-TRICHLOROPHENOL	2.52
CARBAZOLE	4.05
PYRIDINE	3.44
2,3,4,6-TETRACHLOROPHE	1.44

Chromatographic Conditions: 0.32MM x 30M RTX 1.00M 45/4-310@15.

The above compounds were spiked at 20ug/L.

ND = not determined

All recoveries were between 40 and 160, except * compounds; these are scheduled for repeat.

** Bis (2-ethylhexyl) phthalate is also scheduled for repeat.

302112

GULF SOUTH ENVIRONMENTAL LABORATORY INCORPORATED
METHOD DETECTION LIMITS
MATRIX: WATER

INST. B 01/11/93
ANALYST:

COMPOUND NAME	C	D	I	G	H	I	J	MEAN	STD.DEV	REC	MDL
N-NITROSODIMETHYLAMINE	14.27	15.51	14.97	15.84	16.81	16.41	16.65	15.78	0.9327	79%	2.93
BIS(2 CHLOROETHYL)ETHE	16.76	18.27	17.81	17.53	18.08	18.34	18.86	17.95	0.6725	90%	2.11
2-CHLOROPHENOL	17.17	18.05	17.26	17.39	17.63	18.62	18.58	17.81	0.6086	89%	1.91
PHENOL*	16.78	18.27	17.85	17.84	18.58	18.68	19.43	18.20	0.8347	91%	2.62
1,3-DICHLOROBENZENE	12.22	14.11	14.22	13.41	12.64	12.79	14.65	13.43	0.9203	67%	2.89
14DICHLOROBENZENE*	12.80	14.65	14.59	13.68	13.73	12.84	15.29	13.94	0.9461	70%	2.97
1,2-DICHLOROBENZENE	14.04	15.32	15.57	14.86	14.73	14.58	16.87	15.14	0.9121	76%	2.87
BIS(2-CHLOROISOPROPYL)	17.05	18.19	18.02	17.74	18.67	18.94	19.77	18.34	0.8819	92%	2.77
HEXACHLOROETHANE	8.84	11.34	10.17	9.73	9.45	8.69	10.22	9.78	0.9098	49%	2.86
NITROSOPROPYLAMINE**	16.02	15.72	15.37	15.85	16.75	16.34	16.48	16.08	0.4784	80%	1.50
NITROBENZENE	16.91	18.96	18.09	17.59	18.78	19.01	18.78	18.30	0.8044	92%	2.53
ISOPHORONE	18.05	18.90	18.45	18.28	19.54	19.84	19.31	18.88	0.6368	94%	2.00
2-NITROPHENOL*	16.87	17.50	15.84	16.13	16.04	16.75	17.04	16.62	0.5676	83%	1.78
2,4-DIMETHYLPHENOL	11.19	12.13	10.94	15.85	18.12	13.12	18.12	15.07	2.8931	75%	9.09
BIS(2-CHLOROETHOXY)METH	17.65	19.42	18.63	17.69	18.98	19.21	19.33	18.70	0.7503	93%	2.36
2,4-DICHLOROPHENOL*	16.44	17.57	17.51	16.83	17.68	17.73	17.35	17.30	0.4838	86%	1.52
1,2,4-TRICHLOROBENZENE	14.23	15.41	15.17	15.08	15.29	15.07	16.45	15.39	0.7396	77%	2.32
NAPHTHALENE	16.30	17.48	17.14	16.81	17.77	17.89	18.32	17.39	0.6905	87%	2.17
CLOBUTADIENE*	8.71	10.23	8.23	8.19	7.78	7.02	8.05	8.31	0.9885	42%	3.11
4CHLOROMETHYLPHENOL*	17.48	17.66	18.13	17.99	18.64	18.47	18.01	18.05	0.4114	90%	1.29
CLSCYCLOPENTADIENE**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	0%	0.00
246TRICHLOROPHENOL*	18.88	19.97	18.59	19.77	21.35	20.52	20.93	20.00	1.0218	100%	3.21
2-CHLORONAPHTHALENE	17.47	18.53	17.39	17.42	18.60	17.98	18.31	17.96	0.5339	90%	1.68
ACENAPHTHYLENE	17.68	18.25	17.73	17.52	18.37	18.25	18.10	18.00	0.3286	90%	1.03
DIMETHYL PHTHALATE	3.20	4.21	2.56	2.87	3.01	2.63	3.03	3.07	0.5486	15%	1.72
2,6-DINITROTOLUENE	18.00	18.74	18.03	18.27	19.10	19.04	18.05	18.46	0.4874	92%	1.53
ACENAPTHENE*	18.11	18.80	18.35	17.95	19.20	18.62	18.95	18.57	0.4558	93%	1.43
24DINITROPHENOL**	17.85	19.82	19.23	19.17	16.97	17.94	19.70	18.67	1.0823	93%	3.40
2,4-DINITROTOLUENE	19.18	19.30	19.02	18.63	19.02	19.12	18.73	19.00	0.2404	95%	0.76
4NITROPHENOL**	20.43	18.85	16.52	18.23	19.93	18.11	18.39	18.64	1.2867	93%	4.04
FLUORENE	18.26	18.78	18.36	18.31	19.33	19.53	18.78	18.77	0.5065	94%	1.59
4-CHLOROPHENYL PHENYL	17.91	19.03	18.27	18.03	18.89	18.90	18.30	18.48	0.4557	92%	1.43
DIETHYL PHTHALATE	3.91	4.93	3.31	3.87	4.02	3.39	3.96	3.91	0.5296	20%	1.66
4,6-DINITRO-2-METHYLPH	18.30	19.57	20.17	18.99	19.69	20.51	20.97	19.74	0.9098	99%	2.86
DIPHENYLAMINE*	16.72	16.54	16.62	17.27	17.97	17.88	18.10	17.30	0.6833	86%	2.15
1,2-DIPHENYLHYDRAZINE	19.45	19.48	19.16	18.90	19.58	19.56	20.04	19.45	0.3555	97%	1.12
4-BROMOPHENYL PHENYL E	19.00	18.89	18.19	18.64	18.94	18.40	18.92	18.71	0.3113	94%	0.98
HEXACHLOROBENZENE	18.28	19.19	18.76	18.29	19.22	19.33	19.23	18.90	0.4595	95%	1.44
PENTACHLOROPHENOL*	18.76	19.65	20.05	19.09	18.94	19.65	20.78	19.56	0.7048	98%	2.22
PHENANTHRENE	19.26	19.40	19.20	18.85	19.76	20.06	20.23	19.53	0.4951	98%	1.56
ANTHRACENE	18.28	18.38	18.11	17.62	18.38	18.64	18.44	18.26	0.3269	91%	1.03

302113

GULF SOUTH ENVIRONMENTAL LABORATORY INCORPORATED
METHOD DETECTION LIMITS
MATRIX: WATER

INST. B 01/11/93
ANALYST: J

COMPOUND NAME	C	D	F	G	H	I	J	MEAN	STD.DEV	REC	MDL
DI-N-BUTYL PHTHALATE	12.13	11.19	9.21	11.17	12.07	12.12	12.56	11.49	1.1328	57%	3.56
FLUORANTHENE*	19.46	19.43	18.99	18.78	19.58	19.37	20.82	19.49	0.6528	97%	2.05
PYRENE	18.83	19.36	18.53	18.72	19.96	19.56	18.76	19.12	0.5119	96%	1.61
BUTYL BENZYL PHTHALATE	14.80	14.17	12.43	14.14	15.29	15.35	15.49	14.52	1.0754	73%	3.38
BENZO(A)ANTHRACENE	19.71	19.37	18.91	18.79	19.89	19.59	19.32	19.37	0.4043	97%	1.27
CHRYSENE	18.48	19.35	18.91	18.42	19.19	19.34	19.10	18.97	0.3869	95%	1.22
3,3'-DICHLOROBENZIDINE	15.93	15.48	15.71	15.18	17.04	15.20	15.33	15.69	0.6505	78%	2.04
BIS(2-ETHYLHEXYL)PHTHA	24.78	24.90	23.16	31.84	27.82	24.24	39.77	28.07	5.9281	140%	18.63
DI-N-OCTYLPHTHALATE*	19.01	19.49	19.70	19.19	20.42	20.41	20.42	19.81	0.6125	99%	1.93
BENZO(B)FLUORANTHENE	19.46	20.27	19.47	17.34	19.13	18.65	18.33	18.95	0.9450	95%	2.97
BENZO(K)FLUORANTHENE	18.52	18.80	18.52	19.62	20.57	21.53	21.49	19.92	1.2752	100%	4.01
BENZO(A)PYRENE*	17.54	17.74	17.26	17.21	17.95	18.20	18.09	17.71	0.3912	89%	1.23
INDENO(1,2,3-CD)PYRENE	18.44	18.65	17.99	17.52	18.31	18.45	19.08	18.35	0.4927	92%	1.55
DIBENZO(A,H)ANTHRACENE	18.62	18.72	18.53	18.16	18.59	18.93	18.93	18.66	0.2863	93%	0.90
BENZO(G,H,I)PERYLENE	18.53	18.83	18.75	18.16	18.63	19.40	19.45	18.82	0.4646	94%	1.46
ANILINE	14.97	17.00	17.65	17.10	18.66	17.65	18.30	17.33	1.2012	87%	3.78
BENZOIC ACID	15.85	16.45	12.58	15.72	8.75	17.15	14.60	14.44	2.9101	72%	9.15
BENZYL ALCOHOL	18.92	20.42	21.21	18.72	20.11	19.48	20.37	20.03	0.7394	100%	2.32
4-CHLOROANILINE	25.28	28.02	25.21	26.23	30.15	27.88	28.68	27.78	1.5992	139%	5.03
DIBENZOFURAN	18.31	18.73	18.35	18.14	18.99	18.87	18.73	18.60	0.3340	93%	1.05
2-METHYLNAPHTHALENE	16.30	17.57	17.07	16.54	17.65	17.33	18.15	17.23	0.6477	86%	2.04
2-METHYLPHENOL	16.90	18.06	17.44	17.37	17.85	18.06	18.24	17.70	0.4793	89%	1.51
4-METHYLPHENOL	15.94	17.54	16.36	16.98	17.24	16.80	18.19	17.08	0.6947	85%	2.18
4-NITROANILINE	19.42	20.24	22.28	19.99	22.94	21.08	22.89	21.26	1.4488	106%	4.55
3-NITROANILINE	17.90	22.90	20.54	22.23	24.88	22.59	21.11	21.74	2.1891	109%	6.88
2-NITROANILINE	18.40	19.23	18.59	17.68	19.72	19.89	19.36	19.00	0.7821	95%	2.46
2,4,5-TRICHLOROPHENOL	17.84	18.76	17.59	16.85	16.75	18.41	16.88	17.58	0.8024	88%	2.52
CARBAZOLE	21.01	20.52	20.92	20.01	23.57	21.56	22.89	21.50	1.2885	107%	4.05
PYRIDINE	11.23	14.05	13.26	13.49	14.60	13.73	14.13	13.51	1.0945	68%	3.44
2,3,4,6-TETRACHLOROPHE	17.93	18.45	17.93	17.66	18.88	18.77	18.26	18.27	0.4588	91%	1.44

Chromatographic Conditions: 0.32MM x 30M RTX 1.0UM 45/4-310@15.

The above compounds were spiked at 20ug/L.

ND = not determined

The above columns represent analyses SVLLS03C,D,F,G,H,I and J.

302114

Appendic CB
Resumes of Key Quality Assurance/Quality Control Personnel

James L. Collins

Staff Geologist

Mr. Collins has four years experience in supervising field activities, such as monitoring well and soil boring installation; soil, groundwater, surface water, sediment and waste classification sample collection; and UST and soil excavation/removal, as part of CERCLA (Superfund) remedial investigations/feasibility studies (RI/FS), ECRA compliance projects and environmental site assessments. He has served in the capacity of staff geologist in soils and groundwater investigations and environmental site assessments. He has experience in sample collection from a wide variety of media, including soil, groundwater, surface water and sediment, and has supervised drilling, excavation and down-hole geophysics operations.

He has completed and/or assisted other HLA professionals in performing additional activities related to RI/FS, ECRA Compliance projects and environmental site assessments including report preparation, delineation of soil and groundwater contamination, evaluation of groundwater flow direction, permeability testing, regulatory file reviews, aerial photo surveys, site walk throughs, and drainage system evaluations.

Education

B.S., Geology, LaSalle University, 1981

Training

Health and Safety Training: Hazardous Waste Operations, OSHA 29 CFR 1910.120
Delineation of Wetlands Short Course: Rutgers University

Employment History

1990 - Present:	Harding Lawson Associates
1981- 1990:	Non-environmental Employer

Representative Projects

Environmental Audits

Phase I Environmental Site Assessments - Project manager for numerous ESAs of commercial and industrial properties ranging from vacant lots to complex multi-site industrial facilities. Projects addressed issues such as underground storage tanks (USTs), hazardous waste generation, storage and disposal, RCRA and New Jersey ECRA compliance issues, asbestos, lead-based paint, and development of unit costs for environmental liabilities. Clients: banks, attorneys, property developers, manufacturing and industrial facilities.

Phase II and III Environmental Site Assessments - Project manager for a wide variety of projects including design and implementation of various investigation and remediation programs, negotiation with and preparation of submittals to regulatory agencies, and acquisition of negative declarations. Field activities included supervision of monitoring well installations; soil, groundwater, and hazardous waste sampling; test pits and soil removal programs; and UST closures.

Cable Manufacturer, Passaic, New Jersey - Supervised facility decommissioning and decontamination activities and assisted in implementation of an investigation to evaluate the extent of soil and groundwater contamination by petroleum products and metals. Work included supervision of remedial subcontractors, soil and groundwater sampling, stream sediment sampling, delineation of light, non-aqueous phase liquids (LNAPL) and utilization of dye tracers to investigate discharge points of facility drainage structures.

Remedial Investigations/Feasibility Studies/Remedial Actions

CERCLA (Superfund) Sites - Responsible for implementing several phases of soil and groundwater contamination studies at sites contaminated with volatile organics, solvents, petroleum products, polychlorinated biphenyls (PCBs), pesticides, and heavy metals. Supervised and assisted with the interpretation of downhole geophysical investigations in order to correlate data used for defining complex lithologies within contaminated aquifers.

Commercial Property, Nashville, Tennessee - Supervised investigation of methane soil gas survey to evaluate potential impacts to property from neighboring abandoned landfill. Conducted a test pit program to locate and evaluate non-soil fill materials present on the property. Investigated the property for the absence or presence of wetlands.

Memberships

Philadelphia Geological Society

John J. Kohler
Staff Industrial Hygienist

Experience

Mr. Kohler has over five years of experience conducting industrial hygiene surveys, health and safety audits, environmental site assessments, air monitoring for airborne chemicals and dusts, stack testing, and indoor air quality surveys. Other experience includes asbestos project management, health and safety officer on hazardous waste sites, and worker exposure monitoring. Mr. Kohler is also responsible for developing hazard communication programs; writing preparedness, prevention, and contingency (PPC) plans; preparing health and safety plans; developing operations and maintenance (O&M) programs for industrial clients; and, preparing final reports.

Mr. Kohler is presently the Designated Health and Safety Officer for HLA's Northeast Regional Offices.

Registration and Certification

Self-study program for ABIH certification in the comprehensive practice of industrial hygiene
Health and Safety Training: Hazardous Waste Operations, OSHA 29 CFR 1910.120
Asbestos Project Inspector, City of Philadelphia
AHERA Contractor/Worker Supervisor
AHERA/Pennsylvania Building Inspector and Management Planner
New Jersey Certified Asbestos Safety Technician

Education

B.A., Geology, Miami University of Ohio, 1987

Representative Projects

Two chemical waste Superfund sites in southern New Jersey - Health and Safety Officer and Industrial Hygienist during site restoration and various drilling, water sampling, and soil sampling activities. Responsibilities included writing health and safety plans, overseeing HLA personnel and subcontractor personnel in health and safety matters, air monitoring to determine the presence of VOCs, and personal air monitoring to determine worker exposures.

Precious metal recycling facility, San Jose, California - Conducted industrial hygiene surveys and lead exposure monitoring. Responsible for extensive field operations on a quarterly basis, data collection and technical analysis, recommendation of options for remedial actions and engineering controls, and preparation of final reports.

Petroleum refinery, Rodeo, California - Extensive personal and environmental monitoring for various hydrocarbons and solvents at this Northern California oil refinery. Other responsibilities included technical and data evaluation, client negotiations, and preparing final reports.

Asbestos building inspection and management planning for schools in the Philadelphia, Pennsylvania and Patterson, New Jersey Archdiocese - Team leader during AHERA inspection and sampling for asbestos in various school buildings throughout ten counties in New Jersey and Pennsylvania. Prepared asbestos management plans to assist local education authorities in properly handling concerns associated with asbestos present in their buildings.

Several projects for the San Francisco Department of Public Health - Project oversight during asbestos abatement. Managed subcontractor for the client during all phases of asbestos abatement to ensure that stringent requirements of the QA program and all associated regulations were met. Conducted an air monitoring program to ensure that work practices and engineering controls were adequate.

Brian D. LaFlamme
Associate Geochemist

Experience

Mr. LaFlamme has six years of experience in geochemistry, including managing chemical data for several Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) investigations, interpreting isotopic data for the delineation of hydrogeologic units, and designing analytical programs for remedial investigations (RIs). Mr. LaFlamme is experienced in the interpretation of radionuclide data with respect to the mobility of radionuclides in the environment, and the data validation thereof.
Mr. LaFlamme is experienced in designing and writing quality assurance project plans (QAPPs) and sampling plans for a variety of projects.
Mr. LaFlamme has interacted with several regulatory agencies (including EPA) during evaluation of best available technologies for various media. He has also managed quarterly sampling of residential water-supply wells and the generation of a chemical evaluation and hydrogeological investigation reports. Mr. LaFlamme has assisted in evaluating emerging and innovative technologies to assess their potential use for either bench- or pilot- scale testing. He is experienced in the analysis of radionuclides in water samples and the analysis of metals by atomic absorption spectroscopy and colorimetry. Mr. LaFlamme has three years of experience in computer modeling and has written and modified software to interface microsystems with data acquisition units. He has managed complex sampling programs that required selection of appropriate analytical methods and the design, preparation, and utilization of various laboratory instrumentation.

Training

Occupational Safety and Health Administration (OSHA) and EPA 40-hour safety training course
The Use of the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) Installation Restoration Data Management System (IRDMS), seminar, Aberdeen, Maryland, April 1989
Analytical Laboratory Services: Solving the Mysteries, seminar, Chicago, Illinois, May 1989
Fundamentals, Applications, and Instrumentation of Gas Chromatography, seminar, Perkin-Elmer, March 1990
Physical/Chemical Treatment of Hazardous Waste, seminar by EPA, April 1990
2nd Forum on Innovative Hazardous Waste Treatment Technologies: Domestic and International, seminar by EPA, May 1990
Advanced RCRA Seminar, Monterey, California, May 1991
RCRA Seminar, Denver, Colorado, September 1992

Education

M.S., Chemical Oceanography, University of Washington, Seattle, 1985
B.S., Geology and Chemistry, Bridgewater State College, Bridgewater, Massachusetts, 1982

Representative Projects

Evaluation of Technologies

Lowry Landfill, Arapahoe County, Colorado - Interface with engineers on evaluation of technologies to treat radionuclides in waste-pit liquid and groundwater. Support for treatability studies. Client: The Lowry Coalition

Industrial solvents reclaiming site, Winnebago County, Illinois - Evaluation of best available technologies for contaminated soil/sludge material during EE/CA and RAAE reports. Interaction with EPA during revisions of reports. Client: Acme Solvents Technical Committee

Rocky Mountain Arsenal (RMA), Denver, Colorado - Assisted in evaluating emerging and innovative technologies to assess their potential use for either bench- or pilot-scale tests. Recommended technologies on the basis of guidelines established to evaluate treatment potential, merit, cost, and performance. Managed the generation of supporting documents for the demonstration of selected technologies. Documents include Technical Plan, Quality Control Plan, Health and Safety Plan, and Data Management Plan. Client: U.S. Department of the Army (Army)

Mercury cell room, Longview, Washington - Evaluated technologies and commercial products to stabilize free mercury. Work was conducted in support of cleanup activities in a mercury cell room used as part of a chloralkali process in the treatment of wood. Client: Confidential

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Investigations

Industrial solvents reclaiming site, Winnebago County, Illinois - Managed the development of a quality assurance project plan (QAPP) and a sampling plan (SP) for activities to be conducted under the remedial design/remedial action (RD/RA) phase. Client: Acme RD/RA Group

Industrial solvents reclaiming site, Winnebago County, Illinois - Managed the residential water-supply wells sampling program that included quarterly monitoring, preparing reports for EPA and interacting with residents. Client: Acme Solvents Technical Committee

Industrial solvents reclaiming site, Winnebago County, Illinois - Managed the revision of the EE/CA report to incorporate EPA comments. The EE/CA report included the evaluation of removal alternatives for contaminated soil and debris and costing of alternatives with the Cost of Remedial Action (CORA) model. Client: Acme Solvents Technical Committee

Industrial solvents reclaiming site, Winnebago County, Illinois - Managed the revision of the Remedial Action Alternatives Evaluation (RAAE) report to incorporate EPA comments. The RAAE report included the evaluation of remedial alternatives for contaminated soil, bedrock, and groundwater. Client: Acme Solvents Technical Committee

Industrial solvents reclaiming site, Winnebago County, Illinois - Managed the generation of a report that included chemical data assessment and hydrogeologic investigation. Client: Acme Solvents Technical Committee

Industrial solvents reclaiming site, Winnebago County, Illinois - Managed the chemical data for the supplemental RI of a National Priorities List (NPL) site. Management activities included organizing data collected from four different sources. Completed respective sections of the report for review by the client and the regulatory agency. Client: Acme Solvents Technical Committee

Lowry Landfill, Arapahoe County, Colorado - Evaluated the nature and extent of contamination of radionuclides in groundwater and waste-pit liquid (source medium). Assessed potential contribution of radionuclides from anthropogenic sources. Coordinated closely with analytical laboratory in the development of a preparatory step for the analyses of complex matrices. Client: The Lowry Coalition

Lowry Landfill, Arapahoe County, Colorado - Managed chemistry elements in support of an RI. Responsibilities included data validation of organics, metals, and radionuclides, database management, development of analytical programs, management of subcontractor laboratories, and evaluation of nature and extent of contamination. Client: The Lowry Coalition

RMA, Denver, Colorado - Managed the chemical data assessment for the annual surface-water monitoring report and generated appropriate sections of the report. Client: Army, c/o R.L. Stollar & Associates, Inc.

RMA, Denver, Colorado - Managed the inorganic data assessment for the annual groundwater monitoring report and generated appropriate sections of the report. Client: Army, c/o R.L. Stollar & Associates, Inc.

RMA, Denver, Colorado - Assisted in writing sections of the annual report for a groundwater monitoring project. Performed extensive computer work involving generating contaminant plume maps and manipulating data for interpretive effort. Performed the quality assurance/quality control of the inorganic data. Client: Army, c/o R.L. Stollar & Associates, Inc.

RMA, Denver, Colorado - Data manager for an RI/feasibility study (FS) project involving data tracking from collection to report writing. Processed laboratory data through the USATHAMA IRDMS program. Client: Army

Marshall/Boulder Landfill, Boulder, Colorado - Interacted with the laboratory to design an analytical program utilizing appropriate analytical methods for identifying volatile and semivolatile organic compounds, organochlorine, pesticides, polychloride biphenyls (PCBs), chlorinated herbicides, and inorganic parameters at a landfill site. Clients: City of Boulder and Landfill, Inc.

RMA, Denver, Colorado - Interpreted isotopic data collected from groundwater wells and wrote assessment reports on the results, including recommendations for future work. Client: Army, c/o R.L. Stollar & Associates, Inc.

Resource Conservation and Recovery Act Investigations

Materials handling facility, Denver, Colorado - Wrote the Corrective Measures Study Work Plan for activities to be conducted as part of corrective actions. Client: Confidential

Site Assessment

Lyon, France - Provided technical guidance and oversight during the investigation phase of a site assessment project that involved the collection of soil samples at two manufacturing facilities. Client: Confidential

Hazardous materials site assessment, Colorado - Provided oversight and technical assistance during the remediation phase of this site assessment project that involved underground storage tank (UST) systems. Also, generated reports for the client and the regulatory agency.
Client: Confidential

Agency Interaction

Industrial solvents reclaiming site, Winnebago County, Illinois - Assisted in negotiations with EPA for a remedial design/remedial action scope of work. Responsibilities included low-temperature thermal stripping, soil/bedrock vapor extraction, multi-media cap, and groundwater pump and treat.
Client: Acme Solvents Technical Committee

Previous Employment

Under a grant from the National Science Foundation, managed a sampling program to study sediments and interstitial water in the Mariana basin of the west Pacific Ocean. Project involved research scientists from five universities (including two international participants) in a multidisciplinary study of the Mariana Mounds. Ocean bottom sediment and interstitial water samples were taken and bathymetry and heat-flow data were collected.

As project manager in a study funded by the National Science Foundation and Sea Grant, participated in a research project investigating thermal output and seismic variability of oceanic hydrothermal vents off the coast of Washington. In conjunction with pilots of the ALVIN submersible research vessel, two equipment manufacturers, and several research scientists, coordinated weight- and size-restricted design and construction of a remote camera system to be deployed at a depth of 2200 meters.

For the Office of Naval Research, designed and constructed a prototype incubating oven for culturing microbes sampled from hydrothermal vents. Design required development of software to interface a Hewlett-Packard microcomputer with a data acquisition unit for monitoring thermocouples and maintaining oven temperature.

In graduate research funded by the National Science Foundation, studied an alkaline lake (Soap Lake) in eastern Washington. Designed a field and laboratory program to investigate variations in concentrations of radioisotopes in the oxic and anoxic zones of the lake. Analytical results of laboratory adsorption experiments were modeled using a mineral equilibrium FORTRAN program, modified to include adsorption reactions, to support the theory of carbonate complexes increasing the mobility (solubility) of various radioisotopes.

Memberships

American Geophysical Union
Geochemical Society
Hazardous Materials Control Resources Institute

Publications

1985. The influences of carbonate complexes on thorium adsorption. *EOS (Transactions, American Geophysical Union)*, vol. 66, p. 1325 (with J. W. Murray). Presented at the American Geophysical Union Conference, New Orleans, January 1986.

1987. Solid/solution interaction: The effect of carbonate alkalinity on adsorbed thorium. *Geochimica et Cosmochimica Acta*, vol. 51, pp. 243-250 (with J. W. Murray).

Edward A. Nemecek, R.G., C.P.G.
Principal Hydrogeologist

Experience

Mr. Nemecek has 25 years of technical, administrative and management experience in both the private and public sectors including over 12 years of CERCLA work at more than 15 NPL or proposed NPL sites. His RCRA experience includes consent order facility closures and RFI activities. Mr. Nemecek's recent experience encompasses multidisciplinary remedial investigation conceptualization, design and management and consultation on groundwater remedial design/remedial action projects. He has also provided technical advice and consultation to legal counsel and several PRP committees; expert witness services and technical preparations for cost recovery, toxic tort, multiple PRP and insurance coverage litigation; and technical advice regarding state and federal regulatory agency consent order negotiations and adversarial and public hearing preparation. Additional recent experience includes development and implementation of solute transport groundwater models; several dozen complex leaking underground storage tank evaluations; and advice to major financial institutions regarding environmentally sensitive real estate transactions. Mr. Nemecek also serves as Quality Assurance Manager for HLA's Northeast Region.

Registration and Certification

Registered Geologist - Arizona 1986, No. 19197
Certified Professional Geologist - American Institute of Professional Geologists 1986, No. 6980

Training

U.S. Geological Survey, Water Resources Division Training Center: water use seminar; advanced groundwater course; analytical methods to determine aquifer properties and to predict aquifer response
Harding Lawson Associates' RCRA Training Program
OSHA and EPA forty-hour safety training and supervisory courses

Education

B.S., Geology, Arizona State University, 1971
Groundwater Hydrology Course work, University of Arizona

Representative Projects

Hazardous Waste Sites

CERCLA site; remedial investigation/feasibility study for PRP Technical Committee. Client: Kane and Lombard Technical Committee, Baltimore.

Project consultant RCRA site; RCRA facility investigation; VOC/DNAPL in fractured bedrock; dissolved VOC groundwater plume. Client: Confidential, Pennsylvania.

Project consultant; dissolved VOC groundwater plume; VOC/DNAPL interspersed with LNAPL problems in complex fractured bedrock environment. Client: Confidential, Pennsylvania.

Directed investigation of closed specialty steel mill to decommission and dispose of potentially hazardous wastes in compliance with RCRA for potential site sale. Client: Confidential, Pennsylvania.

Project consultant and expert witness; complex landfill groundwater VOC contamination investigation; state Superfund oversight; multimillion dollar CERCLA cost recovery litigation against former trustee. Client: City of Phoenix, Law firms: Squire, Sanders, Dempsey; Landels, Ripley, Diamond.

Project manager for a major chemical distribution company involved in a multiple PRP state Superfund groundwater VOC contamination problem over a 35-square-mile area; conformance with NCP to preserve CERCLA litigation rights. Client: Confidential.

Negotiated with EPA, conceptualized and developed work plans for all phases of NPL site soil and groundwater pesticide contamination study; managed several phases of field work at complex multi-aquifer site. Client: Latham and Watkins, Montrose Chemical Company, California.

Directed hydrogeologic investigation of heavy metal, hydrocarbon, and volatiles contamination of soil and groundwater at 22 sites within facility; provided consultation regarding potential NPL listing; coordinated project, made technical presentations regarding annual work effort. Supervised monitoring/drilling program for approximately 200 on-site and off-site wells. Client: U.S. Air Force/General Dynamics, Fort Worth, Texas.

Managed all phases of two separate bulk pesticide facility soils/groundwater contamination studies; multiple regulatory agency and insurance company negotiations. Provided advice to counsel re: proposed NPL listings, insurance litigation, criminal indictments by Grand Jury. Client: Latham and Watkins; Confidential Client, California.

Wood treatment facility; planning and supervision of 14 aquifer tests with multiple observation wells for a potential EPA Superfund site; soil and groundwater contamination, heavy metals. Client: Marley Cooling Tower Company, California.

CERCLA landfill; coordinated comprehensive technical review of Draft Remedial Investigation report for largest generator by volume. Provided detailed comments to counsel, regulatory agencies, and client. Client: Montrose Chemical Company, Stringfellow Site, California.

Heavy metals contamination; developed strategy with counsel, negotiated technical provisions of Consent Order under State Superfund; designed and implemented remedial investigation. Client: Confidential.

Expert Consultation and Advice

Technical advisor to major responsible party on Stringfellow Technical Committee.

Provided expert advice for law firms on behalf of several mutual clients with hazardous waste problems; negotiated with state and Federal regulatory agencies. Clients: Latham and Watkins; Squire, Sanders, Dempsey; Streich, Lang; Snell and Wilmer; Sills, Cummis.

Assisted legal counsel, negotiated technical appendix of Consent Order for CERCLA Enforcement Action, California. Client: Montrose Chemical Corporation, California.

Preparation for toxic tort defense; Hughes Aircraft Company/Tucson Airport Authority NPL site. Client: Law firm of Latham and Watkins.

Independent expert witness for plaintiffs in successful $45 million CERCLA cost recovery litigation.

Expert testimony in public hearing regarding creation of 600-square-mile irrigation nonexpansion area.

Expert testimony in complex surface water/groundwater interaction hearing.

Provided technical testimony at legislative committee hearings.

Provided expert testimony regarding well construction problems.

Provided expert testimony at series of 14 statewide hearings regarding definition of legally defensible pumpage zones.

Acted as technical liaison with state regulatory agency staff; technical requirements and strategies for adversarial hearings; provision of expert testimony. Client: State of Arizona

Developed and initiated state environmental compliance and monitoring program. Client: State of Arizona.

Digital Modeling

Directed development of 3-D solute transport digital groundwater model of 115 square mile area; analysis of multiple PRP contamination scenarios over 50-year time frame in complex, highly-stressed hydrogeologic environment. Client: Confidential.

Large, multi-aquifer TCE plume; directed development of solute transport digital groundwater model; model used in cost recovery apportionment by EPA for remediation of 6- mile-long plume; Tucson Airport Authority/Hughes Aircraft Company NPL site.

Assisted in development of digital groundwater model of 2,500-square-mile aquifer; transient calibration; independent transient verification; Salt River Valley, Arizona.

5,000 gpm groundwater removal, treatment, and reinjection system; supervised digital model activities for obtaining poor water quality withdrawal permit; reclamation well field. Client: U.S. Air Force/Hughes Aircraft Company.

Directed development of hydraulic digital groundwater model; 1800-square-mile aquifer; Upper Santa Cruz Basin, Arizona.

Revised and recalibrated multi-aquifer groundwater flow model in a complex hydrogeologic environment. Client: State of Washington.

Hydraulic modeling of several water supply problems.

Miscellaneous Technical

Leaking underground storage tanks; project consultant on several dozen leaking underground storage tank projects; major soil and groundwater contamination problems including both free phase and dissolved constituents. Clients: ARCO, Unocal, Chevron, Texaco, Exxon, City of Phoenix, Arizona Public Service.

Prepared Annual Groundwater Monitoring Report under State regulatory program for Palo Verde Nuclear Generating Station, Arizona 1987 - 1991.

Planned, supervised, analyzed 175 aquifer tests within a 2,500-square-mile aquifer.

Conducted multiple aquifer tests for municipal well field.

Investigated, performed aquifer tests and prepared reports for complex groundwater/surface water interference problems, Washington.

Agency oversight representative, dewatering project. Trident submarine base, Washington.

Investigated salt water intrusion problem, Washington.

Performed reconnaissance geologic mapping. Southern Apache County, Arizona.

Memberships

Association of Groundwater Scientists and Engineers
National Water Well Association
American Institute of Professional Geologists (AIPG)

Bharat Patel, P.G.
Associate Hydrogeologist

Experience

Over the past 12 years Mr. Patel has managed hydrogeologic, soils, and geophysical investigations, and designed remedial actions, at hundreds of contaminated sites throughout the United States, India, and Puerto Rico. At landfills, landfarms, lagoons, underground storage tanks (USTs), aboveground storage tanks, buried drums, wetlands, septic systems, sole-source aquifers, and assorted manufacturing plants, Mr. Patel has successfully investigated and remediated hydrocarbons, polychlorinated biphenyls (PCBs), solvents, paints, inks, specialty chemicals, and other hazardous wastes. He has experience simultaneously managing multi-million-dollar cleanups at multiple sites under multiple jurisdictions.

Mr. Patel has negotiated on behalf of clients with sites regulated by the Comprehensive Environmental Response, Compensation, Cleanup and Liability Act (CERCLA), the Resource Conservation and Recovery Act (RCRA), the Environmental Cleanup Responsibility Act (ECRA), and other laws. He has managed compliance with ECRA regulations, assisted with RCRA Part B permit applications, developed closure and post-closure plans, contingency plans, and groundwater monitoring systems. Under contract to U.S. Environmental Protection Agency, Mr. Patel has evaluated applications for RCRA Part B permits and assessed the potential identification of sites on the National Priority List.

Registration and Certification

Geologist - Arkansas 1987, No. 203, Florida 1988, No. 819
Geologist - American Institute of Certified Professional Geologists 1989, No. 7680

Training

OSHA and EPA 40-hour safety training course
Eight-hour hazardous materials supervisory course and refresher
40-hour hazardous field training course, Phoenix Safety Association
Five-day seminar: Design Fundamentals for Site Characterizations and Remediations, Association of Groundwater Scientists and Engineers
Two-day seminar: Critical Issues in Underground Storage Tank Management, National Water Well Association
Five-day seminar: Aquifer Analyses, Association of Groundwater Scientists & Engineers

Education

M.S., Geology, Rutgers University, 1983.
M.S., Geology, Maharaja Sayajirao University, Baroda, India, 1979
B.S., Geology, Gujarat University, Ahmedabad, India, 1977

Representative Projects

Polyurethane foam manufacturing plant, East Rutherford, New Jersey - Managed the investigation of and a feasibility study for the remediation of a five-acre site regulated by New Jersey's Environmental Cleanup and Responsibility Act (ECRA). Client: General Foam Corporation

Dura-Bond recycled waste foam plant in Newark, New Jersey - Managed successful remedial investigation at this ECRA site, including a soil-gas survey, and a feasibility study at a site with volatile organic compound (VOC) and trichloroethylene (TCE) contamination in the soil and groundwater. Designed and implemented a soil remediation program and provided expert testimony resulting in a settlement in favor of the client. Client: General Foam Corporation

Developed and unimproved property, Hopewell Township, Warren Township, Bernards Township, New Jersey - Managed detailed environmental assessments of three sites: determined the extent of the sites' environmental liabilities, performed phase II investigations of two of the sites where a substantial amount of waste was discovered, and installed potable wells. Client: Confidential multinational communications company

Two Superfund sites, Rocky Hill, New Jersey - Conducted hydrogeologic investigation in fractured shale on a groundwater divide within the area of influence of public water supply well field, which are subject to EPA Superfund investigations. Work included installation of five 50-foot wells, the installation of soil borings, and a geophysical investigation to locate source of groundwater contamination. Successfully delineated the responsibilities of PRPs other than the client and fought against more restrictive regulatory designation. Client: Confidential

Picture frame manufacturer, Howell Township, New Jersey - Managed the remedial investigation and remedial action at this ECRA site with more than 50 drums containing chemicals, paints, inks, and specialty chemicals, contaminated soils, and septic material. Hydrogeologic investigation included installation of monitoring wells in the Kirkwood-Cohansey Sand Formation, a designated sole aquifer that supplies drinking water to southern New Jersey. Client: First Fidelity Bank

Mattress manufacturer, Linden, New Jersey - Designed and managed remedial investigation and remedial action at this ECRA site with hydrocarbon contamination. Installed shallow monitoring wells in shale formation to evaluate the effects of leaky USTs on groundwater quality and conducted a short- duration aquifer pump test, supervised soil boring program. Designed a soils excavation program and developed a pump and treat remedial system utilizing activated carbon filters. Client: Simmons

Uncontrolled landfill, Edison, New Jersey - Managed a shallow soil boring program and a geophysical investigation to locate buried drums, coordinated an extensive trenching program prior to removal of more than 5,000 cubic yards of contaminated soils and waste paint, supervised technical team and excavation contractor onsite, coordinated transportation and disposal of waste material, and worked closely with EPA personnel. Conducted fingerprinting investigation which identified responsible party for paint disposal. Client: Confidential

High-temperature brick manufacturer, Woodbridge, New Jersey - At this ECRA site, conducted a hydrogeologic investigation, risk assessment, and remediation plan. Determined the extent of groundwater contamination originating from a 30,000-gallon above-ground fuel tank and five underground storage tanks (USTs) containing gasoline and petroleum products. Designed and installed a system to monitor a groundwater regime that was influenced by tidal effects. Implemented soil remediation program approved by the New Jersey Department of Environmental Protection (NJDEP). Client: A. P. Green Refectories

Paint research and development center, Newark, New Jersey - At this ECRA site, managed a hydrogeologic investigation and designed a cleanup plan approved by the NJDEP. Determined the extent of groundwater contamination originating from 11 USTs containing solvents, waste oil, and fuel oils. Installed onsite and offsite monitoring wells, evaluated field and analytical data, developed a groundwater cleanup plan, and installed a dual pump recovery well/interceptor trench system. Worked closely with city, state, and federal environmental protection and public health and safety officials. Client: John R. Armitage & Co.

Sprinkler system parts manufacturer, Linden, New Jersey - Conducted a soils and hydrogeologic investigation and designed a remedial measure at this ECRA facility, which operated three hazardous material drum storage areas and a 10,000-gallon UST. Discovered and removed five additional USTs, installed wells to measure groundwater quality, and successfully determined the extent of the client's responsibility for contamination despite the site's location in a highly industrialized area where a number of neighboring facilities use similar materials. Designed cleanup of site, inside and outside the building, including removal of floor and remediation of sub-floor. Consulted with client and NJDEP to allow the client, now bankrupt, to sell the property to finance the remediation. Client: AHC Manufacturing Corporation

Electric switch manufacturer, Parsippany, New Jersey - Managed hydrogeologic investigation to determine effects of retention pond operation on the groundwater quality at this ECRA site, installed wells, delineated extent of contamination, supervised removal of USTs and contaminated soil, installed interim product recovery system, and prepared a closure plan. Client: Confidential

Large-diameter concrete pipe manufacturing plant, Wharton, New Jersey - At this 36-acre ECRA site across a river from a Superfund site and surrounded by numerous potential sources of contamination, managed a hydrogeologic investigation of two contaminant plumes and prepared a final remediation plan. Designed and oversaw the installation of 25 wells that monitored the impact on groundwater quality from process water discharged from a retention lagoon, outside painting operation, surface spill areas, and 10 USTs. Conducted hydrogeologic investigation which identified an offsite contaminant source for a groundwater plume covering over 5-acres of the site. Designed and supervised site characterization and remediation program, which involved removal of the USTs and 8,000 cubic yards of contaminated soils from two drum storage areas, USTs, and spill areas. Client: Gifford-Hill American

Landfarm, New Jersey - Prepared RCRA Part B permit applications. Client: Confidential petrochemical company.

Hazardous waste landfill and lagoon, Puerto Rico - Supervised intrusive and geophysical investigation involving installation and design of monitoring wells up to 350 feet deep and an aquifer testing program. Evaluated deep subsurface soils and rock formation to determine presence of solution cavities in the limestone formation and had partial responsibility for evaluating geophysical survey data, specifically micro-gravity anomalies. Client: Confidential

Numerous hazardous waste sites, lagoons, and disposal units, Louisiana, New York, and Puerto Rico - Evaluated RCRA Part B permit applications: included investigation of groundwater, monitoring systems, and local and federal regulatory compliance. Client: U.S. EPA

Hazardous waste sites, Louisiana - Managed investigations of more than 100 hazardous waste sites to assess the severity of potential problems and their potential identification as Superfund sites. Evaluated hazardous waste handling procedures, including treatment, storage, and disposal and reviewed federal, state, and local government files, reports, and court cases, as well as facility environmental permits. Client: Louisiana Department of Environmental Quality

Publications

1983. Geophysical study of talc deposits in the State Line Serpentinite District, Lancaster, Pennsylvania. Master's thesis, Rutgers University, Newark, New Jersey.

1979. Geological field work around Boria, Gujarat. Master's Dissertation, M.S. University, Baroda, India.

Jason M. Schindler
Senior Geologist

Experience

Mr. Schindler has seven years of experience managing soil and groundwater investigation projects involving state and federal compliance activities, environmental site assessments, and underground storage tank investigations and closures. He is responsible for developing technical scopes of work and budgets; ensuring that technical, quality control, budgeting and scheduling objectives are met; and supervising preparation of technical reports and proposals. His experience also includes design and implementation of various investigation and remediation programs, preparation and review of submittals to regulatory agencies, assistance in emergency response activities, and negotiations with regulatory agencies, as well as estimating potential remedial costs to assist clients in business decision making. In addition, Mr. Schindler is experienced in a wide variety of field activities including supervision of monitoring well installations and soil gas surveys; groundwater, soil, and hazardous waste sampling; aquifer testing; supervision of soil borings, test pits and soil removal programs; and numerous storage tank closures in accordance with current federal and state programs.

Registration and Certification

Certified to practice Subsurface Evaluations in New Jersey, No. 0002005

Training

OSHA and USEPA forty-hour safety training course
OSHA eight-hour supervisor training course
Engineering Geology course, Drexel University, Philadelphia, Pennsylvania, 1987
National Ground Water Association Applied Hydrogeology course

Education

B.A., Geology, University of Pennsylvania, Philadelphia, 1985

Representative Projects

Groundwater Investigation

Precision Equipment Manufacturer, Philadelphia, Pennsylvania - Project manager for soil and groundwater investigation to assess impacts to site contaminated by solvents, PCBs and petroleum hydrocarbons from surface spills and leaking storage tanks. Investigation includes identification of potential source areas and investigation of soil and groundwater impacts including vapor, dissolved, and light and heavy non-aqueous phase contamination. The scope of the project includes a soil gas survey, soil and groundwater sampling and interim recovery of light, non-aqueous phase liquids.

Environmental Site Inspection

Former Turbine and Heat Transfer Apparatus Manufacturing and Testing Facility, Lester, Pennsylvania - Project manager for investigation of potential areas of environmental concern and regulatory compliance. Areas of concern include a landfill, numerous underground and aboveground storage tanks, and hazardous and non-hazardous waste storage areas. The investigation includes surveys using ground penetrating radar and magnetometers, and soil boring, test pit, and monitoring well installation and sampling.

Remedial Investigation

Abandoned Site, Edison, New Jersey - Project manager for investigation of site that had been used for illegal dumping of liquid wastes including PCB oils. Study involved soil sampling to determine the extent of PCBs, installation of monitoring wells and collection and analysis of groundwater and surface water samples.

Landfill Closure Investigation

Manufacturer of Asbestos Products, Manheim, Pennsylvania - Project manager for investigation of landfill during closure under RCRA. The landfill was located in a flood plain and contained phenolic resins, asbestos and other wastes. Study involved installation and sampling of soil borings and monitoring wells and aquifer testing to determine the volume of the landfill, the nature and extent of groundwater contamination, and groundwater movement through and around the landfill.

Environmental Site Assessment/Soil and Groundwater Investigation

Polypropylene Manufacturer, West Deptford, New Jersey - Project manager for comprehensive site investigation during property transfer. The study involved identification of more than 30 areas of potential environmental concern, soil sampling, installation and sampling of monitoring wells and aquifer testing.

Underground Storage Tanks

Underground Storage Tank Investigations and Closures in New Jersey, Pennsylvania, Maryland and Virginia - Managed investigations of more than 60 service stations and commercial facilities with leaking underground fuel storage tanks. Projects included initial response to and characterization of releases, management and evaluation of soil gas surveys, installation and sampling of soil borings and monitoring wells, delineation of extent of impact, aquifer testing, conceptual design of remediation programs including groundwater and hydrocarbon recovery and treatment and soil vapor extraction systems.

Environmental Site Assessment/Soil Investigation

Furniture Assembly Plant, Fort Washington, Pennsylvania - Managing site investigation to identify and assess potential issues of environmental concern as part of property transaction. Work includes soil sampling program and background investigation.

Environmental Site Assessment/Soil and Groundwater Investigation

Former Folding Box Company Facility, Canton, Pennsylvania - Managed site investigation of soil and groundwater impacts resulting from facility operations. Scope of work included soil boring program, monitoring well installation, and soil, groundwater and waste sampling.

Soil Investigation

Precision Metal Grinding Plant, Pennsauken, New Jersey - Managing site investigation to evaluate residual contamination from former ash piles.

Oil Spill Cleanup

New Jersey and Virginia - Managed cleanup and post-cleanup sampling of two residences following home heating oil spills.

Underground Storage Tanks

US Air Force Base, Maryland - Provided oversight during integrity testing of numerous underground fuel storage tanks.

Underground Storage Tank Investigation and Remediation

Mercer County Airport, New Jersey - Project geologist during investigation and recovery of jet fuel leak from underground storage tank. Project included installation of an interceptor trench to recover separate-phase petroleum and installation and sampling of monitoring wells to assess the extent of impact.

Memberships

National Ground Water Association, Association of Ground Water Scientists and Engineers

Appendix CC
Corrective Action Form