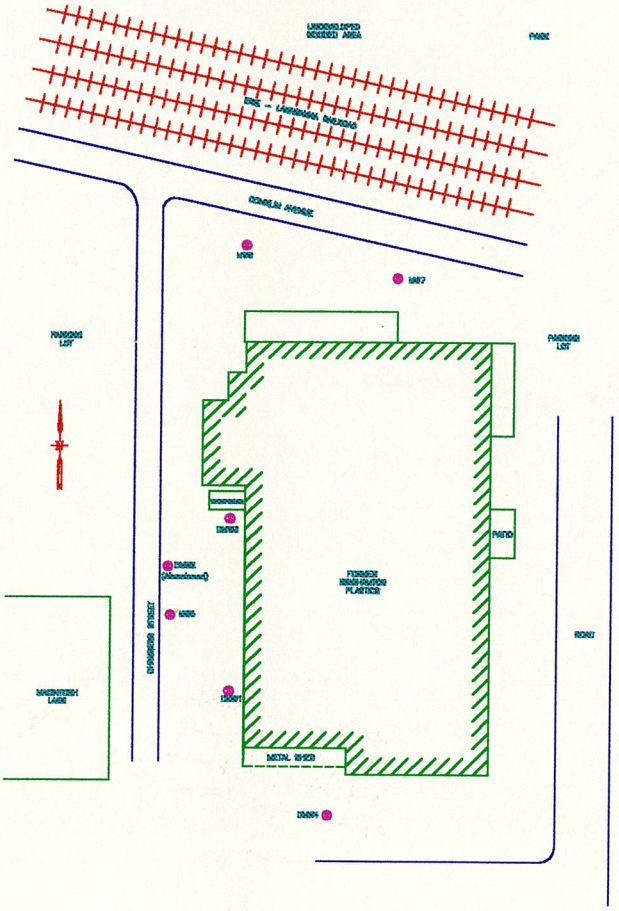
REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORK PLAN

DOVATRON INTERNATIONAL
ORDER ON CONSENT INDEX # B7-0516-97-05
SITE CODE #704024

Former Binghamton Plastics Site
498 Conklin Avenue
Binghamton, New York



Prepared by:

SHIELD ENVIRONMENTAL ASSOCIATES, INC.
Lexington, Kentucky

November 11, 1998
Job No. 396-0460

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1.0 INTRODUCTION

Shield Environmental Associates, Inc. (Shield) has prepared this Remedial Investigation/Feasibility Study (RI/FS) Work Plan for the Former Binghamton Plastics facility in Binghamton , New York, in response to the New York Department of Environmental Conservation's (NYSDEC) request for further site investigation. At this time, information does not indicate expedited (emergency) remedial response activities are required at the site. Previous investigations conducted by various consultants do not indicate immediate actions are necessary to protect human health and the environment.

1.1 Purpose

The purpose of conducting the RI is to evaluate the nature and extent of any identified threat to human health or the environment caused by possible or threatened releases of chemicals of concern from the Former Binghamton Plastics facility (hereinafter called "the site"). The purpose of the FS is to evaluate alternatives for appropriate remedial action to minimize or mitigate any identified risks associated with chemicals of concern from the site.

This work plan describes the scope of work, resources, and schedule needed to collect the data necessary to evaluate present and potential health and environmental risks. The work plan is divided into the following sections:

1.0 Introduction
2.0 Site Background and Setting
3.0 Initial Evaluation
4.0 Work Plan Rationale
5.0 Remedial Investigation Tasks
6.0 Feasibility Study Tasks
7.0 Schedule
8.0 Project Management
9.0 References

Section 1.0 contains the introduction to the Work Plan and discusses the purpose and goals of the project.

Section 2.0 discusses the topography, geology, soil types, hydrogeology, surface water, ambient air quality, meteorology and ecology of the site and surrounding areas. A site history and a summary of previous site investigations are included in this section.

Section 3.0, Initial Evaluation, discusses the waste types, estimated volumes, and potential pathways for the chemicals of concern (soil, ground water, surface water, and air). This section also contains a preliminary risk assessment based upon the data previously collected at the site. The preliminary remedial action alternatives and response objectives are included in this section.

Section 4.0, Work Plan Rationale, discusses the RI/FS objectives, data quality objectives (DQOs), the New York State Standards, Criteria, and Guidelines (SCGs), the federal applicable or relevant and appropriate requirements (ARARs), and the work plan approach.

Section 5.0, Remedial Investigation Tasks, outlines the proposed project activities including preliminary activities, site preparation, waste characterization, site investigations (soil, ground water, surface water, and air), and data management and analysis. Plate 1 illustrates the proposed surface water, ground water and soil sampling locations. The approach for a more detailed risk assessment is also discussed in this section.

Section 6.0 discusses the Feasibility Study Tasks including a description of proposed responses, development of alternatives, initial screening and evaluation of alternatives, and recommendations.

Sections 7.0 through 9.0 contain the schedule, information regarding project management and organization, and references. Components of this RI/FS Work Plan include the Field Sampling and Analysis Plan (FSAP) and the Health and Safety Plan (HASP), Appendices A and B, respectively. The FSAP contains the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP).

1.2 Goals

The goals of the RI/FS are as follows:

- To implement a cost-effective remedial site investigation that provides adequate characterization to assess appropriate remedial actions, if necessary.

- To identify and characterize waste sources and specific chemicals of concern and to determine whether they affect air, land, or water resources at the site.

- To evaluate sources of chemicals of concern, potential pathways of migration, and potential receptors near the site.

- To assess the threat that impacts from site chemicals of concern pose to human health and the environment.

- To develop, screen and evaluate the remedial alternatives for the site and to provide recommendations.

2.0 SITE BACKGROUND AND SETTING

2.1 Site Location

The facility, located at 498 Conklin Avenue, Binghamton, Broome County, New York (Figure 1), is situated in an industrial/residential setting. The site is bounded by McIntosh Laboratories to the west; the Erie-Lakawanna Railroad, a public park and Susquehanna River to the north; and residential properties to the east and south (Figure 2).

2.2 Site Description

2.2.1 Topography

The site is situated at an elevation ranging from approximately 870 to 880 feet above Mean Sea Level. The site topography is relatively level, sloping gently to the north in the area of the building. The parking area on the southern side of the building is approximately 4 feet higher than the rest of the property. The area north of Conklin Avenue slopes steeply towards the Susquehanna River. Figure 1 shows the regional topography of the area.

2.2.2 Site Geology

Twelve ground water monitoring wells and one recovery well (DMW1) have been installed on-site. Additionally, numerous soil borings have been drilled on the west side of the property. Three of the monitoring wells and the recovery well were installed by previous consultants. To date, Shield has installed nine monitoring wells and advanced four soil borings on the site. The following site geology is based on site research and observations from drilling operations.

The surficial sediments at the site consist of a brown, poorly sorted, weathered, glacial till unit and are found at depths ranging from 0 to 25 feet below the ground surface. The weathered till is unstratified and contains clays, silts, sands, gravels and cobbles. The upper weathered till is a brown clay that contains poorly sorted, subrounded gravel.

Below the weathered brown till lies the unweathered till. These sediments are similar to the weathered till and consist of poorly sorted clay, silt, sand, gravel, and cobbles. However, the color grades from light brown to olive gray and contains fewer cobbles.

2.2.3 Soil Types

Based upon the U.S. Department of Agriculture, Soil Conservation Service (USDA SCS), *Soil Survey, Broome County, New York,* dated March 1971, the soil types at the site consist of the Mardin Channery silt loam (8 to 15 percent slopes). The Mardin Channery silt loam consists of deep, gently sloping to steep, well-drained and moderately well-drained soils that form in glacial till.

In addition, the local National Resource Conservation Service (NRCS) office was contacted for information related to hydric soils on site. According to NRCS personnel, hydric soils are not known to exist on the property.

2.2.4 Hydrogeology

2.2.4.1 Regional Hydrogeology

The main ground water aquifer in the area is the Five Mile Point aquifer. The sediments that make up this aquifer are glacial outwash deposits. According to the USGS's *Open File Report No. 91-457*, the aquifer consists of 30- to 70-foot-thick sand and gravel underlain by sand and silt. The aquifer is bounded laterally and partially beneath by glacial till.

Ground water in the study area is hydraulically connected to the Susquehanna River. The ground water in the area generally flows along the valley walls toward the river and is recharged from upland runoff. Pumping from well fields in the towns of Kirkwood and Conklin has altered the natural flow pattern. In well field areas, ground water that previously discharged to the river is now captured by production wells (USGS Open File Report No. 91-457).

2.2.4.2 Site Hydrogeology

The ground water underlying the site appears to be separated into two water-bearing units. A perched water zone appears to be on the southwest side of the property in the vicinity of the contaminated source area. This perched water zone was not encountered on the north and east sides of the property.

Ground water on the southwest side of the property (MW1, MW4, MW5, MW8, MW9, MW10, and MW11) was encountered between approximately 3 and 5 feet below the ground surface. Due to the shallow depth of ground water in this area and the potential for cross-contamination into the uppermost regional aquifer, these wells were not installed below a depth of 20 feet. Based on the first three gauging events, the direction of ground water flow in the perched ground water zone is to the west-northwest towards Chambers Street. Ground water on the north and east sides of the property (MW3, MW6, MW7, and MW12) was encountered between approximately 23 and 32 feet below the ground surface. These wells range from 40 to 48 feet in depth. Ground water flow in this uppermost regional aquifer has been established to be to the east-northeast at a gradient of 0.076 ft/ft. Based on three ground water gauging events, the wells in the uppermost regional aquifer and the wells completed within the perched zone do not appear to be hydraulically connected.

2.2.5 Surface Water

No surface water features (e.g., ponds, streams, springs) are located on the site. The surface water runoff is collected through a series of catch basins, pipes, and open ditches. The catch basins consist of below-ground concrete boxes with grates and curb inlets on the surface that allow water to enter the boxes. The water is transported from the catch basins below the ground to an outfall where the water is discharged to the surface. Catch basins and pipes are used to collect surface water runoff from paved areas. The roof drains discharge to the surface adjacent to the building.

2.2.6 Ambient Air Quality

The site is located in Broome County, New York, Air Quality Control Region 7, in an industrial area. The Region 7 air quality monitoring network consists of six locations where ambient air quality is measured for comparison to the National Ambient Air Quality Standards (NAAQS). The monitoring location in Broome County is in Binghamton and measures for particulate matter less than 10 microns in aerodynamic diameter (PM10). Other monitors located in Region 7 analyze for sulfur oxides, ozone, nitrous oxides and carbon monoxide. The location closest to the Binghamton site that measures for multiple parameters is Camp Georgetown, Chenago County, where sulfur oxides, ozone and acid deposition are measured.

The NAAQS are published in the Federal Register and in the 40 Series Code of Federal Regulations (CFR). New York also publishes state standards in its state regulations. New York has not adopted the federal standard for PM10, but uses it currently to establish compliance. The primary and secondary NAAQS for PM10 are the same and are 50 ug/m^3 for a yearly arithmetic mean average, and 150 ug/m^3 for a maximum 24-hour concentration. According to information from the New York State Air Quality Report Ambient Air Monitoring System, 1995 Annual Division of Air Resources Report, the highest reported annual arithmetic mean for Binghamton was 26 ug/m^3 (1991), and the 1995 data indicate a value of 19 ug/m^3. The 1995 data for Binghamton also shows a maximum 24-hour concentration of 49 ug/m^3 occurring on July 26, 1995. From a review of the Binghamton area data did not note exceedences of PM10.

2.2.7 Meteorology

Data referenced in this subsection were obtained from the National Weather Service, Binghamton Airport office and the Soil Survey for Broome County. Broome County has a continental humid climate. The summers are warm, and the winters are long and cold with frequent periods of snowfall and stormy weather. The Great Lakes do not have a strong direct influence on the area. All climate data are obtained from the Binghamton airport, which is at an elevation of 1,590 feet above Mean Sea Level. Temperature ranges will vary according to location and are normally a function of diurnal valley breeze and local topographic influence.

The regional topography and location of the county favor a considerable amount of cloudiness, most often in late fall and winter. On average, there are 215 cloudy days a year. The prevailing cloudiness also decreases the percentage of possible sunshine from 60 to 70 percent in the summer to 30 percent in winter.

Mean annual precipitation in the area is 36.99 inches, with the greatest recorded 24-hour rainfall event being 3.88 inches (October 15-16, 1955). Showers and thunderstorms occur on 25 to 30 days a year, providing the greatest precipitation during the months of May through October. This is usually followed by a frontal passage bringing cold, dry, stable air behind the precipitation event. The area experiences snowfall for an extended season. Seasonal snowfall ranges from a record high of 134 inches to a low of 47.8 inches. The greatest 24-hour snowfall was 23 inches on February 3-4, 1961.

Prevailing winds in the area are generally westerly. However, local winds can be altered by regional topographic and man-made features such as ridges, water, buildings, and vehicles. The average wind speed is 9 mph in the late summer/early fall season and increases to 12 mph in the winter. The area

experienced an all-time-record wind speed of 74 mph in July 1992. Dense fog will also occur about 50 days a year.

The annual average temperature is 45.5°F, with a yearly average maximum of 54°F and a yearly average minimum of 37°F. The summer months can be very hot, with a record high temperature of 98°F recorded on July 16, 1988. The average high temperature in the summer is 66.9°F, with an average low temperature in the winter of 23.5°F. Winter can be extremely cold, with a record low of -10°F recorded on January 19, 1994. The average relative humidity in the summer months ranges between 50 to 60 percent, with extended periods of high temperature and relative humidity infrequent.

The average annual atmospheric pressure is 28.26 inches of mercury, with high pressure predominating during the late summer/early fall and the lowest pressures in the winter months.

2.2.8 Ecology

As indicated previously, the site is in an industrial complex and has been developed and used for industrial purposes. A large portion of the site is covered with structures and asphalt/concrete for parking and roadways. A small gravel road is also on the western portion of the site.

Vegetation is limited to grassy areas directly around the building and parking areas. Some landscaped areas (shrubs and perennials) are also at the site. Trees (deciduous and evergreen) are sparsely in and around the site, largely in the southwestern portion. Some of the surface water drainage areas (i.e., culverts, outfalls, and drainage ditches) that are topographically low-lying areas also contain small areas of cattails and other plant species indicative of low-lying marshy areas. A portion of the western part of the site contains a field with unmowed, taller grasses and weeds.

2.3 Site History

The facility at the subject site was constructed in 1956 by Binghamton Plastics. Additions to the property were constructed in 1963, 1974, and 1982. Universal Instruments Corporation purchased the facility in the early 1980s and continued operations until Universal Instruments was taken over by Dover Electronics Corporation. In 1993, Dover Electronics was separated from Dover as a stand-alone corporation named Dovatron, Inc. In 1996, Dovatron changed its name to The DII Group. The building has been occupied by McIntosh Laboratories since the late 1980s. The facility has been used as a circuit board assembly plant and is currently operated as an electronic repair facility.

The site consists of a large industrial building (44,800 square feet) with associated parking, landscaping, and storage areas. A complete list of chemical substances used at the plant is not available; however, the use of trichloroethene (TCE) and 1,1,1-trichloroethane (1,1,1-TCA) has been substantiated.

In addition, a 1,000-gallon underground storage tank (UST) that stored hydraulic oil contaminated with 1,1,1-TCA and TCE, was removed in 1986. Figure 2 shows the former location of the tank and significant site features.

Shield reviewed a June 1990 letter to Hagopian Engineering Associates from the Broome County Health Department (Hagopian 1990). This letter indicated three contaminated sites were within a

1/2-mile radius of Conklin Avenue. One of those sites was identified as Binghamton Plastics Dump, which was listed as being located at 498 Conklin Avenue. Reportedly, waste plastics and oils were thought to have been disposed of there. However, this information has not been substantiated.

2.3.1 Historical Aerial Photographic Information

The Town of Binghamton, New York, and the United States Department of Agriculture (USDA) Soil Conservation Service were contacted regarding aerial photos of the site. Historical aerial photographs dated 1978 and 1981 were available for review.

The 1978 photograph shows the facility following construction of the building and one addition reportedly constructed in 1963. The McIntosh Laboratory facility is located to the west, and apparent residential areas are located to the south and west of the subject site. A railroad, public park, and the Susquehanna River are located to the north. The 1981 aerial photograph shows the facility after the final two additions to the building. An additions to the McIntosh Laboratory building were constructed on the east side of the building. Property usage to the north, south, and east of the subject facility was unchanged.

2.3.2 Summary of Previous Site Investigations

2.3.2.1 Hagopian, Stetson-Harza, Harza Northeast Investigations

Starting in 1985, numerous environmental investigations have been conducted at the DII-Binghamton Plastics facility by several environmental consultants. These investigations have been conducted by Hagopian Engineering Associates (Hagopian), Stetson-Harza, and Harza Northeast. Analytical data and maps showing boring locations were not available for all of the previous site work conducted.

2.3.2.2 1986 Tank Removal

A 1,000-gallon hydraulic oil tank was reportedly removed from the site in 1986. The name of the tank removal contractor is unknown, and a tank closure report was not available for review. However, the reports reviewed (*Environmental Site Investigation for Dover Electronics Company, DEM-East and Kirkwood North Locations* and *DEM-East, Phase III Investigation, Final Report*) indicated the tank contained 650 gallons of hydraulic oil contaminated with 1,1,1-TCA and TCE.

2.3.2.3 Hagopian Engineering Associates (Initial Investigation)

A site investigation was conducted by Hagopian Engineering Associates in July 1990. Concrete cores were collected from six locations inside the building to identify an oil staining problem related to the floor tiles. Several soil samples were also collected in this area. Soil samples were also collected in the vicinity of the former tank area and other areas of the site. Exact locations of the samples collected were not identified in the copy of the report reviewed (Hagopian 1990). Samples were analyzed by Upstate Laboratories, Inc. for volatile organic compounds (VOCs) using SW-846 Methods 8010, 8020, and/or 8240. A petroleum scan (FID 310-13) was used to fingerprint selected samples for the presence of petroleum products (gasoline, kerosene, fuel oil and lubricating oil).

Concrete core data indicated no chemical contamination with the exception of hydraulic oil that was

detected in the top surface of one concrete core (Core #3). No contamination was found in the soil samples collected below the concrete cores.

Soil sampling indicated elevated chemical compounds in subsurface soils at two borings (B3C and B4C). Boring B3C contained detectable 1,1,1-TCA at 0.230 mg/kg, TCE at 0.031 mg/kg, and carbon tetrachloride at 0.033 mg/kg. Lubricating oil was also detected in this boring. Boring B4C contained detectable 1,1,1-TCA and TCE at 0.059 mg/kg and 0.088 mg/kg, respectively. Lubricating oil was also detected in this boring.

2.3.2.4 Hagopian Engineering Associates (Phase II Investigation)

In April/May 1991, Hagopian conducted a subsurface Phase II site investigation. During the Phase II investigation, ground water monitoring wells (DMW1-DMW4) were installed and soil gas, soil and ground water samples were collected.

This investigation detected elevated VOCs in the soil and ground water. Elevated levels of 1,1,1-TCA at 1.470 mg/kg and TCE at 2.070 mg/kg were detected in a soil sample collected from DMW1. A soil sample collected from DMW2 showed TCE at a concentration of 0.237 mg/kg. A ground water sample collected from DMW1 showed a TCE concentration of 31.10 mg/L and a 1,1,1-DCA concentration of 17.50 mg/L. Ground water in DMW2 had a TCE concentration of 0.440 mg/L. Hagopian recommended removing the contaminated soil and treating the affected ground water.

2.3.2.5 Stetson-Harza Investigation (Phase III Investigation)

In July 1992, four borings (D-1 through D-4) were drilled 4 to 6 feet below the ground surface. Two composite soil samples (D-1-2 and D-3-4) were analyzed for VOCs using EPA SW-846 Method 8240. One sample (D-1-2) was also analyzed for toxic characteristic leachate procedure (TCLP) metals, TCLP pesticides and herbicides and TCLP volatiles and base neutral acid compounds. Additionally, the ground water monitoring wells (DMW1-DMW4) were redeveloped, sampled and analyzed for VOCs. Ground water elevation data was also collected for this sampling event.

Soil samples collected indicated elevated TCE and tetrachloroethene (PCE) levels. Maximum concentrations of 0.0471 mg/kg PCE and 0.719 mg/kg TCE were detected in D-1-2. TCLP data indicated 0.7 mg/L barium, 0.12 mg/L lead, 0.18 mg/L silver, 0.007 mg/L PCE, and 0.09 mg/L TCE. These concentrations were all below their TCLP regulatory criteria.

Ground water samples collected indicated elevated concentrations of 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), trans and cis 1,2-dichloroethene (1,2-DCE), 1,1,1-TCA, and TCE. Based upon these data, a pump and treat ground water treatment system was recommended.

2.3.2.6 Harza Northeast (Ground Water Treatment System)

Stetson-Harza designed the pump and treat system using the existing well (DMW1) as the extraction well piped to a carbon treatment system (two carbon units placed in series). Chemicals detected in DMW1 included TCE, PCE, 1,1,1-TCA, 1,1,2-trichloroethane (TCA), cis and trans 1,2-DCE, 1,1-DCA, 1,1-DCE, vinyl chloride, chloromethane, methylene chloride, chloroform, and cis-1,1-dichloropropane. TCE, 1,1,1-TCA, cis 1,2-DCE, and 1,1-DCA have been detected at the highest concentrations in the influent samples.

The system consists of a positive displacement pump with pneumatic controller, tanks, pressure gauges, and sampling ports. The system was also fitted with a bag filter prior to carbon treatment. Upon treatment, the system discharges to the Binghamton-Johnson City Sanitary Sewer System. An operational report for the ground water treatment system indicated that approximately 50,030 gallons had been pumped and treated over a 450-day period; however, DII personnel have reported periods of much lower flow from the treatment well. The system has been shut down periodically for maintenance and repair and has not run continuously. The system has also undergone some changes to reduce compressor overheating.

The treatment system at the subject site is operating on a Binghamton-Johnson City Joint Sewage Board permit dated September 2, 1993. The current discharge limits for specific parameters are as follows:

Parameter	**Discharge Limit**
Cadmium	0.30 mg/L
Chromium	5.36 mg/L
Copper	3.38 mg/L
Cyanide	2.31 mg/L
Lead	2.50 mg/L
Mercury	0.001 mg/L
Nickel	3.98 mg/L
Zinc	8.81 mg/L
Oil & Grease	100 mg/L
Total toxic organics	2.13 mg/L
PCBs, total	0.001 mg/L
Flow	1,500 gallons per day
pH	6.0 - 10.0
Flashpoint	140° F

TCE, 1,1,1-TCA, 1,2-DCE and 1,1-DCA have been removed from the ground water during the operation of the ground water treatment system.

2.3.3 Shield Investigations

2.3.3.1 Soil

October 1997 - During the period of October 7 to October 10, 1997, three soil borings that were later converted into monitoring wells (MW5, MW6, and MW7) were advanced to between 20 and 40 feet below the ground surface. The soil borings were drilled through glacial till using a drill rig equipped with 4.25-inch-inside-diameter (I.D.) hollow-stem augers. Continuous soil samples were collected from MW5 to a depth of 16 feet with a split-spoon sampler and field screened with a photoionization detector (PID). The field screening did not detect VOCs in any of the samples collected from MW5. One soil sample, collected from MW5 at a depth of 6 to 8 feet below the ground surface, was submitted to Quanterra Environmental Services for total VOC analysis. Due to their distances from the contamination source, soil samples were not collected from MW6 and MW7.

January-February 1998 - During the period of January 27 to February 5, 1998, twelve on-site soil borings (MW8 through MW13 and SB1 through SB6) were drilled. The soil borings were drilled through glacial till using a drill rig equipped with 4.25-inch I.D. hollow-stem augers. Soil samples were collected from each soil boring with a split-spoon sampler and field screened with a PID. VOCs were not detected in any of the samples that were field screened. Due to a PID malfunction, soil samples from SB3 through SB6 could not be screened. At least one soil sample from each boring in the vicinity of the source area was submitted to an EPA-approved laboratory for analysis.

2.3.3.2 Ground Water

October 1996 - In October 1996, Shield personnel sampled the ground water monitoring wells installed by Hagopian in 1991. The exception was DMW2, which was removed during the widening of Chambers Street. Each well was purged of at least three well volumes of water with a disposable bailer prior to sampling. The ground water samples were submitted to Quanterra Environmental Services for VOC analysis using EPA SW-846 Method 8240 and semivolatile organic compound analysis using EPA SW-846 Method 8270.

October 1997 - In October 1997, Shield supervised the installation of three additional ground water monitoring wells (MW5, MW6 and MW7), as discussed in Section 4.2.1. Water was encountered at approximately 8 to 10 feet below the ground surface during the drilling of MW5. MW5 was completed to a depth of 20 feet. Water was encountered approximately 30 feet below the surface during the drilling of MW6 and MW7. These wells were completed to a depth of 40 feet. The wells were constructed of 2-inch-diameter, Schedule 40 PVC pipe with 0.010-inch slotted well screen located at the bottom 10-foot interval of each well. A silica sand filter pack was placed to 2 feet above the screen in the annular space of each well. A 2-foot-thick bentonite seal was placed above the filter pack. The remaining annular space was filled with grout to approximately 1 foot below the ground surface. The wells were sealed in 8-inch manholes with locking, watertight caps inside 2-foot by 2-foot concrete well pads.

Following installation, each well was developed until the discharge was free of sediment or until the well ran dry. Precautions were taken during monitoring well drilling, construction, and development activities to prevent cross contamination of the well. These precautions included using pre-cleaned augers for all drilling operations. Additionally, personnel who handled the PVC casing and developed the wells used clean latex gloves to prevent contaminants from entering the well.

On October 15, 1997, all wells on site were purged of at least 3 well volumes of water with a disposable bailer prior to sampling. The samples were placed in an iced cooler and submitted to Quanterra Environmental Services for VOC analysis using EPA SW-846 Method 8260A.

January-February 1998 - During the period of January 27 to February 4, 1998, six ground water monitoring wells (MW8 through MW13) were installed at the locations shown in Figure 6. These wells were also installed by Nothnagle Drilling Company, Scottsville, New York. The wells were constructed in the same manner as MW5, MW6 and MW7 described above.

Following installation, each well (with the exception of MW13, which was dry) was developed until the discharge was free of sediment or until the well ran dry. Precautions were taken during monitoring well drilling, construction, and development activities to prevent cross contamination of the well. These precautions included using precleaned augers for all drilling operations.

Additionally, personnel who handled the PVC casing and developed the wells used clean latex gloves to prevent contaminants from entering the wells.

On February 5, 1998, the water levels in all on-site monitoring wells (DMW1 through MW13) were gauged with an electronic water level indicator accurate to 0.01 feet. DMW2 was removed during the widening of Chambers Street and could not be gauged, however, MW8 was placed in the general vicinity of the former location of DMW2. As discussed in Section 3.2.2., a perched aquifer appears to be present in the vicinity of the source area on the west side of the building. The water in this perched zone was encountered between approximately 2 to 3 feet below the ground surface. Based on this gauging event, movement within the perched aquifer appears to be to the west-northwest toward Chambers Street. The uppermost regional aquifer was encountered between approximately 22 to 28 feet below the ground surface in DMW3, MW6, MW7 and MW12. Ground water flow in the regional aquifer is to the northeast.

On February 5, 1998, all monitoring wells (with the exception of MW13 which was dry) were purged and sampled using a disposable bailer. Water samples from all wells were placed in an iced cooler and transported to an EPA-approved laboratory for total VOC analysis using EPA SW-846 Method 8260A. Water samples collected from DMW1, MW5, and MW9 located within or in the vicinity of the source area were analyzed for the full Target Compound List/Target Analyte List (TCL/TAL).

3.0 INITIAL EVALUATION

3.1 Waste Types and Extent of Contamination

This section describes the types of chemicals that have previously been documented at the site and surrounding areas. Informational sources used to prepare this section include statements from employees at the site, historical reports, available agency files, existing literature sources, ground water and soil laboratory analysis collected during previous site investigations, and publicly available documents.

The primary waste types are soil and ground water contaminated with dense nonaqueous phase liquids (DNAPLs), TCE and 1,1,1-TCA. These liquids were released during previous site manufacturing activities. The site-specific parameter list (SSPL) includes TCE, 1,1,1-TCA, PCE and their decomposition products: 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, vinyl chloride, and chloroethane.

The volume of VOC contamination in ground water and soils has not been established. Additional investigations outlined in the task section of this RI/FS Work Plan will be designed to better estimate contaminants and volumes. The quantity and period of contaminant release has not been determined.

3.1.1 Ground Water

TCE and 1,1,1-TCA have consistently been detected in ground water samples collected from monitoring wells completed in the perched aquifer on the west side of the facility (DMW1, MW5, MW8, MW10, and MW11). The highest TCE and 1,1,1-TCA concentrations (35.2 mg/L and 32.7 mg/L, respectively) were detected in ground water collected from the treatment well (DMW1) on August 13, 1992. High concentrations of TCE (21.0 mg/L) were also detected in samples collected from MW5 on February 2, 1998. VOCs have not been detected in ground water samples collected from wells completed within the uppermost regional aquifer (MW3, MW6, MW7 and MW12).

3.1.1.1 Lateral Extent

The lateral extent of the contamination/perched aquifer is currently not defined on the northwest side of the site. An additional monitoring well (MW14) has been proposed to define the extent of VOC-contaminated ground water laterally. The FSP includes the location of the proposed monitoring well (Plate 1). Soils in the area of the perched aquifer may fill material or may have been reworked during prior construction activities. This could explain the limited lateral extent of the perched aquifer.

3.1.1.2 Vertical Extent

Ground water at the site has been encountered in two distinct water bearing units. An isolated perched aquifer is approximately 2 to 3 feet below the ground surface on the west side of the site, between the building and Chambers Street. The top of the uppermost regional aquifer is

approximately 25 to 30 feet below the ground surface. Contamination has not been detected in ground water samples collected from wells completed within the regional aquifer. Therefore, the analytical results suggest the vertical extent of contamination has been defined within the isolated perched aquifer. Additionally, historical ground water elevation data suggest the perched aquifer and the uppermost regional aquifer are not hydraulically connected.

3.1.2 Soil

Due to the shallow depth of the perched aquifer, contaminated soils within the vadose zone have not been detected. Soil samples containing detectable VOC concentrations were collected within the saturated zone on the west side of the property. Test excavations have been proposed in this area to locate the source of ground water contamination.

3.1.2.1 Lateral Extent

The source area of contamination at the site has not been located. It is assumed the source area exists within the vadose zone underneath or adjacent to the west side of the facility. This source area appears to be responsible for the elevated levels of chlorinated organics in the perched aquifer.

3.1.2.2 Vertical Extent

Based on data from soil borings and the apparent absence of contamination in the uppermost regional aquifer, it is assumed the contamination source does not extend below a depth of 10 feet.

3.2 Potential Pathways for Contaminant Migration

The most likely pathway for contaminant migration at the site are the utility conduits on the west side of the building and under Chambers Street. Additionally, soil excavation related to the underground storage tank removal may have provided a pathway for the migration of chemicals from beneath the building.

3.2.1 Ground Water

To date, VOCs have consistently been detected in wells installed into the perched water zone (i.e., DMW1, MW5, MW8, MW9, MW10, and MW11). Based on observations made during well development and purging, the hydraulic conductivity of the subsurface media in the area of the perched aquifer is higher than the conductivity of the media in the area of the uppermost regional aquifer. Fill material was encountered to a depth of approximately 10 feet below the ground surface in MW9. Till was encountered in the remaining wells, however it was not possible to establish if this material was placed here or reworked during previous construction activities. Blow counts conducted during drilling indicated a less resistant, less compact media in this area.

The absence of VOCs in ground water samples collected from the uppermost regional aquifer may be explained by the lower conductivity of the deeper unweathered till. Current data suggest that ground water containing VOCs is isolated within the perched aquifer and may travel laterally to

the utility conduits on site and underneath Chambers Street.

3.2.2 Surface/Storm Water

The on-site storm water flow begins at the southern property boundary. The water then flows topographically downgradient to the front of the property through a storm water sewer system. Storm water on the west side of the site enters the sewer system under Chambers Street, which connects into the main storm water sewer line under Conklin Avenue. Storm drains on the east side of the building connect directly into the sewer line under Conklin Avenue. The surface water/storm water exits the site through a culvert that runs north under Conklin Avenue and discharges into a ditch near the railroad tracks. VOCs were not detected in a water sample collected from a catch basin at the front of the property (CB-44).

3.2.3 Soil

As discussed earlier, the location of soil contamination in the vadose zone (source area contamination) has not been clearly established. Based on data obtained to date, it appears that the source area is underneath or on the west side of the building.

Elevated TCE and 1,1,1-TCA concentrations in the soil are anticipated to exist in the material around the building foundation, utility trenches and/or footer drains. If these areas do contain NAPL TCE and/or 1,1,1-TCA, they could act as secondary source areas and pathways for chemical migration.

3.2.4 Air

Another potential migration route for contamination could be through air particulates that contain the chemicals or through direct volatilization. However, field screening during most previous field activities has not indicated VOC levels above background. All intrusive field activities performed during the RI/FS will be monitored using a calibrated PID or an FID.

3.3 Preliminary Risk Assessment

This section presents a preliminary review of the current human health risk that may exist at the site due to historical activities. To characterize the risk fully, calculations should be made based on current analytical data collected from soil, ground water, surface water, and air media, as applicable. A more comprehensive human health risk assessment will be conducted once additional analytical data have been collected and evaluated.

3.3.1 Chemicals of Concern

Shield's *Baseline Summary Report* outlines where samples have been collected at the site, the analyses performed, and the firm that collected the samples. Historical analytical data from the site indicates TCE, 1,1,1-TCA and their degradation products are the main chemicals of concern. During previous sampling events, some SVOCs have been detected at elevated levels in on-site soil samples.

During implementation of the RI/FS field work, selected soil and ground water samples in the source area will be analyzed for the full TCL/TAL. When soil, ground water and/or surface water samples are collected away from the source area, they will be analyzed for the SSPL compounds: TCE, 1,1,1-TCA, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCA, 1,1-DCE, PCE, vinyl chloride and chloroethane. Additional chemicals of concern may be added to the SSPL based on the compounds detected during the TCL/TAL analyses.

3.3.2 Exposure Assessment

The risk of site personnel and visitors being exposed to contaminants is currently anticipated to be low to nonexistent. The site is in a commercial/industrial area, is presumably covered with clean soil, and is partially covered by the building and other structures (e.g., asphalt/concrete materials). Therefore, the wastes are not directly accessible to humans. For these same reasons, air or direct surface runoff should not represent a significant contaminant exposure route for individuals at the site. VOCs were not detected in storm water samples collected from catch basin 44 (CB-44).

On-site ground water does not pose a risk to human health since no drinking water wells are on the site. The lateral migration of contaminated off-site ground water could potentially result in exposure if the ground water surfaces off-site or if affected ground water comes into contact with the Five Mile Point's drinking water aquifer.

Currently, data suggests that the Five Mile Point's aquifer has not been affected by vertical contaminant migration. Water samples from four on-site monitoring wells screened in the uppermost aquifer have been sampled and analyzed for VOCs. To date, all analytical results have been nondetect.

3.3.3 Risk Characterization

Shield personnel and NYSDEC officials have reviewed the available site data, performed site reconnaissance and limited investigations, and indicated the site does not pose an immediate, short-term risk requiring emergency action at the current time. The agency, however, is concerned about possible long-term impacts; therefore, it has recommended initiating a site investigation.

An immediate emergency response is not required at this time since no known imminent danger to human health or the environment exists. Impacts from the vadose zone are generally localized, and contamination has not been found at the downgradient edge of the site property. The New York State ground water standards have been exceeded for PCE, TCE, 1,1,1-TCA, 1,1-DCA, vinyl chloride, chloroethane, and 1,2-dichloroethene (total) in source area ground water monitoring wells.
Short-term exposures can occur at considerably higher concentrations with no health effects as indicated by the health advisory or subchronic concentrations in the 1986 *Superfund Public Health Evaluation Manual, Acceptable Subchronic Intake - Adult*. Finally, access to the ground water is limited although it is not restricted off-site. Although the ground water does not appear to pose an immediate risk to human health and the environment, the concentrations of the chemicals of concern measured in source area soil samples and ground water samples indicate a potential for

longer-term risks to human health.

4.0 WORK PLAN RATIONALE

This section presents the basis for planning, collecting and analyzing additional data for the site. It addresses the development of remedial actions for site wastes by conducting feasibility studies at the site. This section also presents objectives for the investigations as well as DQO and SCG requirements. The approach for the work plan is also outlined in this section.

This Work Plan has assigned project responsibilities and indicates the project schedule. The lead agency for the site is the NYSDEC, Division of Environmental Remediation. It is assumed that the NYSDEC will take the lead in preparing the Community Relations Plan (CRP) and will conduct other public information activities for the site.

It is also assumed that this work plan will be used by the lead regulatory agency, other participating regulatory agencies, and the contractor executing the site work. It is likely that the work plan and associated documents (i.e., FSAP and HASP) will be modified as additional information for the site becomes available.

4.1 Objectives

The objectives for the Former Binghamton Plastics site are as follows:

- Investigate the soil vadose zone, surface water, ground water, and ecology at the site and surrounding areas.
- Investigate potential sources and secondary sources of the chemicals of concern.
- Establish the nature and extent of impacts from contaminant releases at the site.
- Conduct site characterization studies as necessary.
- Conduct data analyses.
- Perform a baseline risk assessment to establish human health and environmental risks.
- If required, conduct detailed remedial evaluations for the identified alternatives selected.
- Develop response options and prepare recommendations for remedial actions at the site, if necessary.
- Prepare reports and summarize results of site investigations, risk assessments, and remedial alternatives evaluation.

4.2 Data Quality Objectives Requirements

The DQO process is a "series of planning steps based on the Scientific Method that is designed so that the type, quantity, and quality of environmental data used in decision making are appropriate for the intended application" (USEPA 1993). DQOs help to clarify study objectives, define types of data to collect, establish appropriate conditions from which to collect data, and specify levels of decision. Guidance for developing DQOs will be partially based on the NYSDEC's *Guidance for the Development of Data Usability Summary Reports* and a preliminary, prepublication copy of the USEPA document entitled *Data Quality Objectives Process for Superfund, Interim Final Guidance* dated September 1993. This USEPA document substantially revises and updates existing USEPA documents regarding DQOs.

The data collected at the site will be separated into two sets of analytical requirements. The first set will include a full TCL/TAL (Table 4 of the QAPP). This data will be collected primarily in the source area and will be used to assure all chemicals of concern are included in the SSPL.

The second analytical requirement will be the SSPL, which will include TCE, 1,1,1-TCA, PCE and their degradation products. This data will be used to define the concentrations and the vertical/lateral extent of VOCs in the on-site soil and on- and off-site ground water. Additional analyses such as dissolved oxygen, redox potential, nitrogen, sulfate, etc. may be performed on selected samples. This data will help to indicate the degree of natural attenuation/degradation that the chemicals originally released have undergone. This data will be collected to assist in conducting a risk assessment, evaluating remedial alternatives, and developing the final remedial action tasks and engineering design.

4.3 New York State Standards, Criteria and Guidelines (SCGs)

The data collected during the RI will be used to identify the applicable SCGs. The SCGs will be evaluated during the FS. Table 1 summarizes the potential SCGs primarily identified for the project.

4.4 Work Plan Approach

The RI will be approached in a phased manner, beginning with procuring the site subcontractor, scheduling, reviewing the site data, and obtaining off-site access. These actions will be followed by field activities to characterize the waste materials, establish the vertical and lateral extent of source area contamination in the unsaturated zone, and establish the vertical and lateral extent of ground water contamination in the source area and downgradient (on-site and off-site). These activities will be performed by advancing borings, installing monitoring wells, and excavating trenches along the potential migration pathways.

Also, ground water flow parameters (i.e., hydraulic conductivities, permeability, and transmissivities) will be established in the perched zone using limited pump tests. Steps will be taken to locate all potential ground water discharge points.

Test pits will also be excavated along potential contaminant pathways to assist in waste

characterization. Waste encountered during the test pit excavations will be sampled and characterized as to its chemical makeup. The vertical and lateral extent of contamination in secondary source areas will be defined as will the risk potential and possible remedial alternatives to reduce risks to acceptable levels.

Ground water characterization will include conducting a well water supply survey near the site and installing and constructing an additional on-site ground water monitoring well. Information regarding the types and concentrations of source area chemicals will be obtained through sampling and analysis of the water, soil, and surface water at identified locations. These data will be used to assess off-site exposures and corresponding risks.

The types, nature, and extent of chemicals in on-site/off-site media will be identified by waste characterization. Potential exposure routes will be defined by the storm water, surface water and ground water investigations. The chemicals of concern will be identified and quantified by the field sampling programs. A risk assessment will then be conducted. Following the identification of any unacceptable risks, remedial alternatives for reducing these risks to acceptable levels would be evaluated during the FS.

4.5 Habitat-Based Assessment (HBA)

A habitat-based assessment (HBA) will be performed as part of the RI/FS in accordance with the NYSDEC Division of Fish and Wildlife guidance document entitled *Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites* (October 1994) and other applicable guidance documents. The objective of this document is to provide guidance for evaluating ecological impacts in areas contaminated with hazardous waste. The HBA is intended for implementation at hazardous waste sites in New York State during the RI and FS phases. The site-specific analysis developed using the HBA will guide the state regulatory agencies in deciding when, where, and to what extent remediation is warranted for the protection of biotic resources.

5.0 REMEDIAL INVESTIGATION TASKS

5.1 Preliminary Project Activities

The following subsections outline the preliminary project RI activities for the Former Binghamton Plastics site.

5.1.1 Site Access

Prior to initiating the project activities, the on- and off-site facility(s) will be notified and permission from the respective property owners and tenants will be obtained in writing.

5.1.2 Permits/Approvals/Notices

Appropriate local/state/federal authorities will be contacted to inform them of site activities and to obtain the necessary permits/approvals in accordance with the Order on Consent Index # B7-0516-97-05. Additionally, the following notices or contacts should be made prior to initiating any site activities:

- NYSDEC will provide the required public notice/meetings prior to site activities.
- Zoning approvals will be obtained for support facility placement, if necessary.
- Utility companies will be contacted for information and requirements for site utility location and any required on-site hookups (telephone, water, electric, etc.).
- Police, fire, hospital and rescue squad agencies will be contacted regarding emergency response.
- Nearby tenants/landowners will be contacted about phone use for emergencies, if required.
- Site tenants will be contacted regarding parking of equipment or supplies.

5.2 Site Activities

As indicated earlier, the site investigations have been developed to obtain pertinent information on the nature and extent of the occurrence of site-related chemicals of interest on and off the site while taking into consideration the nature of the glacial deposits in the study area. Field sampling and analysis protocols will follow state guidelines and the USEPA Region IV's *Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual (SOPQAM)* dated February 1, 1991. The FSAP for the Former Binghamton Plastics project is contained in Appendix A. The HASP is contained in Appendix B.

5.2.1 Soil/Unsaturated Zone

The purpose of soil sampling is to establish the vertical and horizontal extent and contaminant concentrations in the soil/vadose zone at the site. Soil sampling will be conducted during the RI using two main sampling techniques. The first technique involves using an excavator (e.g., trackhoe or backhoe) to establish if utility conduits/footer drains are acting as pathways for contaminant migration. The second sampling technique will entail using split-spoon soil samplers advanced with a mobile drill rig.

Soil samples will be collected during the monitoring well installation and during advancement of the source area borings. All soil samples will be analyzed by Quanterra Environmental Services of North Canton, Ohio. The following two sections give a general description of the soil sampling activities. The FSAP (Appendix A) contains more precise sampling protocols.

5.2.1.1 Test Pit Excavations

Initially, the test pits will be excavated around the perimeter of the building. The test pits will be excavated in areas where man-made conduits and building footers exist. Test pits will also be excavated in the area of the former underground storage tank. It is estimated that seven test pits will be excavated along the west side of the building. If field screening devices and laboratory analysis of the test pit material indicate contamination in the man-made conduits, one or more test pits will be excavated downgradient along the conduit to establish the extent of contaminant migration.

A backhoe or trackhoe will be used to excavate the test pits. The excavated material will be stockpiled on plastic during the excavation. If the field screening equipment records measurable detections or if field personnel visually observe contamination, the contaminated material will be transported to a central stockpile on the west side of the building. The excavated material will be sampled and analyzed; it will be stockpiled on and covered with plastic while awaiting disposal. The test pits will be backfilled with "clean" fill material. If no visual signs of contamination are observed by personnel or detected by the field screening equipment during the test pit excavation, the original material will be used to backfill the pit. Access to the excavation areas and stockpiled soil will be restricted using barricades and caution tape. Excavations will not be left open over night.

As outlined in the appended FSAP, approximately two soil samples will be collected from each test pit. One soil grab sample will be collected from the area with the most elevated PID/FID reading or the most visually contaminated area. If contamination is detected with field screening instruments or is visually observed, limited excavation will continue to define the extent of contamination. Additional soil samples will be collected from the final excavation walls and bottom. These samples will be a confirmatory sample to establish the remaining contaminant concentration in the excavation walls. The confirmatory sample with the highest field screening result will be submitted to the laboratory for analysis. If the material around the conduit or building footer does not appear to be contaminated, then one confirmatory sample will be collected from the test pit walls. If abundant water enters the excavation from a potential source area, a water sample will be collected and analyzed for the SSPL or TCL/TAL.

As outlined in the HASP, the personal protective equipment (PPE) used during excavation activities will begin at Level D. If VOC concentrations in the breathing zone consistently remain at 1 ppm above background (as detected with a calibrated PID/FID), respiratory protection will be upgraded to Level B. The PID will be calibrated using a 0.6 response factor as recommended by the manufacturer for the detection of TCE. This response factor is similar for all of the halogenated organics listed in the equipment manual. Additionally, if particulate monitoring indicates particulate concentrations exceed 100 ug/m^3 above background, dust suppression techniques will be implemented.

5.2.1.2 Soil/Unsaturated Zone - Borings

During monitoring well installation and utility conduit investigation activities, split-spoon soil samples will be collected. Samples will be collected continuously for the total depth of the borings.

The samples will be described for lithologic content and field screened using a calibrated PID/FID. It is anticipated that one soil sample with the highest field screening result for every 10 feet will be submitted for laboratory analysis to establish a vertical profile of contaminant concentrations. All split-spoon soil samples will be collected in accordance with the FSAP. Currently, only one downgradient monitoring well and two utility conduit soil borings are planned downgradient of the suspected source area.

Utility Conduit Area Soil Sampling

Soil borings will be advanced in the vicinity of Manhole 282 (MH 282) and Catch Basin 342 (CB 342). Split-spoon samples will be collected continuously from each boring and field screened with a PID. The sample with the highest field screening result will be submitted to the laboratory for analysis. The base of the utility conduits is not anticipated to exceed a depth of 4 feet. Each boring will be advanced to a depth of 6 feet below the ground surface.

5.2.2 Ground Water

Ground water monitoring well installation, monitoring well sampling and till water aquifer testing will be conducted during the RI field activities. The ground water investigative activities will be conducted to establish the vertical and lateral extent of affected ground water and to determine aquifer(s) parameters at the subject site.

Historically, twelve monitoring wells and one recovery well have been installed on-site. Currently however, eleven monitoring wells and one recovery well are on the site. Four monitoring wells have been installed into the uppermost regional aquifer down- and sidegradient of the suspected source area. VOCs have not been detected in ground water samples collected from any of these wells. To avoid cross contamination of the uppermost regional aquifer, no wells have been installed into this aquifer directly below the suspected source area and contaminated perched aquifer. The lateral extent of the perched aquifer has been defined to the west by MW13 and to

the east by MW12. One additional well (MW14) has been proposed to define the extent of the perched aquifer downgradient to the north. Shield's *Baseline Summary Report* contains well construction details and monitoring well analyses. As part of the RI, it is anticipated that at least two ground water sampling events will occur after the proposed monitoring well is installed.

5.2.2.1 Monitoring Well Installation

Initially, Shield proposes that one ground water monitoring well (MW14) be installed on the northwest side of the property. This well has been proposed to define the northern extent of the perched aquifer.

The monitoring well will be installed using 4.25-inch I.D. hollow stem augers and constructed with 2-inch PVC riser and screen. A maximum of 10 feet of screen will be installed in the well. All drill cuttings will be containerized and characterized for disposal.

If water is encountered in the monitoring well, the well will be developed to remove suspended sediment using a submersible pump. Water and sediment will be removed until the suspended sediment is less than 50 NTUs or until the well runs dry. The development water will be placed in a 55-gallon drum and staged on site pending analysis and disposal.

5.2.2.2 Chemical Ground Water Analysis

After the proposed monitoring well is installed, ground water sampling will be conducted if water is present in the well. The monitoring well will be developed and purged in accordance with the FSP. All on-site wells will be purged and sampled using the low-flow sampling procedures as described in the FSP. The ground water sample collected from MW5 will be analyzed for the full TCL/TAL compounds. Samples from the remaining monitoring wells will be analyzed for the SSPL.

5.2.2.3 Aquifer Flow Parameters Analysis (Limited Pump Test)

Aquifer testing will be performed on the perched aquifer using a step drawdown test and limited pump test for at least two on-site wells. The monitoring wells that will be used for the limited pump tests are DMW1 and MW5.

The purpose of the step drawdown test is to establish the approximate maximum flow rate of the well. The limited pump test will be used to estimate hydraulic conductivity, transmissivity, and permeability of the aquifer in which the test well is installed. The test will also establish a radius of influence from the pumping well.

The test will be performed by establishing a constant pumping rate. The constant pumping rate will be within an accuracy of plus or minus 0.1 gallon a minute. A pressure transducer equipped with a data logger will be installed in the pumping well below the pump. The transducer will measure the water level during pumping. The pumped well water will be pumped to and treated by the on-site activated carbon water treatment system. It is estimated the duration of the step

drawdown pump test will be 4 to 5 hours.

The step drawdown test and the limited pump test will be performed on two wells. DMW1 was constructed with the screen installed from 5 feet to 15 feet below the ground surface. According to the soil boring logs, this well was installed into a fine to coarse gravel. This gravel is most likely fill material placed after the underground storage tank removal. In addition to having a transducer in the pumping well, pressure transducers with data loggers will be installed in several temporary 2-inch-diameter observation wells as well as currently existing monitoring wells.

After the limited pump test from DMW1 and the appropriate decontamination procedures have been completed, a pump will be installed in MW5. MW5 was constructed with the screen installed from 10 to 20 feet below the ground surface. According to the soil boring logs, MW5 was installed into till described as a grayish-brown clay with poorly sorted subrounded gravel. A second step drawdown test and limited pump test will be conducted on MW5 as described above.

The aquifer tests will be conducted within two different types of media (fill/gravel and till). These tests should provide sufficient data to evaluate the permeability/conductivity/transmissivity of the entire perched aquifer.

5.2.3 Surface/Storm Water

With the exception of the standing water in the catch basins, there is no surface water on site. Storm water will be sampled and analyzed for the SSPL to establish the VOC concentrations on-site. Also, surface water will be collected from two locations off-site and downgradient of the property, where storm water flows under Conklin Avenue. Surface water samples will be collected during relatively low flow periods. Samples will not be collected during or shortly after significant rain events. These samples will be collected to establish whether any detectable concentrations of SSPL VOCs are in the storm water leaving the site.

The surface/storm water sampling will be conducted at the following locations (Plate 1):

Manhole 282 (MH-282)
Catch Basin 342 (CB-342)
Catch Basin 45 Outfall (CBO-45)

Surface/storm water samples will be collected in accordance with the procedures described in the FSAP. Discharge measurements of the flowing surface water at the property boundary will be made for volumetric analyses. The surface water and sediment sampling is anticipated to be conducted using Level D PPE.

5.2.4 Air

An initial air monitoring survey will be conducted at the site to establish baseline conditions. This survey will take place in and around the perimeter of the site in Level D PPE. Readings will be collected along the property boundaries using a properly calibrated PID and/or FID meter held 6 to

12 inches above the ground surface and at the breathing zone. Additionally, background particulate concentrations will be established using a Miniram particulate/dust monitor. The readings will be recorded in a field notebook and analyzed at a later time.

Air monitoring techniques will be used at the site during test pit excavations and drilling activities. The air monitoring program will be performed with a PID and/or an FID, and a particulate monitor and will be used primarily for the health and safety of the site personnel. Ambient air readings will be collected during the trenching operations and continuously during test pit activities. Shield personnel will record ambient air readings in the site log book.

5.3 Remedial Investigation Report

The purpose of the remedial investigation is to establish the concentrations and define the extent of the contaminants on and off site. The data collected during the RI will be presented in a in a report and submitted to the NYSDEC for review.

6.0 FEASIBILITY STUDY TASKS

The main objective of the FS will be to identify appropriate and cost-effective alternatives for addressing any risks to human health and the environment as required by law, and will include the no action alternative.

6.1 Development of Remedial Objectives

Site objectives for the response will be established based upon human health and the environment concerns, information gathered during the RI, state guidance documents, Section 300.68 of the National Contingency Plan (NCP), USEPA guidance, and the requirements of other applicable state or federal statutes.

Based upon the results of the RI, a site-specific statement of objectives for the response will be prepared. This statement of objectives will be organized in terms of components amenable to descrete remedial measures (e.g., a statement describing the evaluation of alternatives for treatment of ground water, soil, etc.) and will include the specific cleanup criteria to be used.

6.2 Identify Areas of Contamination

This task entails summarizing information from the site background reports/data and interpreting the information acquired during the RI investigative activities to establish the extent of contamination. The areas of contamination will be categorized by media (i.e. soil, ground water, air). The vertical and lateral extent of contamination in these media will be identified.

6.3 Identify Technologies/Process Options

Technologies/process options will be developed that will incorporate remedial technologies, response objectives, and other appropriate considerations into a comprehensive, site-specific approach. Technologies/process options will include various treatment, removal, containment, and no action options. The technologies/process options will be developed in close consultation with the NYSDEC. Technologies that reduce the mobility, toxicity, or volume of contaminants or lead to a permanent remedy will be considered in the technologies/process options.

6.4 Development of Remedial Alternatives

Alternatives will be developed that will incorporate remedial technologies, response objectives, and other appropriate considerations into a comprehensive, site-specific approach. Alternatives will include various treatment, removal, containment, and no action options. The alternatives will be developed in close consultation with the NYSDEC. Technologies that are innovative; reduce the mobility, toxicity, or volume of contaminants; or lead to a permanent remedy will be considered in the alternatives.

6.5 Initial Screening of Alternatives

The identified alternatives will be screened to eliminate those that are clearly not feasible or appropriate prior to undertaking detailed evaluations of the remaining alternatives. The following considerations will be used as a basis for the initial screening:

- EFFECTIVENESS: Only those alternatives that satisfy the response objectives and contribute substantially to the protection of human health and the environment will be considered further. Both short-term and long-term components of effectiveness will be evaluated. Source control alternatives will be selected to achieve adequate control of source materials. Remedial alternatives will be selected to minimize or mitigate any identified excess risk to human health or the environment. Alternatives that result in a reduction in the toxicity, mobility, or volume of chemical constituents will be favored.

- IMPLEMENTABILITY AND RELIABILITY: Alternatives that may prove extremely difficult to implement or will not achieve the remedial objectives in a reasonable period will be eliminated. Both technical and administrative considerations will be used for the alternatives screening.

6.6 Detailed Evaluation of Remedial Alternatives

The alternative remedies that pass the initial screening above will undergo a more detailed evaluation as discussed below.

The detailed development of the remaining, feasible remedial alternatives may include:

- Description of appropriate treatment and disposal technologies.

- Special engineering considerations required to implement the alternatives (e.g., pilot treatment facility, additional studies needed to proceed with the final remedial design).

- Environmental impacts of proposed methods and costs for mitigating any adverse effects.

- Operation, maintenance, and monitoring requirements of the remedy.

- Off-site disposal needs and transportation plans, if appropriate.

- Temporary storage requirements.

- Safety requirements for remedial implementation (including both on-site and off-site safety considerations).

- A description of how the alternative could be phased into individual operable units. The description will include a discussion of how various operable units of the total remedy could be implemented individually or in groups, resulting in a significant improvement to the

environment or savings in costs.

- A description of how the alternative could be segmented into areas to allow for the implementation of differing phases of the alternative.

Alternatives will be evaluated using technical, environmental, and economic criteria. At a minimum, the following criteria will be used to evaluate the alternatives:

- *Overall Protection of Human Health and the Environment* will address whether a remedy provides adequate protection and will describe how risks posed through each pathway are eliminated, reduced or controlled through treatment, engineering controls, or institutional controls.

- *Compliance with SCGs* will address whether a remedy will meet all of the state requirements and SCGs of other federal environmental statutes and/or provide grounds for invoking a waiver.

- *Long-Term Effectiveness and Permanence* is the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met.

- *Reduction of Toxicity, Mobility, or Volume Through Treatment* is the anticipated performance of the treatment technologies employed by a remedy.

- *Short-Term Effectiveness* will address the time needed to achieve protection from any adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

- *Implementability* is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

- *Cost* will include the estimated capital, operation, and maintenance costs, as well as net present worth costs.

The individual analysis of alternatives will include a technical description of each alternative that outlines the waste management strategy involved and identifies the key SCGs associated with each alternative. The analysis will also include a discussion of the performance of that alternative with respect to each of the evaluation criteria. A table summarizing the results of this analysis will be prepared. Once the individual analyses are complete, the alternatives will be compared and contrasted with one another with respect to each of the evaluation criteria.

The preferred alternative will represent the best balance across all the evaluation criteria examined in the detailed analysis. In making this selection, the statutory preference for a treatment that permanently and cost-effectively reduces the toxicity, mobility or volume of the waste will be considered.

6.7 Feasibility Study

A report presenting the results of the above activities and the recommended remedial alternative will be prepared. The report will contain a conceptual design of the selected remedial alternative. The conceptual design will include the engineering approach including the implementation schedule, special implementation requirements, institutional requirements, phasing and segmenting considerations, preliminary design criteria, preliminary site and facility layouts, cost estimates (including operation and maintenance costs), operating and maintenance requirements and duration, and an outline of the safety plan for implementation.

7.0 SCHEDULE

Figure 3 outlines the anticipated schedule for the RI/FS activities associated with the Former Binghamton Plastics project. This schedule assumes that the state and The DII Group will cooperate in a joint effort to complete these tasks in an expedited manner. Only the major tasks associated with the project are indicated in this schedule.

It is assumed that periodic meetings will be conducted with state personnel to facilitate the smooth and rapid progress of site activities. At the current time, it is anticipated that quarterly meetings will be held with the state or other regulatory personnel.

8.0 PROJECT MANAGEMENT

8.1 Project Organization

The RI/FS activities to be conducted at the Former Binghamton Plastics site will be under the jurisdiction and oversight of the NYSDEC. The DII Group has selected Shield to manage the various activities.

Three major activities have been identified for the Former Binghamton Plastics project. These tasks include:

- Site investigations
- Risk assessment
- Remedial alternatives evaluation

8.2 Key Personnel

The key personnel identified for this project include the NYSDEC's Project Manager, James A. Moras, P.E., and Thomas Smach V.P., The DII Group. The remaining personnel will be selected by Shield.

8.2.1 Shield's Project Director

Daniel V. Terrell III, will serve as the Project Director. Mr. Terrell will be responsible for assessing and monitoring the overall project progress, approving project plans and reports, making conclusions/recommendations, and leading major briefings/meeting negotiations.

8.2.2 Shield's Project Manager

Michael E. Morris, P.G., will serve as the Project Manager. His responsibilities will include project team management, being the focal point for day-to-day client interactions and conducting briefings and client regulatory meetings. Mr. Morris will also be responsible for project scheduling, budget monitoring, technical task integration and communications and coordination of team leaders and field efforts. He will also monitor the project for adherence to the QAPP.

8.2.3 Quality Assurance Officer

Barbara H. Jones will serve as the Quality Assurance Officer. Ms. Jones has the primary responsibility for overseeing and implementing the quality assurance (QA) program. She reports directly to the Project Director. In her role as Quality Assurance Officer, Ms. Jones will provide independent oversight so that overall QA procedures are in place for the project.

8.2.4 Site Supervisor

Kreg Mills will be designated as the Site Supervisor. Mr. Mills will be responsible for overseeing all on-site activities. He will also interact with other field personnel so that field efforts are

successfully completed. The Site Supervisor will communicate regularly with the Project Manager concerning the project status, additional material and/or labor needs, etc., and keep a daily summary of all on-site activities.

8.2.5 Site Health and Safety Officer

The Health and Safety Officer is responsible for the proper operation of all safety equipment, monitoring activities during site work, selecting the necessary level of personal protection, and enforcing the HASP. Sarah Donaldson will act as the Health and Safety Officer for this project. The Health and Safety Officer will have the authority to stop work if conditions exceed allowable limits. The Health and Safety Officer will assist other members of the field team as needed to maintain the safe operation of the field program.

8.2.6 Sample Custody Officer

Kreg Mills will be the Sample Custody Officer. Mr. Mills will be responsible for the proper completion of sample custody forms as well as packing and shipping samples. He will also be responsible for notifying the analytical laboratory of sample shipments including the number and types of samples that are being shipped.

8.2.7 Sampling Personnel

Sampling personnel are responsible for helping the Project Manager during sample collection. Specific responsibilities include proper sample collection, packaging, documentation, and chain-of-custody documentation until samples are released to another party for storage or transport to the analytical laboratory. Sampling personnel will also be responsible for the correct and complete decontamination of sampling equipment.

8.2.8 Drilling/Excavation/Surveying Subcontractors

The drilling/excavation/surveying subcontractors are responsible for supplying all services (including labor), equipment and materials required to perform the excavation/drilling/surveying activities. The excavation subcontractors are further responsible for conducting necessary maintenance and QC of required equipment and for following decontamination procedures specified in the FSP, HASP, and QAPP. Upon completing the work, the subcontractors will be responsible for demobilizing all equipment, cleaning up any materials deposited on-site, and properly filling excavated/drilled areas as directed.

8.2.9 Analytical Subcontractor

The analytical subcontractor for this portion of the project will be Quanterra Environmental Services, a full-service analytical laboratory. Quanterra will be responsible for the analysis of all waste, soil, and liquid samples collected from the site. The laboratory will also be responsible for the QA/QC implementation and documentation of all analyses performed on the samples.

8.2.10 Other Authorized Personnel

All field personnel are to comply with federal, state and local safety codes, ordinances, and regulations to maintain safe working conditions at the job site. All personnel will be responsible for reporting unsafe working conditions to the Health and Safety Officer, Site Supervisor, or Project Manager. Prompt reporting of unsafe conditions is critical to provide field personnel with proper information, first aid, or other medical treatment in a timely manner; therefore, all questions or inquiries must be addressed to one of these persons immediately.

The Project Manager, Site Supervisor, and Health and Safety Officer are responsible for enforcing health and safety requirements including the following:

- Team members have received the required health and safety training.
- Team members are familiar with the health and safety procedures outlined in this plan.
- Equipment used on-site is suitable and adequate.
- Standard operating procedures are followed.

The designated Health and Safety Officer has direct responsibility for administering and coordinating all site health and safety activities. The Site Supervisor and/or Health and Safety Officer will be in the field full-time while site activities are in progress. The Health and Safety Officer is responsible for responding to any unanticipated health and safety concerns encountered. Appropriate actions will be directed by the Health and Safety Officer to protect site workers.

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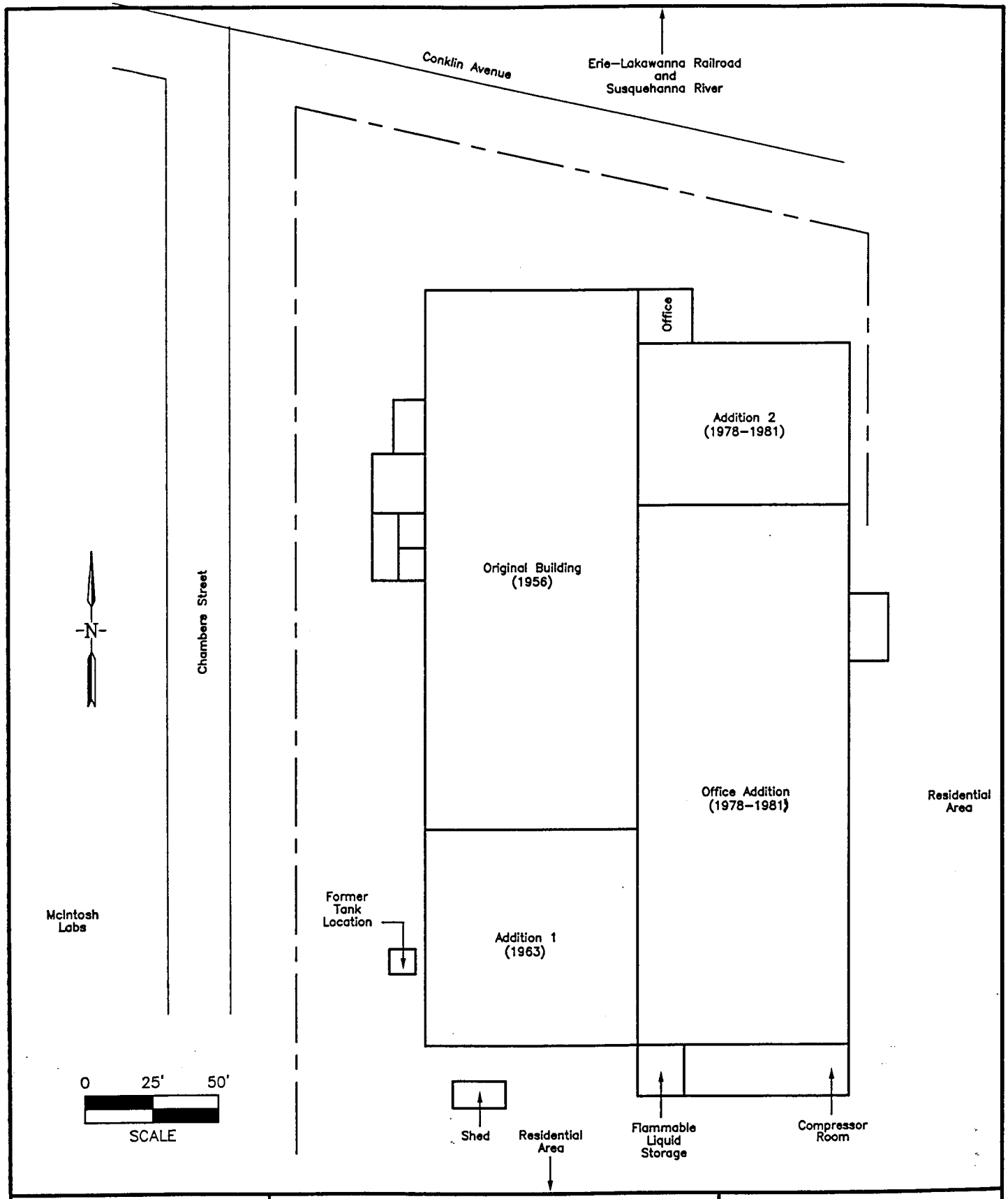
SOURCE: USGS Topographic Quadrangle Maps
Binghamton East, New York
1968 – Photoinspected 1976
Binghamton West, New York
1968 – Photoinspected 1976

N

0 1,000' 2,000'
SCALE

DATE: 12/2/97	FIGURE 1	**SHIELD**
DRAWN BY: P.D.H.	SITE LOCATION MAP DII – BINGHAMTON PLASTICS CONKLIN AVENUE BINGHAMTON, NEW YORK	ENVIRONMENTAL ASSOCIATES, INC.
APPROVED BY: M.M.		LEXINGTON, KENTUCKY
CLIENT NO.: 396–0460		

09

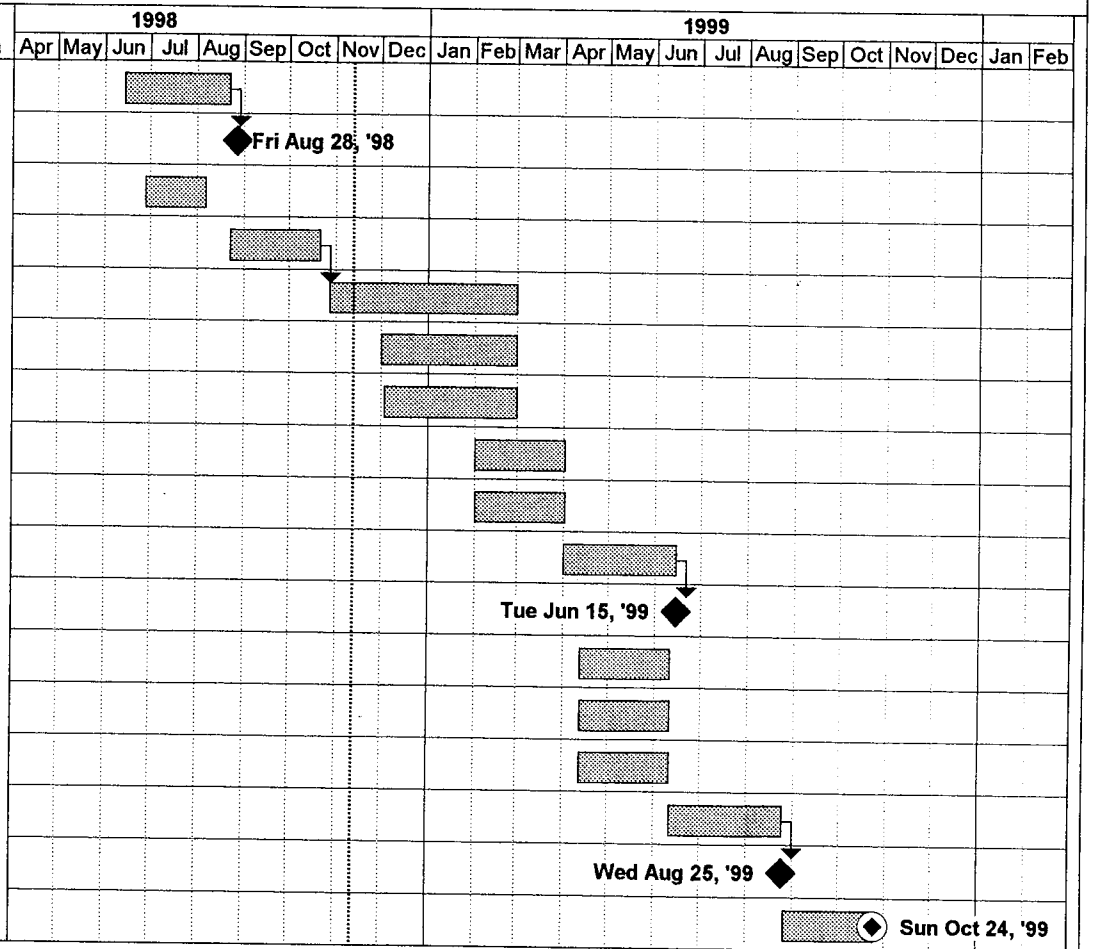


DATE: 1/23/98	FIGURE 2	**SHIELD**
DRAWN BY: P.D.H.	MAP SHOWING HISTORICAL SITE FEATURES AND SURROUNDING PROPERTIES	ENVIRONMENTAL ASSOCIATES, INC.
APPROVED BY: M.M.	DII – BINGHAMTON PLASTICS	
CLIENT NO.: 396–0460	CONKLIN AVENUE, BINGHAMTON, NEW YORK	LEXINGTON, KENTUCKY

60460–2

FIGURE 3
FORMER BINGHAMTON PLASTICS
RI / FS Schedule

ID	Task Name	Duration
1	Task 1 - Project Planning (RI/FS Work Plan)	70d
2	Submittal of RI/FS Work Plan to the NYSDEC	1d
3	Task 2 - Citizens Participation Plan Preparation (Prepared by NYSDEC)	40d
4	NYSDEC Review and Approval of Work Plan/CPP	60d
5	Task 3 - RI/FS Field Investigation	124d
6	Task 4 - Sample and Analysis/Validation	90d
7	Task 5 - Data Evaluation	88d
8	Task 6 - Risk Assessment	60d
9	Task 7 - Treatability Studies	60d
10	Task 8 - RI Report	75d
11	Submittal of RI Report	1d
12	NYSDEC Review and Approval of the RI Report	60d
13	Task 9 - Remedial Alternatives Development and Screening	60d
14	Task 10 - Detailed Analysis of Alternatives	60d
15	Task 11 - FS Report	75d
16	Submittal of FS Report	1d
17	NYSDEC Review and Approval of FS	60d



Project: DII-BINGHAMTON
Date: Thu 11/12/98

Task

Milestone

TABLE 1
POTENTIAL APPLICABLE STANDARDS, CRITERIA AND GUIDELINES (SCGs)

1) Division of Water Technical and Operational Guidance Services (1.1.1) Ambient Water Quality Standards and Guidance Values (originator: Jon Zambruno)

2) Technical and Administrative Guidance Memorandum: Determination of Soil Cleanup Objectives and Clean Levels (TAGM 4046) 1994

3) New York State Inactive Hazardous Waste Site Citizen Participation Plan, August 30, 1998

4) Fresh Water Wetlands Mapping and Classification Regulations 6 NY CRR Part 664

5) NYSDEC Division of Environmental Remediation Guidance for the Development of Data Usability Summary Reports

* The SCG's will potentially expand after the conclusion of the RI

FIELD SAMPLING AND ANALYSIS PLAN

FIELD SAMPLING PLAN (FSP)
QUALITY ASSURANCE PROJECT PLAN (QAPP)

DOVATRON INTERNATIONAL
ORDER ON CONSENT INDEX #B7-0516-97-05
SITE CODE #704024

Former Binghamton Plastics Site
498 Conklin Avenue
Binghamton, New York

Prepared by:

SHIELD ENVIRONMENTAL ASSOCIATES, INC.
Lexington, Kentucky
November 11, 1998

Job No. 396-0460

FIELD SAMPLING PLAN

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TABLES

ATTACHMENTS

1 USEPA Low-Flow Sampling Guidance

1.0 INTRODUCTION

The Field Sampling and Analysis Plan (FSAP) for the Former Binghamton Plastics State Superfund Site, City of Binghamton, Broome County, New York, supplements information found in the Remedial Investigation/Feasibility Study (RI/FS) Work Plan. The Work Plan develops the objectives and scope of work, and defines what and how site activities will occur. The FSAP consists of two documents: the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP). The FSP describes how various field sampling and analytical activities will be performed. The FSP also identifies the sampling and analytical objectives and provides detailed procedures for sample collection, handling, shipping, and analysis. Quality assurance/quality control (QA/QC) procedures are specified in the QAPP.

Since the Work Plan has delineated specific field operation procedures, the FSP will concentrate solely on specific sampling and analysis protocols. This FSP will conform, where appropriate, to the United States Environmental Protection Agency (USEPA) *Superfund Remedial Design and Remedial Action Guidance* (USEPA) 1986.

1.1 Site Location and Description

The site is located in the City of Binghamton, Broome County, New York (Figure 1). The property measures approximately 4 acres and is 700 to 800 feet south of the Susquehanna River at 498 Conklin Avenue. Figure 2 shows the site and surrounding properties.

1.2 Site History

The facility at the subject site was constructed in 1956 by Binghamton Plastics. Additions to the property were constructed in 1963, 1974, and 1982. Universal Instruments Corporation purchased the facility in the early 1980s and continued operations until Universal Instruments was taken over by Dover Electronics Corporation. In 1993, Dover Electronics was separated from Dover as a stand alone corporation named Dovatron, Inc. In 1996, Dovatron changed its name to the DII Group. The building has been occupied by McIntosh Laboratories since the late 1980s. The facility has been used as a circuit board assembly plant and is currently operated as an electronic repair facility.

The subject site consists of a large industrial building (44,800 square feet) with associated parking, landscape, and storage areas. A complete list of chemical substances used at the plant is not available; however, the use of trichloroethene (TCE) and 1,1,1-trichloroethane (1,1,1-TCA) has been substantiated.

In addition, a 1,000-gallon underground storage tank (UST) that was used to store hydraulic oil contaminated with 1,1,1-TCA and TCE, was removed in 1986. Figure 2 shows the former location of the tank and significant site features.

Shield reviewed a June 1990 letter to Hagopian Engineering Associates from the Broome County Health Department (Hagopian 1990). This letter indicated three contaminated sites were within a 1/2-mile radius of Conklin Avenue. One of those sites was identified as Binghamton Plastics Dump,

which was listed as being located at 498 Conklin Avenue. Reportedly, waste plastics and oils were thought to have been disposed of at the site. However, this information has not been substantiated.

Shield Environmental Associates, Inc. (Shield) has conducted periodic groundwater monitoring and additional site investigations that have substantiated the presence of TCE, 1,1,1-TCA, and their degradation products in the soils and groundwater at the site. The contamination appears to be isolated to a perched water zoned on the west side of the building and may have infiltrated the utility conduits in Chambers Street.

2.0 SAMPLING OBJECTIVES

2.1 General Objectives

The objectives for representative sample collection are:

- To perform sampling such that the sample taken is truly representative of the material or medium being sampled;
- To use proper sampling, sample handling, preservation, and QC techniques;
- To properly identify the collected samples and document their collection in permanent field records;
- To maintain sample chain-of-custody forms; and
- To protect the collected samples by properly packing and transporting (shipping) them to a laboratory for analysis.

This section briefly outlines only those field sampling and analysis procedures required to conduct the various site investigations during the RI/FS. Detailed descriptions of the procedures that will be used to accomplish these tasks are given in the following sections. The site investigation activities to be performed have been devised based upon the available data. Some adjustments to these prepared activities may be required as additional data become available or as field conditions dictate. The following sections provide specific sampling objectives for the proposed drilling, excavation/trenching, sampling, and air monitoring activities. A description of the waste sampling activities is also included in this document. The schedule for these activities is provided in the Work Plan prepared for the site entitled *Remedial Investigation/Feasibility Study Work Plan, Former Binghamton Plastics Site, City of Binghamton, Broome County, New York.*

2.2 Subsurface Soil Sampling

Soil sampling activities will be conducted using an excavator (test trenches) and a drill rig (soil borings and monitoring wells). The purpose of the sampling activities is to locate source areas and to define the extent of the site related contaminants at the study area and their existing concentrations. Procedures for soil sampling are outlined in Section 5.3 of this document.

These activities will be conducted to further evaluate the extent of the affected soils at the site; refine chemical concentrations at suspected exposure locations; and amend and modify the Health and Safety Plan (HASP) and other pertinent documents, as appropriate. The data collected will be used to further refine estimated volumes of affected soils requiring treatment.

2.3 Ground Water Sampling

All existing and newly installed monitoring wells will be sampled. The purpose of these samples

is to establish the water quality in the newly installed wells and to evaluate the current contaminant concentrations in existing wells and compare them to past sampling events. Procedures for ground water sampling are outlined in Section 5.4 of this document.

The objective of the ground water sampling is to establish the extent and concentration of contaminants in the on-site and off-site ground water. The data collected will be used to refine the extent of affected ground water.

2.4 Surface Water/Storm Water Sampling

Surface water samples will be collected from selected catch basins and catch basin outfalls on and off site. These samples will be collected to establish the presence or absence of contaminants in run-off water that passes through the storm sewer system at the site. Procedures for surface water/storm water sampling are outlined in Section 5.4 of this document.

The objective of the surface water sampling is to establish the extent and concentration of contaminants in storm water run-off. The data collected will be used to establish the presence of contaminants within the storm water utility conduits at the site.

3.0 SAMPLE LOCATION, FREQUENCY, AND DESIGNATION

Samples collected at the site and surrounding areas will be of various media, including soil, sediment, ground water, and surface water. Table 1 summarizes the sample locations, minimum frequencies, and analytes proposed for the site sampling activities. It is anticipated that the test trenches, monitoring wells, and soil borings will be located in the areas shown on Plate 1. The sampling locations will be in areas with data gaps or areas where data collection will refine existing information on the extent of areas with elevated chemical concentrations. Table 2 is a sampling summary that outlines proposed sampling locations, identification, types of samples collected, and analyses performed.

A minimum of 10 percent of the environmental samples collected will be for QA/QC purposes. These samples will be in the form of duplicate samples, spiked samples, and field and trip blanks. Additional information on QA/QC procedures is contained in the QAPP.

Each sample collected for analysis will be assigned a specific identification number. The Site Manager will oversee the numbering system so that each sample is correctly identified and no inadvertent duplications are assigned. The Site Manager will keep a Sample Identification and Tracking Log of all samples by matrix and sample location (Figure 3). Copies of all chain-of-custody forms will also be maintained in this log.

Sample identification numbers may consist of at least three separate elements:

- Sequential sample location number.
- Sample type and number.
- Sample depth, if applicable.

Sample locations will be designated by the following codes preceded by a sequential location number or predesignated identification number:

T	- Test Trench
MW	- Monitoring Well
SB	- Soil Boring
MH	- Manhole
CB	- Catch Basin
CBO	- Catch Basin Outfall

The sample types are designated with the following codes:

SS - Subsurface soil sample
GW - Ground Water Sample
SW - Surface Water Sample

4.0 SITE MANAGEMENT PLAN

This section provides general operating guidelines for work to be conducted at the site including site access, traffic control and organization of the field team. Responsibilities of each of the field team members are also indicated in this section.

4.1 Site Control

4.1.1 Site Access

The MacIntosh Laboratory facility, located on the subject site, is an active facility; therefore, site access will not be restricted. However, work zones, such as trenching areas and drilling sites, will be properly barricaded to prevent access by unauthorized personnel.

4.1.2 Traffic Control

Traffic will be restricted from active work zones using traffic cones or barricades as needed.

4.2 Project Organization and Personnel Responsibilities

Shield's project team at the site will work under the direction of the Project Director and Project Manager. Project personnel responsibilities are listed below.

- Project Director: Daniel V. Terrell III will serve as the Project Director. Mr. Terrell will be responsible for assessing and monitoring the overall project progress, approving project plans and reports, making conclusions/recommendations, and leading major briefings/meeting negotiations.

- Project Manager: Michael E. Morris, P.G., will serve as the Project Manager. Mr. Morris' responsibilities will include project team management, being the focal point for day-to-day client interactions and conducting briefings and client regulatory meetings. Mr. Morris will be responsible for project scheduling, budget monitoring, technical task integration and communications and coordination of team leaders and field efforts. He will also monitor the project for adherence to the QAPP.

- Quality Assurance Officer: Barbara Jones will serve as the Quality Assurance Officer. Ms. Jones will have the primary responsibility for overseeing and implementing the quality assurance (QA) program. She will report directly to the Project Director. In her role as Quality Assurance Officer, Ms. Jones will provide independent oversight so that overall QA procedures are in place for the project.

- Site Supervisor: Kreg Mills will be designated as the Site Supervisor. Mr. Mills will be responsible for overseeing all on-site activities. He will also interact with other field personnel so that field efforts are successfully completed. The Site Supervisor will communicate regularly with the Project Manager concerning the project status, additional material and/or labor needs, etc., and keep a daily summary of all on-site activities.

- Site Health and Safety Officer: The Health and Safety Officer is responsible for proper operation of all safety equipment, monitoring activities during site work, selecting the necessary level of personal protection, and enforcing the HASP. Sarah Donaldson will act as the Health and Safety Officer for this project. The Health and Safety Officer will have the authority to stop work if conditions exceed allowable limits. The Health and Safety Officer will assist other members of the field team as needed to maintain the safe operation of the field program.

- Sample Custody Officer: Kreg Mills will be the Sample Custody Officer. Mr. Mills will be responsible for the proper completion of sample custody forms as well as packing and shipping samples. He will also be responsible for notifying the analytical laboratory of sample shipments including the number and types of samples that are being shipped.

- Sampling Personnel: Sampling personnel are responsible for helping the Site Manager during sample collection. Specific responsibilities include proper sample collection, packaging, documentation, and chain-of-custody documentation until samples are released to another party for storage or transport to the analytical laboratory. Sampling personnel will also be responsible for the correct and complete decontamination of sampling equipment.

- Drilling/Excavation/Surveying Subcontractors: The drilling/excavation/surveying sub-contractors are responsible for supplying all services (including labor), equipment and materials required to perform the excavation/drilling/surveying activities. The excavation subcontractors are further responsible for conducting necessary maintenance and QC of required equipment and for following decontamination procedures specified in the FSP, HASP, and QAPP. Upon completing the work, the subcontractors will be responsible for demobilizing all equipment, cleaning up any materials deposited on-site, and properly filling excavated/drilled areas as directed.

- Analytical Subcontractor: The analytical subcontractor for this portion of the project will be Quanterra Environmental Services, a full-service analytical laboratory. Quanterra will be responsible for analyzing all waste, soil, sediment, and liquid samples collected from the site. The laboratory will also be responsible for the QA/QC implementation and documentation of all analyses performed on the samples.

5.0 SAMPLING/MONITORING EQUIPMENT AND PROCEDURES

5.1 Introduction

This section of the FSP outlines the step-by-step procedures necessary to perform sampling and other field activities at the site. Site personnel should be trained and familiar with these procedures prior to sampling activities. Any questions on methodology or procedures should be addressed to the Project Director or Site Manager.

All of the site samples will be collected, preserved and stored according to laboratory and USEPA procedures. The laboratory will supply all sampling glassware or other containers necessary for sample collection. A list of equipment and decontamination procedures for sampling activities is contained in Table 3. Persons performing sampling should also be familiar with the HASP and QAPP prepared for this site. Personal Protective Equipment (PPE) levels appropriate for each site activity are contained in Table 4.

As appropriate, sampling activities will conform to the USEPA document entitled *Compendium of ERT Waste Sampling Procedures* dated January 1991 and the *Region II CERCLA Quality Assurance Manual* dated October 1989.

5.2 Air Monitoring

The purpose of the air monitoring program at the site is to establish the presence and concentrations of airborne chemicals of concern and to establish the level of worker protection needed. The following equipment may be used for air monitoring at the site: an oxygen/combustible gas indicator; a particulate monitor (Miniram); a photoionization detector (PID); and/or a flame ionization detector (FID).

5.2.1 Air Quality Monitoring

5.2.1.1 Pre-excavation Monitoring

An air quality survey will initially be conducted at the site. This survey will take place in and around the perimeter of the site to establish air quality conditions as well as conditions encountered during the sampling activities. Readings will be collected at the perimeter of the site using a calibrated oxygen/combustible gas indicator, a particulate monitor, and FID or PID at the locations shown on Plate 1. Readings will be collected 6 to 12 inches above the ground surface and at the breathing zone (approximately 5 feet above the ground surface). Readings will be recorded in a field logbook or on an air monitoring log (Figure 4) and identified so that field locations can be readily found. Table 5 provides an air monitoring equipment list.

5.2.1.2 Excavation/Drilling Monitoring

Readings will also be collected using an FID or PID, a particulate monitor, and an oxygen/combustible gas indicator throughout excavation and drilling activities. These readings will be collected continuously in the active work zone, both upwind and downwind, to assess air quality conditions. Readings should be collected in the vicinity of the breathing zone and entered/recorded

in the field logbook or air monitoring log. If readings exceed those levels specified in the HASP, PPE levels will be upgraded as appropriate.

5.3 Subsurface Soil Sampling

Subsurface soil sampling will be conducted as part of the activities described in the RI/FS Work Plan. Subsurface sampling will occur during drilling and test trench excavations.

Subsurface soil samples will be collected using one or more of the following methods or a combination of sampling techniques:

Method 1 Split spoon sampling through a hollow stem auger conducted during soil boring and monitoring well installation.

Method 2 Backhoe bucket in test trench excavations that exceed a depth of 4 feet.

Method 3 Stainless steel trowels for stockpiled soils and test trench excavations that do not exceed a depth of 4 feet.

It is anticipated that subsurface soil sampling activities will be carried out using Level D or B PPE, depending on site conditions and air monitoring results. Field equipment and personnel will set up in an upwind direction from the trenching/sampling areas unless field conditions dictate otherwise.

The following equipment is available for field use for soil sampling: stainless steel spoons and trowels; stainless steel shovels; stainless steel hand augers; disposable equipment; drill rigs with associated equipment (e.g., split-spoon samplers, shelby tubes); and backhoes or track-mounted excavation equipment. Table 6 provides a soil sampling equipment list.

Soil samples collected for VOC analyses will be containerized immediately. The samples should be placed in precleaned sampling containers, supplied by the laboratory, so that no headspace is left in the container after it is closed. Samples for VOC analyses must be stored at 4°C until they are received by the laboratory. Headspace analysis will be performed in the field on a separate representative portion of each sample. Each headspace analysis will be performed on equal volumes of sample placed in resealable storage bags and allowed to volatilize at ambient temperature for approximately 15 minutes.

Some compounds can be detected in the parts per billion and/or parts per trillion range. Extreme care must be taken to prevent cross-contamination of these samples. The following precautions should be taken when trace levels are of concern:

- Sample containers for source samples or samples suspected of containing high concentrations of chemicals will be placed in separate plastic bags immediately after collecting, preserving, tagging, etc.

- Highly contaminated samples will never be placed in the same ice chest with confirmatory samples. Highly contaminated samples should be enclosed in plastic bags before placing them in ice chests. Ice chests or shipping containers for source samples or samples suspected to contain high concentrations of chemicals should be lined with clean plastic bags.

- One member of the field team will take all the notes, fill out labels, etc., while the other member performs the sampling.

- Personnel should use equipment constructed of Teflon®, stainless steel or glass that has been properly precleaned when collecting samples for trace metals or organic compound analyses. Teflon® or glass is preferred for collecting samples where trace metals are of concern. Equipment constructed of plastic or PVC will not be used to collect samples for trace organic compound analyses.

The step-by-step sampling procedures for soil sampling activities at the site are as follows:

- Review FSP, HASP, and QAPP.

- Assemble equipment.

- Calibrate FID or PID and oxygen/combustible gas indicator.

- Decontaminate equipment (see Table 3).

- Don PPE as appropriate.

- Collect soil sample using stainless steel spoon or shovel, hand auger, split spoons, shelby tubes, excavator bucket, etc., as appropriate.

- Immediately cap, seal and label a representative portion of the sample for VOC analysis; place in a cooler at 4°C.

- Place a representative portion of the sample into a container for headspace analysis.

- Place sample in appropriate containers for volatiles, semivolatiles, metals, and/or pH analyses; cap the samples, seal and label.

- Collect air readings according to the HASP.

- Note weather conditions.

- Record information in field logbook.

- Decontaminate equipment (see Table 3) and move to next sampling location.

- Backfill sample locations as appropriate.

- At the end of each day, ship or transport samples to the laboratory under chain of custody.

To prevent cross contamination, disposable gloves must be worn by sampling personnel and changed between sampling points. Table 6 contains a list of equipment necessary for soil sampling activities.

All equipment used to collect soil samples will be cleaned and repaired, if necessary, before being

stored at the conclusion of field studies. Any cleaning conducted in the field or field repairs should be thoroughly documented in field records.

All contaminated samples will be clearly labeled as such when they are submitted for laboratory analyses. Any observations (odor, appearance, container labeling, etc.) made by the field team that might alert the laboratory to potential dangers or provide laboratory personnel with information on possible constituents in the samples (high concentrations) will be explained on the sample label. These observations will be explained verbally to the sample custodian or other laboratory personnel, as necessary.

The collection of auxiliary information and data is particularly important when collecting samples. Any field analyses, including those conducted with safety equipment such as FIDs, oxygen/combustible gas indicators, or approximate analyses such as those obtained with pH indicator paper, will be recorded in field logbooks. Photographs will be used extensively during sampling operations for recording this information. Documentation of field activities will be conducted by the following:

- Detailed notation in field logbooks.
- Photographs, as appropriate.
- Completion of field forms (e.g., air monitoring log, sample tracking log, etc.).
- Collection of QA samples.

Notations in field logbooks will include at a minimum:

- Time and date of field activities.
- Weather conditions.
- Names of all site personnel including regulators, subcontractors, and others.
- Clear, concise summary of field activities.
- Notation of photographs taken during field activities.
- Documentation and summary of decontamination procedures.
- Problems encountered or unusual occurrences.
- Health and safety information, as appropriate.
- Deviation from any aspects of the RI/FS Work Plan, FSP, HASP or QAPP.

5.4 Ground Water and Surface Water Monitoring/Sampling

5.4.1 Shallow Ground Water and Surface Water Sampling

If water is encountered in the test trenches, water or liquid samples will be collected from the test trenches. These samples will be collected and handled in a manner similar to surface water samples by dipping or scooping a sample into the laboratory container. Appropriate safety precautions will also be taken if it appears that the sample is leachate or free organic liquid.

A step-by-step checklist for sampling surface water and ground water encountered in catch basins and test trenches is as follows:

- Review the FSP, HASP, and QAPP.
- Assemble supplies and equipment.
- Calibrate temperature, pH, and conductivity meters, if appropriate.
- Decontaminate sampling equipment (see Table 3).
- Don PPE, as appropriate.
- Collect a sample by placing the sample container into material to be sampled or use a dipper, Kemmerer or other sampler, as needed. Sampling equipment will be constructed of stainless steel, glass or Teflon®. For volatile samples, completely fill the vials to eliminate air bubbles.
- Seal and label sample, complete chain of custody, place sample in cooler and keep at 4°C.
- Decontaminate equipment (see Table 3) and move to next sample location.
- Ship or transport samples to the laboratory under chain-of-custody documentation at the end of each day.

In addition to the sampling equipment previously mentioned, a dipper, Kemmerer or other sampler and appropriate sample jars should be at the site for liquid sampling if needed. An equipment list for surface water sampling is contained in Table 7.

5.4.2 Ground Water Sampling (Monitoring Wells)

Monitoring wells will be purged and sampled using a low-flow (minimal drawdown) ground water sampling procedure as outlined in the USEPA Ground Water Issue publication EPA/540/S-95/504. A copy of this EPA publication is contained in Attachment 1. The wells will be purged with a variable speed water pump at a rate that equals the natural recharge rate of the well. Measurements of pH, specific conductance, dissolved oxygen, redox potential, turbidity, and temperature will be collected every 3 to 5 minutes using a flow-through cell as the well is purged until all parameters have stabilized. Stabilization is achieved when three successive readings are within plus or minus 0.1 for pH, plus or minus 3 percent for conductivity, plus or minus 10 mv for redox potential, and plus or minus 10 percent for turbidity and DO. An electronic data logger will collect and store the

data. If the natural recharge rate of a well is insufficient to keep up with the minimum purge rate, the well will be purged dry and allowed to recharge a minimum of 4 hours but no more than 24 hours before sampling. After the indicator parameters have stabilized, the water samples will be collected from the end of the discharge tube at a pumping rate of 0.1 to 0.2 L/min or less.

This method allows for the collection of a representative ground water sample by drawing water into a well at its natural recharge rate, therefore minimizing volatilization due to the cascading effect produced by drawdown. Additionally, since the submersible pump is placed within the screened interval of each well, stagnant water trapped within the riser will not mix with the ground water being sampled. For these and other reasons, the above-mentioned USEPA Ground Water Issue publication (p. 6) states that "Bailers are inappropriate devices for low-flow sampling."

The step-by-step sampling procedures for ground water sampling activities at the site are as follows:

- Review FSP, HASP, and QAPP.
- Assemble equipment.
- Decontaminate all sampling and monitoring equipment
- Calibrate flow-through cell (i.e., temperature, conductivity, redox, pH, dissolved oxygen, turbidity meter).
- Gauge each well with a ground water level indicator accurate to 0.01 feet.
- Purge each well at a rate that is equal to or less than the natural recharge rate of the aquifer until temperature, conductivity, redox, pH, dissolved oxygen, and turbidity parameters stabilize, and the ground water does not exceed 50 nephelometric turbidity units (NTUs).
- Reduce pumping rate to no more than 0.2 L/min.
- Collect ground water samples into the appropriate containers for analyses, with the proper preservative if necessary, label, and place in an iced cooler at 4°C.
- Record all information including the initial ground water level, purge rate, chemical and physical parameters, duration of purging event, etc.
- Decontaminate equipment (see Table 3) and move to the next sampling location.
- At the end of each day, ship or transport samples to the laboratory under chain of custody.

To prevent cross contamination, disposable gloves must be worn by sampling personnel and changed between sampling points. Table 7 contains a list of equipment necessary for surface water and ground water sampling activities.

All equipment used to collect water samples will be cleaned and repaired, if necessary, before being stored at the conclusion of field studies. Any cleaning conducted in the field or field repairs should be thoroughly documented in field records.

All contaminated samples will be clearly labeled as such when they are submitted for laboratory analyses. Any observations (odor, appearance, container labeling, etc.) made by the field team that might alert the laboratory to potential dangers or provide laboratory personnel with information on possible constituents in the samples (high concentrations) will be explained on the sample label.

Notations in field logbooks will include at a minimum:

- Time and date of field activities.
- Weather conditions.
- Names of all site personnel including regulators, subcontractors, and others.
- Clear, concise summary of field activities.
- Notation of photographs taken during field activities.
- Documentation and summary of decontamination procedures.
- Problems encountered or unusual occurrences.
- Health and safety information, as appropriate.
- Deviation from any aspects of the RI/FS Work Plan, FSP, HASP or QAPP.

5.4.3 Aquifer Flow Parameters Analysis (Limited Pump Tests)

Aquifer testing will be performed using a step drawdown and limited pump tests on at least two on-site wells. The purpose of the step drawdown test is to establish the maximum drawdown and pumping rate of the wells. The limited pump tests will establish the approximate hydraulic conductivity, transmissivity, and permeability of the perched aquifer. Additional information on the pump tests is contained in the RI/FS Work Plan.

The step-by-step procedures for performing the step drawdown and limited pump tests at the subject site are as follows:

- Review FSP, HASP, and QAPP.
- Decontaminate the water level indicator, submersible pump and pressure transducers/data loggers (Table 3).
- Place a pressure transducer/data logger and the submersible pump into the pumping well.
- Place a pressure transducer/data logger into adjacent observation wells.
- Set the data loggers to collect water depths in each well at 10 second intervals.
- Adjust the pumping rate of the submersible pump to maintain the maximum drawdown in the

well without pumping the well dry.

- Upon determining the pumping rate required to maintain a constant flow rate and the maximum drawdown in the pumping well, discontinue pumping and allow the well to recover to the initial water level.

- When the water level in the pumping well reaches equilibrium, begin the pump test at the predetermined pumping rate.

- Each pump test will run for approximately 5 hours.

- Upon completion of the test, down load the data from the pressure transducers/data loggers onto a computer disk and remove the equipment from the pumping and observation wells.

- Decontaminate equipment (Table 3) and move to next sample location.

5.5 Field Analytical Procedures

QA procedures for field instruments (FID, PID, oxygen/combustible gas indicator, etc.) are an essential part of these standard operating procedures. To satisfy QA/QC procedures, all field analyses will be conducted in duplicate at least 10 percent of the time. A record of these duplicate analyses will be kept in field logbooks. A significant difference in the replicate analyses will result in recalibration of the instruments used, reexamination of the analytical methodology being used, or re-examination of the sampling procedures and locations.

All field analyses must be traceable to the specific individual performing the analyses and to the specific equipment used. This information will be entered into the field logbooks for all field analyses. Time records will be kept in local time and will be recorded to the nearest 5 minutes. Additional details on the QA/QC procedures are contained in the QAPP.

5.6 Decontamination and Waste Handling Procedures

Contaminated soil generated during the exploratory trenching activities will be stockpiled and barricaded on the west side of the building pending analysis and disposal. Soil cuttings generated during drilling activities and water generated during well development and purging will be drummed and staged on the west side of the building pending analysis and disposal. Decontamination water (Table 3) will also be drummed and staged on the west side of the building pending analysis and disposal.

6.0 SAMPLE HANDLING AND ANALYSES

A NYSDOH ELAP CLP certified laboratory (Quanterra Environmental Services) approved by the NYSDEC for Superfund sites will be used for conducting analyses. When samples arrive at the laboratory, they are logged in, the chain-of-custody forms signed, and the condition of the samples recorded (e.g., any visible signs of tampering or damage).

Laboratory QA/QC procedures typically include using an extracted standard or spike as a quantitative check of the samples. Laboratory verification of any apparent discrepancies will be required prior to data submittal. More detail on these procedures is contained in the QAPP.

6.1 Sample Analysis Methods

Most of the subsurface soil and all of the sediment, surface water and ground water samples will be analyzed for site-specific parameters using USEPA SW-846 Method 8260A. The site-specific parameter list (SSPL) is as follows:

Trichloroethene (TCE)
1,1,1- Trichloroethane (1,1,1-TCA)
1,1 - Dichloroethene (1,1-DCE)
cis - 1,2 - Dichloroethene (cis-1,2-DCE)
trans - 1,2 - Dichloroethene (trans-1,2-DCE)
1,1 - Dichloroethane (1,1-DCA)
Tetrachloroethene (PCE)
Chloroethane
Vinyl Chloride

Selected ground water samples will also be analyzed for the following natural attenuation parameters:

Dissolved oxygen
Redox potential
Nitrogen
Sulfate

Selected soil and ground water samples included in Table 1 will be analyzed for the full Target Analyte List/Target Compound List (TAL/TCL). The samples selected for the TAL/TCL are from areas close to the source area. The TAL/TCL consists of total VOCs (Method 8260A), semivolatile organic compounds (Method 8270B), pesticides/PCBs (8080A), TAL metals (Method 6010), total cyanides (Method 9012) and mercury (Method 7471A). Samples from stockpiled soils requiring disposal will also be submitted for TCLP volatiles analysis (Table 8).

6.2 Sample Preservation Methods

Some samples require preservation immediately upon collection in the field to maintain sample integrity. All samples preserved with chemicals are to be identified with sample tags indicating they have been preserved. All chemical preservatives will be supplied by the laboratory. Preservatives

required for routine sample analyses are specified by the NYSDEC ASP.

Samples that should not be preserved in the field include the following:

- Samples collected within a hazardous waste site that are known or thought to be highly contaminated with toxic materials. Barrel, closed container, spillage, or other source samples from hazardous waste sites are not to be preserved with any chemical. These samples may be preserved by placing the sample container on ice, if necessary.

- Samples that have extremely low or high pH or that may generate potentially dangerous gases if they were preserved.

- Samples for metals analyses that are shipped by air will not be preserved with nitric acid in excess of the amount specified in by the NYSDEC ASP.

- Samples for purgeable organic compound analyses that are shipped by air will not be preserved.

VOC samples will be containerized immediately and stored at 4°C until they are received by the laboratory. Water samples that will be analyzed for VOCs will be placed in unpreserved 40-ml vials.

6.3 Sample Containers

The sample container selection is established by the type of analyses required. Table II, 40 CFR Part 136 (Table 8) lists standard sample containers used.

6.4 Shipping Requirements

Samples may be shipped to the laboratory either by vehicles or by common carrier for overnight delivery. Samples must be shipped to the laboratory within 24 hours of collection. Samples collected at the Dover Electronics site will be classified as either environmental or hazardous material samples. Examples of environmental samples include drinking water, ground water, surface water, soil, sediment, or effluent not known to contain high concentrations of hazardous materials. Samples known to contain hazardous materials may require shipment as dangerous goods. The Project Manager will make this designation at the site.

6.5 Holding Times

The elapsed time between sample collection and the initiation of laboratory analyses must be within a specific time frame, which is dependent upon the type of analysis. Holding times for routine samples are established by the NYSDEC ASP.

6.6 Sample Documentation

All sample identification, field records, and chain-of-custody records will be recorded with waterproof, nonerasable ink. If errors are made in any of these documents, field personnel will make corrections by simply crossing a single line through the error and entering the correct information. All corrections will be initialed and dated by the sampler. If possible, all corrections should be made by the individual making the error.

If stick-on labels are used to enter information onto sample tags, logbooks, or sample containers, these labels should not be able to be removed later without leaving obvious indications of the attempt. Labels should never be placed over previously recorded information. Corrections to information recorded on stick-on labels should be made as stated in the previous paragraph.

6.6.1 Sample Identification

The method of sample identification used depends on the type of sample collected. Sample identification procedures for soil, air, or water samples have been previously discussed in Section 3. Samples for in situ field analyses are those collected for specific field analyses or measurements where the data are recorded directly in bound field logbooks or recorded directly on the chain-of-custody record. Examples of such in situ field measurements and analyses include pH, temperature, turbidity and conductivity. Also included in this category are those field measurements or analyses such as surveying measurements that are made with field instruments or analyzers where no sample is actually collected. As much as possible, the identification procedures for in situ field analyses will conform with the labeling described in Section 3.

6.6.1.1 Sample Labels

Samples, other than those collected for in situ field measurements or analyses, are identified by using a standard sample label (Figure 5) that is attached to the sample container. The sample labels are sequentially numbered. The following information will be included on the sample label:

- Client's name.
- Job number.
- Sample identification number.
- Date and time of sample collection.
- Signature(s) of the sampler(s) or the designated sampling team leader.
- Whether the sample is preserved or unpreserved.
- General types of analyses to be conducted (parameter).
- If a sample is split with a regulatory agency or other party, sample labels with identical information should be attached to each sample container by the party receiving the split sample. Blind, duplicate, spiked or blank samples will not be identified as such, but will be given fictitious identification numbers. Complete documentation on the submission of blind samples will be recorded in bound field logbooks for future reference.

6.6.1.2 Custody Seals

Sample coolers will be sealed prior to shipment using a custody seal (Figure 6). At a minimum, the sampler will provide the following information on the custody seal:

- Date shipped.
- Sampler's signature and organization.

6.6.2 Chain-of-Custody Procedures

The possession of samples or other physical materials will be traceable from the time they are obtained until they are received by the laboratory. A sample is in custody if:

- It is in the field investigator's or the transferee's actual possession; or
- It is in the field investigator's or the transferee's view, after being in his/her physical possession; or
- It was in the field investigator's or the transferee's physical possession and then he/she secured it to prevent tampering; or
- It is placed in a designated secure area.

6.6.2.1 Chain-of-Custody Record

The field chain-of-custody record (Figure 7) is used to record the custody of all samples collected and maintained by field sampling personnel. The chain-of-custody record also serves as a sample logging mechanism for the receiving laboratory.

The following minimum information must be supplied to complete the field chain-of-custody record:

- Project job number.
- Project name.
- All samplers and/or the sampling team leader must sign the designated signature block.
- Sample identification number, date and time of sample collection, grab or composite sample designation, the sample matrix, and a brief description of the sample location.
- The total number of sample containers and the method of preservation.
- The field sampler(s) and subsequent transferee(s) must document the transfer of the samples listed on the record in the spaces provided at the bottom of the record. One of the samplers documented under the sampler(s) section must be the person that originally relinquished the samples/evidence or a designated field sample custodian who receives and maintains samples from sampling teams under secure conditions. Both the person relinquishing the samples and the person receiving them must sign the form; the date and time that this occurred must be documented in the proper space on the record. Usually, the last person receiving the samples or evidence should be a laboratory sample custodian or other evidence clerk.

- The remarks section at the bottom of the record is used to record airbill numbers or registered or certified mail serial numbers.

The chain-of-custody record is a legal document. Once the record is completed, it becomes an accountable document and must be maintained in the project file.

6.6.2.2 Field Custody Procedures

- To simplify the chain-of-custody record and eliminate potential litigation problems, as few people as possible should handle the sample or physical evidence during the investigation or inspection.

- The field sampler is responsible for the proper handling and custody of the samples collected until they are properly and formally transferred to another person or facility.

- Sample labels (Figure 5) will be completed for each sample using waterproof, nonerasable ink.

- All coolers will be sealed prior to shipment using a custody seal such as that shown on Figure 6.

- All samples must be documented in bound field logbooks.

- A chain-of-custody record will be completed for all samples. A separate chain-of-custody record will be used for each final destination or laboratory used for sample analysis.

6.6.2.3 Transfer of Custody and Shipment

- All samples will be accompanied by a chain-of-custody record. When transferring the possession of samples, the individual receiving the samples will sign, date, and note the time that he/she received the samples on the chain-of-custody record. This chain-of-custody record documents transfer of custody of samples from the field sampler to other persons, laboratories, or other entities.

- Samples will be properly packaged for shipment and delivered or shipped to the designated laboratory for analyses. Shipping containers will be secured by using strapping tape and custody seals. The custody seals will be placed on the containers so that they cannot be opened without breaking the seals. The seals will be signed and dated by the field sampler/team leader.

- When samples are split with any party, that party should sign the chain-of-custody record.

The original and one copy of the chain-of-custody record will be placed in a plastic bag inside the secured shipping container when samples are shipped. One copy of the record will be retained by the field sampler or team leader. The original record will be transmitted to the field sampler or team leader after samples are accepted by the laboratory. This copy will become a part of the project file.

6.6.3 Field Records

Field sampling personnel will use only bound field logbooks for the maintenance of field records. Other bound logbooks such as bound surveyors logbooks are acceptable as long as pages cannot be removed without tearing them out.

Preferably, logbooks should be dedicated specifically to the project. The sampler's name, project name, and project code should be entered on the inside of the front cover of the logbook. All entries should be dated and the time of entry recorded. At the end of each day's activity or entry of a particular event, if appropriate, the sampler should draw a diagonal line at the conclusion of the entry and initial it indicating the conclusion of the entry or the day's activity.

All aspects of sample collection and handling as well as visual observations will be documented in the field logbooks. All sample collection equipment (where appropriate), field analytical equipment, and equipment used to make physical measurements should also be identified in field logbooks. All calculations, results, and calibration data for field sampling, field analytical, and field physical measurement equipment will also be recorded in the field logbooks. All field analyses and measurements must be traceable to the specific piece of field equipment used and to the field sampler collecting the sample, or making the measurement or analyses.

All entries in field logbooks will be dated, will be legible, and will contain accurate and conclusive documentation of an individual's project activities. Since field records are the basis for later written reports, language should be objective, factual, and free of personal notes or other terminology that might prove inappropriate. Once completed, these field logbooks become accountable documents and must be maintained as part of the project files.

6.6.4 Photographs

All photographs taken by sampling personnel will be identified on the back of the print with the following information:

- An accurate description of what the photograph shows, including the name of the facility or site and its location.
- Orientation of the photograph (e.g., looking northeast, etc.).
- Signature of the photographer.

If the photograph was taken with a Polaroid camera, the information will be entered on the back of each photograph as soon as it is taken, including the date and time of the photograph. If a 35mm camera is used, it should be equipped with an automatic date stamp. A serial-type record of each frame exposed will be kept in the bound field logbook along with the information required for each photograph. The film will be developed, and the field sampler will then enter the required information on the prints, using the serialized photographic record from the bound field logbook to identify each photograph.

7.0 REFERENCES

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U.S. Environmental Protection Agency. October 1989. *Region II CERCLA Quality Assurance Manual.*

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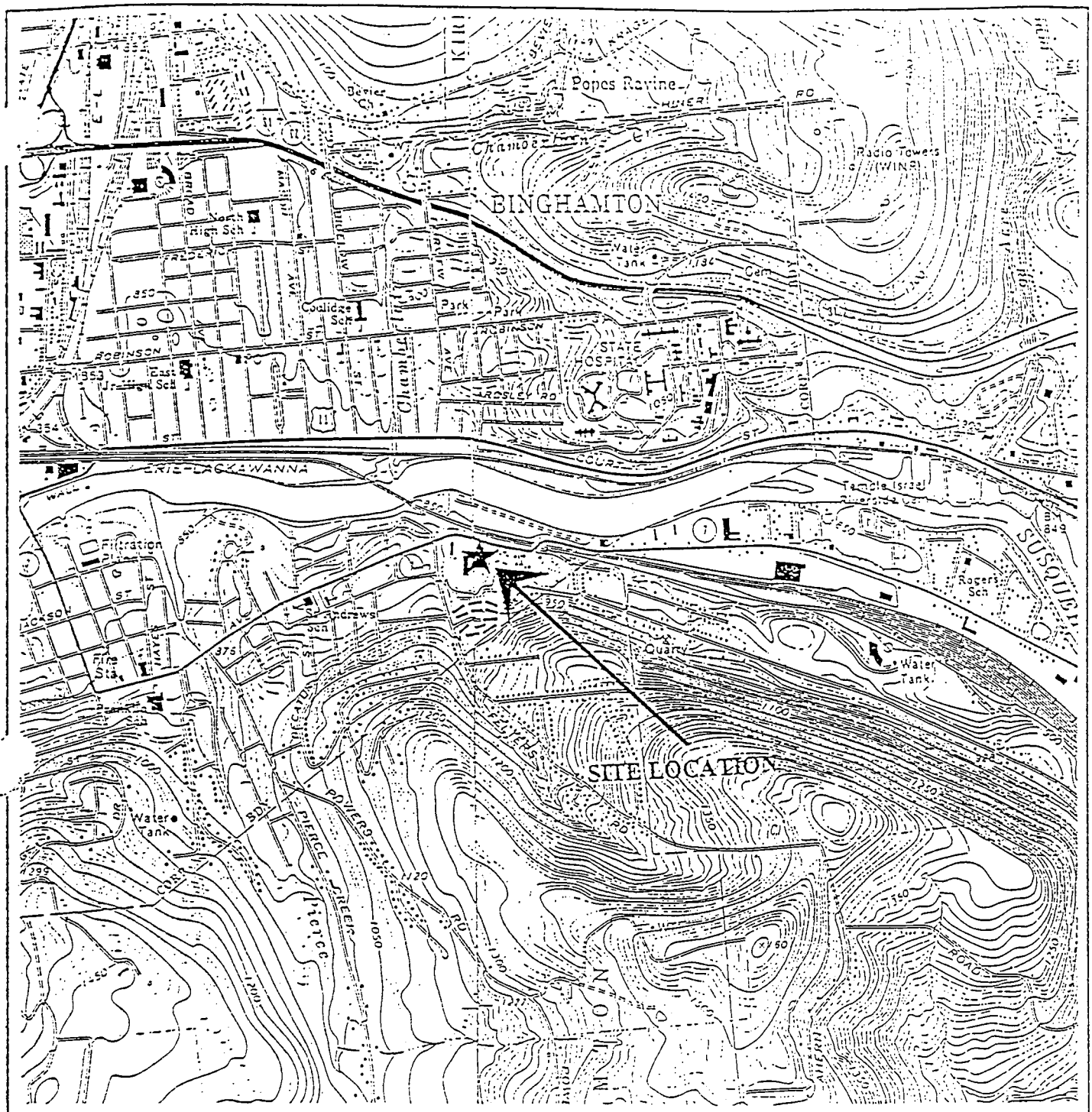
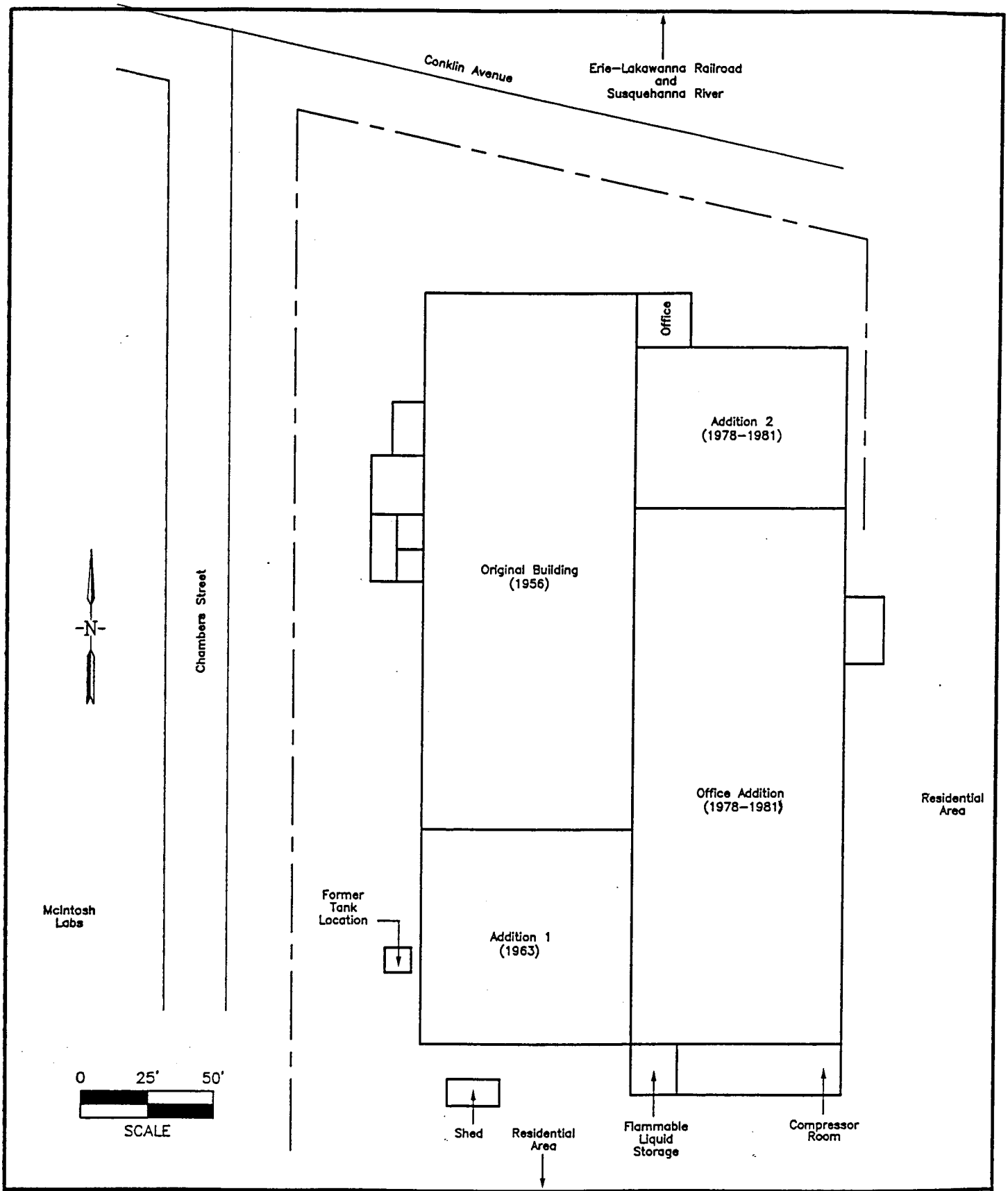


SOURCE: USGS Topographic Quadrangle Maps
Binghamton East, New York
1968 – Photoinspected 1976
Binghamton West, New York
1968 – Photoinspected 1976

0 1,000' 2,000'

SCALE

DATE: 12/2/97	FIGURE 1	**SHIELD**
DRAWN BY: P.D.H.	SITE LOCATION MAP DII – BINGHAMTON PLASTICS CONKLIN AVENUE BINGHAMTON, NEW YORK	ENVIRONMENTAL ASSOCIATES, INC.
APPROVED BY: M.M.		LEXINGTON, KENTUCKY
CLIENT NO.: 396-0460		



DATE: 1/23/98	FIGURE 2	**SHIELD**
DRAWN BY: P.D.H.	MAP SHOWING HISTORICAL SITE FEATURES AND SURROUNDING PROPERTIES	ENVIRONMENTAL ASSOCIATES, INC.
APPROVED BY: M.M.	DII – BINGHAMTON PLASTICS	
CLIENT NO.: 396–0460	CONKLIN AVENUE, BINGHAMTON, NEW YORK	LEXINGTON, KENTUCKY

60460–2

DII-BINGHAMTON PLASTICS

Sample Identification and Tracking Log

Sample Matrix of Location: _____

SAMPLE IDENTIFICATION NUMBER	DATE SAMPLE COLLECTED	ANALYTES	C of C No.	DATE SHIPPED TO LAB	DATE ANALYSES RECEIVED	COMMENTS

C:\SHIELD\DIIBING

DATE: 8/14/98	FIGURE 3	SHIELD
DRAWN BY: JAG	SAMPLE IDENTIFICATION AND TRACKING LOG DII–BINGHAMTON PLASTICS CONKLIN AVENUE BINGHAMTON, NEW YORK	ENGINEERING ASSOCIATES, INC., P.C. LEXINGTON, KENTUCKY
APPROVED BY: MEM		
CLIENT NO.: 396–0460		

DII-BINGHAMTON PLASTICS

Air Monitoring Log

Location	Date	Time	Taken By	OVA (ppm)	Hnu (ppm)	Oxygen (ppm)	Carbon Monoxide (%)	Combustible Gas (% LEL)	Instrument ID No.	Notes/Other

Note : Always collect background readings upwind from the work area prior to the start of activities and record in the log book.

C:\SHIELD\DIIBING

DATE: 8/14/98	FIGURE 4	SHIELD ENGINEERING ASSOCIATES, INC., P.C.
DRAWN BY: JAG	AIR MONITORING LOG DII–BINGHAMTON PLASTICS CONKLIN AVENUE BINGHAMTON, NEW YORK	LEXINGTON, KENTUCKY
APPROVED BY: MEM		
CLIENT NO.: 396–0460		

SHIELD ENVIRONMENTAL ASSOCIATES, INC.
3150 Custer Drive, Suite 301, Lexington, KY 40517

Site:_____ Project:_____

Sample ID:_____

Date:_____ Time:_____

Sampler:_____ Analysis:_____

C:\SHIELD\DIIBING

DATE: 8/14/98	FIGURE 5	SHIELD ENGINEERING ASSOCIATES, INC., P.C.
DRAWN BY: JAG	STANDARD SAMPLE LABEL DII–BINGHAMTON PLASTICS CONKLIN AVENUE BINGHAMTON, NEW YORK	LEXINGTON, KENTUCKY
APPROVED BY: MEM		
CLIENT NO.: 396–0460		

Quanterra Environmental Services

№ 069458

Custody Seal

DATE

SIGNATURE

Quanterra Environmental Services

№ 069458

C:\SHIELD\DIIBING

DATE: 8/14/98	FIGURE 6
DRAWN BY: MEM	CUSTODY SEAL DII–BINGHAMTON PLASTICS CONKLIN AVENUE BINGHAMTON, NEW YORK
APPROVED BY: DG	
CLIENT NO.: 396–0460	

SHIELD

ENGINEERING ASSOCIATES, INC., P.C.

LEXINGTON, KENTUCKY

SHIELD ENVIRONMENTAL ASSOCIATES, INC.

3150 CUSTER DRIVE, SUITE 301
LEXINGTON, KY 40517
PHONE (606) 271-0269
FAX (606)271-1204

PROJECT NAME _____ CONTACT NAME _____ TELEPHONE NO. _____

Samplers: Print Name		Signature									ANALYSIS									
Project No.		Composite	Grab	Date	Time	Sample Type				No. of Containers										
SAMPLE ID	SAMPLE LOCATION					Water	Liquid	Oil	Solid											REMARKS

COMMENTS: _____

Relinquished by: (Signature)			Received by: (Signature)	Date	Time
Relinquished by: (Signature)			Received by: (Signature)	Date	Time
Dispatched by: (Signature)	Date	Time	Received for Laboratory by:	Date	Time
Method of Shipment				Date	Time

C:\SHIELD\DIIBING

DATE: 8/14/98

DRAWN BY: MEM

APPROVED BY: DG

CLIENT NO.: 396-0460

FIGURE 7

CHAIN-OF-CUSTODY RECORD
DII-BINGHAMTON PLASTICS
CONKLIN AVENUE
BINGHAMTON, NEW YORK

SHIELD
ENGINEERING ASSOCIATES, INC., P.C.
LEXINGTON, KENTUCKY

TABLE 1
SAMPLE LOCATION AND FREQUENCY SUMMARY

Sample Location	Sample Type	Number of Samples	Analyses/Extraction
Test Trenches	Soil	1-2 samples[1]	SSPL or TCL/TAL
	Water/liquid	1 grab[2]	SSPL or TCL/TAL
Soil Borings	Soil	1-2 samples per boring	TCL/TAL
Monitoring Well	Soil	2-3 samples per well	SSPL
	Water/liquid	1 grab per well	SSPL or TCL/TAL
Surface Water Samples	Water	1 grab per sampling point	SSPL

[1] One or more grab samples of affected material if contamination is observed.
[2] A water sample will be collected, if present.
SSPL: Site Specific Parameter List: TCE, 1,1,1-TCA, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCA, PCE, Chloroethane, Vinyl Chloride
TCL/TAL - Target Compound List/Target Analyte List

TABLE 2
SAMPLING SUMMARY

Location	Sample ID	Estimated Trench/Sample Depth	Samples	Analysis	Comments
Test Trench 1	T1-SS1 T1-SS2 T1-GW	4-6' 2-4'	grab sample grab sample grab sample	SSPL* SSPL* SSPL*	Sample collected from native soil Sample collected only if contamination is observed. Ground water sampled if present.
Test Trench 2	T2-SS1 T2-SS2 T2-GW	4-6' 2-4'	grab sample grab sample grab sample	SSPL* SSPL* SSPL*	Sample collected from native soil Sample collected only if contamination is observed. Ground water sampled if present.
Test Trench 3	T3-SS1 T3-SS2 T3-GW	4-6' 2-4'	grab sample grab sample grab sample	SSPL* SSPL* SSPL*	Sample collected from native soil Sample collected only if contamination is observed. Ground water sampled if present.
Test Trench 4	T4-SS1 T4-SS2 T4-GW	4-6' 2-4'	grab sample grab sample grab sample	SSPL* SSPL* SSPL*	Sample collected from native soil Sample collected only if contamination is observed. Ground water sampled if present.
Test Trench 5	T5-SS1 T5-SS2 T5-GW	4-6' 2-4'	grab sample grab sample grab sample	SSPL* SSPL* SSPL*	Sample collected from native soil Sample collected only if contamination is observed. Ground water sampled if present.
Test Trench 6	T6-SS1 T6-SS2 T6-GW	4-6' 2-4'	grab sample grab sample grab sample	SSPL* SSPL* SSPL*	Sample collected from native soil Sample collected only if contamination is observed. Ground water sampled if present.
Test Trench 7	T7-SS1 T7-SS2 T7-GW	4-6' 2-4'	grab sample grab sample grab sample	SSPL* SSPL* SSPL*	Sample collected from native soil Sample collected only if contamination is observed. Ground water sampled if present.

Table 2 (continued)

Location	Sample ID	Estimated Sample Depth	Samples	Analysis	Comments
Monitoring Well 1	MW1-GW		grab sample	SSPL	
Monitoring Well 3	MW3-GW		grab sample	SSPL	
Monitoring Well 4	MW4-GW		grab sample	SSPL	
Monitoring Well 5	MW5-GW		grab sample	TCL/TAL	
Monitoring Well 6	MW6-GW		grab sample	SSPL	
Monitoring Well 7	MW7-GW		grab sample	SSPL	
Monitoring Well 8	MW8-GW		grab sample	SSPL	
Monitoring Well 9	MW9-GW		grab sample	SSPL	
Monitoring Well 10	MW10-GW		grab sample	SSPL	
Monitoring Well 11	MW11-GW		grab sample	SSPL	
Monitoring Well 12	MW12-GW		grab sample	SSPL	
Monitoring Well 13	MW13-GW		grab sample	SSPL	
Monitoring Well 14	MW14(SS8-10') MW14-GW	8-10'	grab sample grab sample	SSPL SSPL	Depth of sample analyzed may be altered based on field screening results.
Soil Boring 7	SB7(SS3'-5')	3'-5'	grab sample	TAL/TCL	Depth and number of samples may be altered based on field screening results.
Soil Boring 8	SB8(SS3'-5')	3'-5'	grab sample	TAL/TCL	Depth and number of samples may be altered based on field screening results.
Manhole 282	MH 282-SW	NA	grab sample	SSPL	
Catch Basin 342	CB 342-SW	NA	grab sample	SSPL	
Catch Basin Outfall 45	CBO 45-SW	NA	grab sample	SSPL	

SSPL - Site Specific Parameter List: TCE, 1,1,1-TCA, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE 1,1-DCA, PCE, Chloroethane, Vinyl Chloride
* Samples where contamination is most likely present will be analyzed for the full TCL/TAL
NA - Not Applicable

TABLE 3
EQUIPMENT AND DECONTAMINATION PROCEDURES
FOR SAMPLING EQUIPMENT

Equipment

- Containers for contaminated soil or water and equipment
- Brush for removing soil accumulations
- Tap water
- Distilled or purified water
- Alconox or other biodegradable detergent
- Brush for washing equipment
- Containers or buckets for handling wash and rinse waters
- Steam cleaner, if required
- 10% reagent-grade nitric acid (HNO_3)
- pesticide-grade methanol or hexane
- Aluminum foil

Decontamination Procedures

- Remove/brush accumulations of dirt and containerize or stockpile for disposal.
- Place sampling equipment in container with soapy water using a brush to remove any particulate matter or surface film.
- Rinse equipment thoroughly with tap water (hot water if available). Tap water may be used from any municipal water treatment system.
- Rinse with 10% reagent-grade nitric acid if sampling for metals. Carbon steel split spoons should be rinsed with 1% nitric acid to reduce the possibility of leaching metals.
- Tap water rinse (hot water if available).
- Pesticide-grade methanol rinse followed by hexane rinse when sampling for organics.
- Perform final rinse with analyte-free water. Analyte-free water must comply with requirements outlined in Section 4.6 of the QAPP.
- Air dry and wrap in aluminum foil.
- If equipment will not be used immediately, store in a clean, dry, tamperproof area.
- If equipment is grossly contaminated, additional washes and rinses may be required.
- Containerize wash waters and soils; seal and label for disposal.

Notes: Steam cleaning may be substituted for wash and rinse steps.

TABLE 3 (Continued)

Decontamination Procedures (Low-Flow Sampling Equipment)

- Prerinse: Operate pump in a deep basin containing 8-10 gallons of potable water for 2 minutes and flush other equipment with potable water for 2 minutes.
- Wash: Operate pump in a deep basin containing 8-10 gallons of nonphosphate detergent solution, such as Alconox, for 2 minutes and flush other equipment with fresh detergent solution for 2 minutes.
- Rinse: Operate pump in a deep basin containing 8-10 gallons of potable water for 2 minutes and flush other equipment with potable water for 2 minutes.
- Final Rinse: Operate pump in a deep basin containing deionized/distilled water to pump out 1 to 2 gallons of this final rinse water.
- Containerize wash waters and soils; seal and label for disposal.

Monitoring instruments or other equipment that cannot be washed should be covered with plastic bags or other suitable material to prevent contamination. Sampling equipment that requires plastic tubing should be disassembled and the tubing replaced with clean tubing between samples.

TABLE 4
SUMMARY OF SITE ACTIVITIES AND PPE LEVELS

Site Activity	PPE Level*
• Subsurface soil sampling (excavation/drilling)	D+
• Ground water sampling	D
• Surface water sampling	D
• Air monitoring during excavation and/or drilling	D+
• Pilot studies	D

* PPE levels may be upgraded depending upon air monitoring results.

\+ Level D will be used for all sampling activities unless air readings indicate B is warranted.

TABLE 5
AIR MONITORING EQUIPMENT LIST

Sampling Equipment/Materials:

- FSP, HASP, and QAPP
- Site map
- PID
- Oxygen/combustible gas indicator
- Calibration logs and gases
- Field logbook
- Personal protective equipment (PPE)

TABLE 6
SOIL AND SEDIMENT SAMPLING EQUIPMENT LIST

Sampling Equipment:

- FSP, HASP, and QAPP
- Personal protective equipment, as appropriate
- Decontamination equipment
- Excavator
- Drill rig
- Plastic for stockpiling
- Stainless steel spoons, scoops, and shovels
- Bentonite powder for sealing borings
- Disposable latex gloves
- Sample jars, seals, labels, chain-of-custody forms, and aluminum foil
- Cooler and ice
- PID
- Oxygen/combustible gas indicator
- Field logbook
- Stake or marker to locate trench/boring
- Measuring tape
- Site map
- Camera

TABLE 7
GROUND WATER AND SURFACE WATER SAMPLING EQUIPMENT LIST

Sampling Equipment:

- Field Sampling and Analysis Plan, Health and Safety Plan, and Quality Assurance Project Plan
- Personal protective equipment, as appropriate
- Decontamination equipment
- Water level indicator
- Variable-rate submersible pump with Teflon® tubing
- In-line pH, redox, turbidity, dissolved oxygen, temperature meter
- Sample jars, seals, labels, chain-of-custody forms
- Cooler and ice
- Disposable latex sampling gloves
- Field log book
- Site Map
- Camera

TABLE 8
SUMMARY OF ANALYTICAL METHODS, CHEMICAL CONTAINERS, PRESERVATION METHODS AND SAMPLE VOLUMES

Compound	SW846 Method	Matrix	Container	Preservation	Amount Required	Holding Time
Total Volatile Organic Compounds and SSPL	8260A 8260A	solid aqueous	G, TFE G, TFE	cool 4°C cool 4°C	2 x 60 ml 3 x 40 ml	7 days
Semivolatile Organic Compounds	8270B 8270B	solid aqueous	G, TFE G, TFE	cool 4°C cool 4°C	120 ml 1 L	5 days*
Pesticides/PCBs	8080A 8080A	solid aqueous	G, TFE G, TFE	cool 4°C cool 4°C	120 ml 1 L	5 days*
TAL Metals	6010A 6010A	solid aqueous	G,TFE P	cool 4°C HNO_3 to pH<2	4 oz 1 L	6 months
Mercury	7471A	solid aqueous	G,TFE P	cool 4°C HNO_3 to pH<2	4 oz 1L	26 days
Total Cyanide	9012 9012	solid aqueous	P P	cool 4°C HNO_3 to pH<2	4 oz 250 ml	6 months
pH		solid aqueous	P P	none required none required	4 oz 250 ml	analyze immediately
TCLP - volatiles	8260A	waste	G, TFE	cool 4°C	2x1 L	7 days**

* 5 days after verified time of sample receipt until extraction; 40 days for analysis of extract
** 7 days after verified time of sample receipt until extraction; 7 days for analysis of extract
SSPL - Site-Specific Parameter List
G - Glass
P - Plastic
TFE - Teflon coated Lid

ATTACHMENT 1

USEPA LOW-FLOW SAMPLING GUIDANCE

United States Environmental Protection Agency | Office of Research and Development | Office of Solid Waste and Emergency Response | EPA/540/S-95/504 April 1996

EPA Ground Water Issue

LOW-FLOW (MINIMAL DRAWDOWN) GROUND-WATER SAMPLING PROCEDURES

by Robert W. Puls[1] and Michael J. Barcelona[2]

Background

The Regional Superfund Ground Water Forum is a group of ground-water scientists, representing EPA's Regional Superfund Offices, organized to exchange information related to ground-water remediation at Superfund sites. One of the major concerns of the Forum is the sampling of ground water to support site assessment and remedial performance monitoring objectives. This paper is intended to provide background information on the development of low-flow sampling procedures and its application under a variety of hydrogeologic settings. It is hoped that the paper will support the production of standard operating procedures for use by EPA Regional personnel and other environmental professionals engaged in ground-water sampling.

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I. Introduction

The methods and objectives of ground-water sampling to assess water quality have evolved over time. Initially the emphasis was on the assessment of water quality of aquifers as sources of drinking water. Large water-bearing units were identified and sampled in keeping with that objective. These were highly productive aquifers that supplied drinking water via private wells or through public water supply systems. Gradually, with the increasing awareness of subsurface pollution of these water resources, the understanding of complex hydrogeochemical processes which govern the fate and transport of contaminants in the subsurface increased. This increase in understanding was also due to advances in a number of scientific disciplines and improvements in tools used for site characterization and ground-water sampling. Ground-water quality investigations where pollution was detected initially borrowed ideas, methods, and materials for site characterization from the water supply field and water analysis from public health practices. This included the materials and manner in which monitoring wells were installed and the way in which water was brought to the surface, treated, preserved and analyzed. The prevailing conceptual ideas included convenient generalizations of ground-water resources in terms of large and relatively homogeneous hydrologic *units*. With time it became apparent that conventional water supply generalizations of *homogeneity* did not adequately represent field data regarding pollution of these subsurface resources. The important role of *heterogeneity* became increasingly clear not only in geologic terms, but also in terms of complex physical,

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chemical and biological subsurface processes. With greater appreciation of the role of heterogeneity, it became evident that subsurface pollution was ubiquitous and encompassed the unsaturated zone to the deep subsurface and included unconsolidated sediments, fractured rock, and *aquitards* or low-yielding or impermeable formations. Small-scale processes and heterogeneities were shown to be important in identifying contaminant distributions and in controlling water and contaminant flow paths.

It is beyond the scope of this paper to summarize all the advances in the field of ground-water quality investigations and remediation, but two particular issues have bearing on ground-water sampling today: aquifer heterogeneity and colloidal transport. Aquifer heterogeneities affect contaminant flow paths and include variations in geology, geochemistry, hydrology and microbiology. As methods and the tools available for subsurface investigations have become increasingly sophisticated and understanding of the subsurface environment has advanced, there is an awareness that in most cases a primary concern for site investigations is characterization of contaminant flow paths rather than entire aquifers. In fact, in many cases, plume thickness can be less than well screen lengths (e.g., 3-6 m) typically installed at hazardous waste sites to detect and monitor plume movement over time. Small-scale differences have increasingly been shown to be important and there is a general trend toward smaller diameter wells and shorter screens.

The hydrogeochemical significance of colloidal-size particles in subsurface systems has been realized during the past several years (Gschwend and Reynolds, 1987; McCarthy and Zachara, 1989; Puls, 1990; Ryan and Gschwend, 1990). This realization resulted from both field and laboratory studies that showed faster contaminant migration over greater distances and at higher concentrations than flow and transport model predictions would suggest (Buddemeier and Hunt, 1988; Enfield and Bengtsson, 1988; Penrose et al., 1990). Such models typically account for interaction between the mobile aqueous and immobile solid phases, but do not allow for a mobile, reactive solid phase. It is recognition of this third *phase* as a possible means of contaminant transport that has brought increasing attention to the manner in which samples are collected and processed for analysis (Puls et al., 1990; McCarthy and Degueldre, 1993; Backhus et al., 1993; U. S. EPA, 1995). If such a phase is present in sufficient mass, possesses high sorption reactivity, large surface area, and remains stable in suspension, it can serve as an important mechanism to facilitate contaminant transport in many types of subsurface systems.

Colloids are particles that are sufficiently small so that the surface free energy of the particle dominates the bulk free energy. Typically, in ground water, this includes particles with diameters between 1 and 1000 nm. The most commonly observed mobile particles include: secondary clay minerals; hydrous iron, aluminum, and manganese oxides; dissolved and particulate organic materials, and viruses and bacteria. These reactive particles have been shown to be mobile under a variety of conditions in both field studies and laboratory column experiments, and as such need to be included in monitoring programs where identification of the *total* mobile contaminant loading (dissolved + naturally suspended particles) at a site is an objective. To that end, sampling methodologies must be used which do not artificially bias *naturally* suspended particle concentrations.

Currently the most common ground-water purging and sampling methodology is to purge a well using bailers or high speed pumps to remove 3 to 5 casing volumes followed by sample collection. This method can cause adverse impacts on sample quality through collection of samples with high levels of turbidity. This results in the inclusion of otherwise immobile artifactual particles which produce an overestimation of certain analytes of interest (e.g., metals or hydrophobic organic compounds). Numerous documented problems associated with filtration (Danielsson, 1982; Laxen and Chandler, 1982; Horowitz et al., 1992) make this an undesirable method of rectifying the turbidity problem, and include the removal of potentially mobile (contaminant-associated) particles during filtration, thus artificially biasing contaminant concentrations low. Sampling-induced turbidity problems can often be mitigated by using low-flow purging and sampling techniques.

Current subsurface conceptual models have undergone considerable refinement due to the recent development and increased use of field screening tools. So-called hydraulic *push* technologies (e.g., cone penetrometer, Geoprobe®, QED HydroPunch®) enable relatively fast screening site characterization which can then be used to design and install a monitoring well network. Indeed, alternatives to conventional monitoring wells are now being considered for some hydrogeologic settings. The ultimate design of any monitoring system should however be based upon adequate site characterization and be consistent with established monitoring objectives.

If the sampling program objectives include accurate assessment of the magnitude and extent of subsurface contamination over time and/or accurate assessment of subsequent remedial performance, then some information regarding plume delineation in three-dimensional space is necessary prior to monitoring well network design and installation. This can be accomplished with a variety of different tools and equipment ranging from hand-operated augers to screening tools mentioned above and large drilling rigs. Detailed information on ground-water flow velocity, direction, and horizontal and vertical variability are essential baseline data requirements. Detailed soil and geologic data are required prior to and during the installation of sampling points. This includes historical as well as detailed soil and geologic logs which accumulate during the site investigation. The use of borehole geophysical techniques is also recommended. With this information (together with other site characterization data) and a clear understanding of sampling

objectives, then appropriate location, screen length, well diameter, slot size, etc. for the monitoring well network can be decided. This is especially critical for new in situ remedial approaches or natural attenuation assessments at hazardous waste sites.

In general, the overall goal of any ground-water sampling program is to collect water samples with no alteration in water chemistry; analytical data thus obtained may be used for a variety of specific monitoring programs depending on the regulatory requirements. The sampling methodology described in this paper assumes that the monitoring goal is to sample monitoring wells for the presence of contaminants and it is applicable whether mobile colloids are a concern or not and whether the analytes of concern are metals (and metalloids) or organic compounds.

II. Monitoring Objectives and Design Considerations

The following issues are important to consider prior to the design and implementation of any ground-water monitoring program, including those which anticipate using low-flow purging and sampling procedures.

A. Data Quality Objectives (DQOs)

Monitoring objectives include four main types: detection, assessment, corrective-action evaluation and resource evaluation, along with *hybrid* variations such as site-assessments for property transfers and water availability investigations. Monitoring objectives may change as contamination or water quality problems are discovered. However, there are a number of common components of monitoring programs which should be recognized as important regardless of initial objectives. These components include:

1) Development of a conceptual model that incorporates elements of the regional geology to the local geologic framework. The conceptual model development also includes initial site characterization efforts to identify hydrostratigraphic units and likely flow-paths using a minimum number of borings and well completions;

2) Cost-effective and well documented collection of high quality data utilizing simple, accurate, and reproducible techniques; and

3) Refinement of the conceptual model based on supplementary data collection and analysis.

These fundamental components serve many types of monitoring programs and provide a basis for future efforts that evolve in complexity and level of spatial detail as purposes and objectives expand. High quality, reproducible data collection is a common goal regardless of program objectives.

High quality data collection implies data of sufficient accuracy, precision, and completeness (i.e., ratio of valid analytical results to the minimum sample number called for by the program design) to meet the program objectives. Accuracy depends on the correct choice of monitoring tools and procedures to minimize sample and subsurface disturbance from collection to analysis. Precision depends on the repeatability of sampling and analytical protocols. It can be assured or improved by replication of sample analyses including blanks, field/lab standards and reference standards.

B. Sample Representativeness

An important goal of any monitoring program is collection of data that is truly representative of conditions at the site. The term *representativeness* applies to chemical and hydrogeologic data collected via wells, borings, piezometers, geophysical and soil gas measurements, lysimeters, and temporary sampling points. It involves a recognition of the statistical variability of individual subsurface physical properties, and contaminant or major ion concentration levels, while explaining extreme values. Subsurface temporal and spatial variability are facts. Good professional practice seeks to maximize representativeness by using proven accurate and reproducible techniques to define limits on the distribution of measurements collected at a site. However, measures of representativeness are dynamic and are controlled by evolving site characterization and monitoring objectives. An evolutionary site characterization model, as shown in Figure 1, provides a systematic approach to the goal of consistent data collection.

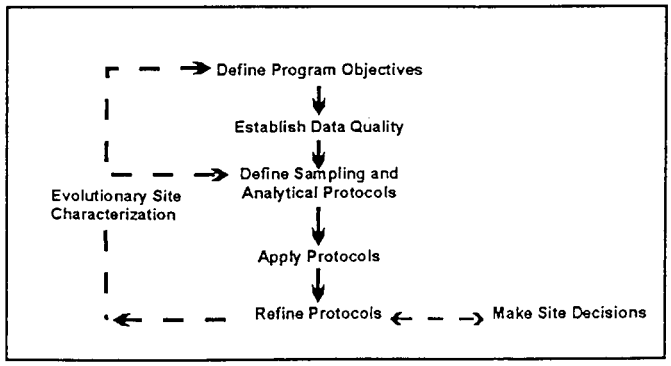

Figure 1. Evolutionary Site Characterization Model

The model emphasizes a recognition of the causes of the variability (e.g., use of inappropriate technology such as using bailers to purge wells; imprecise or operator-dependent methods) and the need to control avoidable errors.

1) Questions of Scale

A sampling plan designed to collect representative samples must take into account the potential scale of changes in site conditions through space and time as well as the chemical associations and behavior of the parameters that are targeted for investigation. In subsurface systems, physical (i.e., aquifer) and chemical properties over time or space are not statistically independent. In fact, samples taken in close proximity (i.e., within distances of a few meters) or within short time periods (i.e., more frequently than monthly) are highly auto-correlated. This means that designs employing high-sampling frequency (e.g., monthly) or dense spatial monitoring designs run the risk of redundant data collection and misleading inferences regarding trends in values that aren't statistically valid. In practice, contaminant detection and assessment monitoring programs rarely suffer these *over-sampling* concerns. In corrective-action evaluation programs, it is also possible that too little data may be collected over space or time. In these cases, false interpretation of the spatial extent of contamination or underestimation of temporal concentration variability may result.

2) Target Parameters

Parameter selection in monitoring program design is most often dictated by the regulatory status of the site. However, background water quality constituents, purging indicator parameters, and contaminants, all represent targets for data collection programs. The tools and procedures used in these programs should be equally rigorous and applicable to all categories of data, since all may be needed to determine or support regulatory action.

C. Sampling Point Design and Construction

Detailed site characterization is central to all decision-making purposes and the basis for this characterization resides in identification of the geologic framework and major hydro-stratigraphic units. Fundamental data for sample point location include: subsurface lithology, head-differences and background geochemical conditions. Each sampling point has a proper use or uses which should be documented at a level which is appropriate for the program's data quality objectives. Individual sampling points may not always be able to fulfill multiple monitoring objectives (e.g., detection, assessment, corrective action).

1) Compatibility with Monitoring Program and Data Quality Objectives

Specifics of sampling point location and design will be dictated by the complexity of subsurface lithology and variability in contaminant and/or geochemical conditions. It should be noted that, regardless of the ground-water sampling approach, few sampling points (e.g., wells, drive-points, screened augers) have zones of influence in excess of a few feet. Therefore, the spatial frequency of sampling points should be carefully selected and designed.

2) Flexibility of Sampling Point Design

In most cases *well-point* diameters in excess of 1 7/8 inches will permit the use of most types of submersible pumping devices for low-flow (minimal drawdown) sampling. It is suggested that *short* (e.g., less than 1.6 m) screens be incorporated into the monitoring design where possible so that comparable results from one device to another might be expected. *Short*, of course, is relative to the degree of vertical water quality variability expected at a site.

3) Equilibration of Sampling Point

Time should be allowed for equilibration of the well or sampling point with the formation after installation. Placement of well or sampling points in the subsurface produces some disturbance of ambient conditions. Drilling techniques (e.g., auger, rotary, etc.) are generally considered to cause more disturbance than *direct-push* technologies. In either case, there may be a period (i.e., days to months) during which water quality near the point may be distinctly different from that in the formation. Proper development of the sampling point and adjacent formation to remove fines created during emplacement will shorten this water quality *recovery* period.

III. Definition of Low-Flow Purging and Sampling

It is generally accepted that water in the well casing is non-representative of the formation water and needs to be purged prior to collection of ground-water samples. However, the water in the screened interval may indeed be representative of the formation, depending upon well construction and site hydrogeology. Wells are purged to some extent for the following reasons: the presence of the air interface at the top of the water column resulting in an oxygen concentration gradient with depth, loss of volatiles up the water column, leaching from or sorption to the casing or filter pack, chemical changes due to clay seals or backfill, and surface infiltration.

Low-flow purging, whether using portable or dedicated systems, should be done using pump-intake located in the middle or slightly above the middle of the screened interval. Placement of the pump too close to the bottom of the well will cause increased entrainment of solids which have collected in the well over time. These particles are present as a result of well development, prior purging and sampling events, and natural colloidal transport and deposition. Therefore, placement of the pump in the middle or toward the top of the screened interval is suggested. Placement of the pump at the top of the water column for sampling is only recommended in unconfined aquifers, screened across the water table, where this is the desired sampling point. Low-

flow purging has the advantage of minimizing mixing between the overlying stagnant casing water and water within the screened interval.

A. Low-Flow Purging and Sampling

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface which can be affected by flow regulators or restrictions. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological situation. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practical taking into account established site sampling objectives. Typically, flow rates on the order of 0.1 - 0.5 L/min are used, however this is dependent on site-specific hydrogeology. Some extremely coarse-textured formations have been successfully sampled in this manner at flow rates to 1 L/min. The effectiveness of using low-flow purging is intimately linked with proper screen location, screen length, and well construction and development techniques. The reestablishment of natural flow paths in both the vertical and horizontal directions is important for correct interpretation of the data. For high resolution sampling needs, screens less than 1 m should be used. Most of the need for purging has been found to be due to passing the sampling device through the overlying casing water which causes mixing of these stagnant waters and the dynamic waters within the screened interval. Additionally, there is disturbance to suspended sediment collected in the bottom of the casing and the displacement of water out into the formation immediately adjacent to the well screen. These disturbances and impacts can be avoided using dedicated sampling equipment, which precludes the need to insert the sampling device prior to purging and sampling.

Isolation of the screened interval water from the overlying stagnant casing water may be accomplished using low-flow minimal drawdown techniques. If the pump intake is located within the screened interval, most of the water pumped will be drawn in directly from the formation with little mixing of casing water or disturbance to the sampling zone. However, if the wells are not constructed and developed properly, zones other than those intended may be sampled. At some sites where geologic heterogeneities are sufficiently different within the screened interval, higher conductivity zones may be preferentially sampled. This is another reason to use shorter screened intervals, especially where high spatial resolution is a sampling objective.

B. Water Quality Indicator Parameters

It is recommended that water quality indicator parameters be used to determine purging needs prior to sample collection in each well. Stabilization of parameters such as pH, specific conductance, dissolved oxygen, oxidation-reduction potential, temperature and turbidity should be used to determine when formation water is accessed during purging. In general, the order of stabilization is pH, temperature, and specific conductance, followed by oxidation-reduction potential, dissolved oxygen and turbidity. Temperature and pH, while commonly used as purging indicators, are actually quite insensitive in distinguishing between formation water and stagnant casing water; nevertheless, these are important parameters for data interpretation purposes and should also be measured. Performance criteria for determination of stabilization should be based on water-level drawdown, pumping rate and equipment specifications for measuring indicator parameters. Instruments are available which utilize in-line flow cells to continuously measure the above parameters.

It is important to establish specific well stabilization criteria and then consistently follow the same methods thereafter, particularly with respect to drawdown, flow rate and sampling device. Generally, the time or purge volume required for parameter stabilization is independent of well depth or well volumes. Dependent variables are well diameter, sampling device, hydrogeochemistry, pump flow rate, and whether the devices are used in a portable or dedicated manner. If the sampling device is already in place (i.e., dedicated sampling systems), then the time and purge volume needed for stabilization is much shorter. Other advantages of dedicated equipment include less purge water for waste disposal, much less decontamination of equipment, less time spent in preparation of sampling as well as time in the field, and more consistency in the sampling approach which probably will translate into less variability in sampling results. The use of dedicated equipment is strongly recommended at wells which will undergo routine sampling over time.

If parameter stabilization criteria are too stringent, then minor oscillations in indicator parameters may cause purging operations to become unnecessarily protracted. It should also be noted that turbidity is a very conservative parameter in terms of stabilization. Turbidity is always the last parameter to stabilize. Excessive purge times are invariably related to the establishment of too stringent turbidity stabilization criteria. It should be noted that natural turbidity levels in ground water may exceed 10 nephelometric turbidity units (NTU).

C. Advantages and Disadvantages of Low-Flow (Minimum Drawdown) Purging

In general, the advantages of low-flow purging include:

- samples which are representative of the *mobile* load of contaminants present (dissolved and colloid-associated);
- minimal disturbance of the sampling point thereby minimizing sampling artifacts;
- less operator variability, greater operator control;

- reduced stress on the formation (minimal drawdown);
- less mixing of stagnant casing water with formation water;
- reduced need for filtration and, therefore, less time required for sampling;
- smaller purging volume which decreases waste disposal costs and sampling time;
- better sample consistency; reduced artificial sample variability.

Some disadvantages of low-flow purging are:

- higher initial capital costs,
- greater set-up time in the field,
- need to transport additional equipment to and from the site,
- increased training needs,
- resistance to change on the part of sampling practitioners,
- concern that new data will indicate a *change in conditions* and trigger an *action*.

IV. Low-Flow (Minimal Drawdown) Sampling Protocols

The following ground-water sampling procedure has evolved over many years of experience in ground-water sampling for organic and inorganic compound determinations and as such summarizes the authors' (and others) experiences to date (Barcelona et al., 1984, 1994; Barcelona and Helfrich, 1986; Puls and Barcelona, 1989; Puls et. al. 1990, 1992; Puls and Powell, 1992; Puls and Paul, 1995). High-quality chemical data collection is essential in ground-water monitoring and site characterization. The primary limitations to the collection of *representative* ground-water samples include: mixing of the stagnant casing and *fresh* screen waters during insertion of the sampling device or ground-water level measurement device; disturbance and resuspension of settled solids at the bottom of the well when using high pumping rates or raising and lowering a pump or bailer; introduction of atmospheric gases or degassing from the water during sample handling and transfer, or inappropriate use of vacuum sampling device, etc.

A. Sampling Recommendations

Water samples should not be taken immediately following well development. Sufficient time should be allowed for the ground-water flow regime in the vicinity of the monitoring well to stabilize and to approach chemical equilibrium with the well construction materials. This lag time will depend on site conditions and methods of installation but often exceeds one week.

Well purging is nearly always necessary to obtain samples of water flowing through the geologic formations in the screened interval. Rather than using a general but arbitrary guideline of purging three casing volumes prior to sampling, it is recommended that an in-line water quality measurement device (e.g., flow-through cell) be used to establish the stabilization time for several parameters (e.g. , pH, specific conductance, redox, dissolved oxygen, turbidity) on a well-specific basis. Data on pumping rate, drawdown, and volume required for parameter stabilization can be used as a guide for conducting subsequent sampling activities.

The following are recommendations to be considered before, during and after sampling:

- use low-flow rates (<0.5 L/min), during both purging and sampling to maintain minimal drawdown in the well;
- maximize tubing wall thickness, minimize tubing length;
- place the sampling device intake at the desired sampling point;
- minimize disturbances of the stagnant water column above the screened interval during water level measurement and sampling device insertion;
- make proper adjustments to stabilize the flow rate as soon as possible;
- monitor water quality indicators during purging;
- collect unfiltered samples to estimate contaminant loading and transport potential in the subsurface system.

B. Equipment Calibration

Prior to sampling, all sampling device and monitoring equipment should be calibrated according to manufacturer's recommendations and the site Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP). Calibration of pH should be performed with at least two buffers which bracket the expected range. Dissolved oxygen calibration must be corrected for local barometric pressure readings and elevation.

C. Water Level Measurement and Monitoring

It is recommended that a device be used which will least disturb the water surface in the casing. Well depth should be obtained from the well logs. Measuring to the bottom of the well casing will only cause resuspension of settled solids from the formation and require longer purging times for turbidity equilibration. Measure well depth after sampling is completed. The water level measurement should be taken from a permanent reference point which is surveyed relative to ground elevation.

D. Pump Type

The use of low-flow (e.g., 0.1-0.5 L/min) pumps is suggested for purging and sampling all types of analytes. All pumps have some limitation and these should be investigated with respect to application at a particular site. Bailers are inappropriate devices for low-flow sampling.

1) General Considerations

There are no unusual requirements for ground-water sampling devices when using low-flow, minimal drawdown techniques. The major concern is that the device give consistent results and minimal disturbance of the sample across a range of *low* flow rates (i.e., < 0.5 L/min). Clearly, pumping rates that cause minimal to no drawdown in one well could easily cause *significant* drawdown in another well finished in a less transmissive formation. In this sense, the pump should not cause undue pressure or temperature changes or physical disturbance on the water sample over a reasonable sampling range. Consistency in operation is critical to meet accuracy and precision goals.

2) Advantages and Disadvantages of Sampling Devices

A variety of sampling devices are available for low-flow (minimal drawdown) purging and sampling and include peristaltic pumps, bladder pumps, electrical submersible pumps, and gas-driven pumps. Devices which lend themselves to both dedication and consistent operation at definable low-flow rates are preferred. It is desirable that the pump be easily adjustable and operate reliably at these lower flow rates. The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and some volatiles loss. Gas-driven pumps should be of a type that does not allow the gas to be in direct contact with the sampled fluid.

Clearly, bailers and other *grab* type samplers are ill-suited for low-flow sampling since they will cause repeated disturbance and mixing of *stagnant* water in the casing and the *dynamic* water in the screened interval. Similarly, the use of inertial lift foot-valve type samplers may cause too much disturbance at the point of sampling. Use of these devices also tends to introduce uncontrolled and unacceptable operator variability.

Summaries of advantages and disadvantages of various sampling devices are listed in Herzog et al. (1991), U. S. EPA (1992), Parker (1994) and Thurnblad (1994).

E. Pump Installation

Dedicated sampling devices (left in the well) capable of pumping and sampling are preferred over <u>any</u> other type of device. Any portable sampling device should be slowly and carefully lowered to the middle of the screened interval or slightly above the middle (e.g., 1-1.5 m below the top of a 3 m screen). This is to minimize excessive mixing of the stagnant water in the casing above the screen with the screened interval zone water, and to minimize resuspension of solids which will have collected at the bottom of the well. These two disturbance effects have been shown to directly affect the time required for purging. There also appears to be a direct correlation between size of portable sampling devices relative to the well bore and resulting purge volumes and times. The key is to minimize disturbance of water and solids in the well casing.

F. Filtration

Decisions to filter samples should be dictated by sampling objectives rather than as a *fix* for poor sampling practices, and field-filtering of certain constituents should not be the default. Consideration should be given as to what the application of field-filtration is trying to accomplish. For assessment of truly dissolved (as opposed to operationally *dissolved* [i.e., samples filtered with 0.45 µm filters]) concentrations of major ions and trace metals, 0.1 µm filters are recommended although 0.45 µm filters are normally used for most regulatory programs. Alkalinity samples must also be filtered if significant particulate calcium carbonate is suspected, since this material is likely to impact alkalinity titration results (although filtration itself may alter the CO_2 composition of the sample and, therefore, affect the results).

Although filtration may be appropriate, filtration of a sample may cause a number of unintended changes to occur (e.g. oxidation, aeration) possibly leading to filtration-induced artifacts during sample analysis and uncertainty in the results. Some of these unintended changes may be unavoidable but the factors leading to them must be recognized. Deleterious effects can be minimized by consistent application of certain filtration guidelines. Guidelines should address selection of filter type, media, pore size, etc. in order to identify and minimize potential sources of uncertainty when filtering samples.

In-line filtration is recommended because it provides better consistency through less sample handling, and minimizes sample exposure to the atmosphere. In-line filters are available in both disposable (barrel filters) and non-disposable (in-line filter holder, flat membrane filters) formats and various filter pore sizes (0.1-5.0 µm). Disposable filter cartridges have the advantage of greater sediment handling capacity when compared to traditional membrane filters. Filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of 1 L of ground water following purging and prior to sampling. Once filtration has begun, a filter cake may develop as particles larger than the pore size accumulate on the filter membrane. The result is that the effective pore diameter of the membrane is reduced and particles smaller than the stated pore size are excluded from the filtrate. Possible corrective measures include prefiltering (with larger pore size filters), minimizing particle loads to begin with, and reducing sample volume.

G. Monitoring of Water Level and Water Quality Indicator Parameters

Check water level periodically to monitor drawdown in the well as a guide to flow rate adjustment. The goal is minimal drawdown (<0.1 m) during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience. In-line water quality indicator parameters should be continuously monitored during purging. The water quality

indicator parameters monitored can include pH, redox potential, conductivity, dissolved oxygen (DO) and turbidity. The last three parameters are often most sensitive. Pumping rate, drawdown, and the time or volume required to obtain stabilization of parameter readings can be used as a future guide to purge the well. Measurements should be taken every three to five minutes if the above suggested rates are used. Stabilization is achieved after all parameters have stabilized for three successive readings. In lieu of measuring all five parameters, a minimum subset would include pH, conductivity, and turbidity or DO. Three successive readings should be within ± 0.1 for pH, ± 3% for conductivity, ± 10 mv for redox potential, and ± 10% for turbidity and DO. Stabilized purge indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable values during purging. Dissolved oxygen and turbidity usually require the longest time for stabilization. The above stabilization guidelines are provided for rough estimates based on experience.

H. Sampling, Sample Containers, Preservation and Decontamination

Upon parameter stabilization, sampling can be initiated. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. Sampling flow rate may remain at established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates less than 0.5 L/min are appropriate. The same device should be used for sampling as was used for purging. Sampling should occur in a progression from least to most contaminated well, if this is known. Generally, volatile (e.g., solvents and fuel constituents) and gas sensitive (e.g., Fe^{2+}, CH_4, H_2S/HS^-, alkalinity) parameters should be sampled first. The sequence in which samples for most inorganic parameters are collected is immaterial unless filtered (dissolved) samples are desired. Filtering should be done last and in-line filters should be used as discussed above. During both well purging and sampling, proper protective clothing and equipment must be used based upon the type and level of contaminants present.

The appropriate sample container will be prepared in advance of actual sample collection for the analytes of interest and include sample preservative where necessary. Water samples should be collected directly into this container from the pump tubing.

Immediately after a sample bottle has been filled, it must be preserved as specified in the site (QAPP). Sample preservation requirements are based on the analyses being performed (use site QAPP, FSP, RCRA guidance document [U. S. EPA, 1992] or EPA SW-846 [U. S. EPA, 1982]). It may be advisable to add preservatives to sample bottles in a controlled setting prior to entering the field in order to reduce the chances of improperly preserving sample bottles or introducing field contaminants into a sample bottle while adding the preservatives.

The preservatives should be transferred from the chemical bottle to the sample container using a disposable polyethylene pipet and the disposable pipet should be used only once and then discarded.

After a sample container has been filled with ground water, a Teflon™ (or tin)-lined cap is screwed on tightly to prevent the container from leaking. A sample label is filled out as specified in the FSP. The samples should be stored inverted at 4°C.

Specific decontamination protocols for sampling devices are dependent to some extent on the type of device used and the type of contaminants encountered. Refer to the site QAPP and FSP for specific requirements.

I. Blanks

The following blanks should be collected:

(1) field blank: one field blank should be collected from each source water (distilled/deionized water) used for sampling equipment decontamination or for assisting well development procedures.

(2) equipment blank: one equipment blank should be taken prior to the commencement of field work, from each set of sampling equipment to be used for that day. Refer to site QAPP or FSP for specific requirements.

(3) trip blank: a trip blank is required to accompany each volatile sample shipment. These blanks are prepared in the laboratory by filling a 40-mL volatile organic analysis (VOA) bottle with distilled/deionized water.

V. Low-Permeability Formations and Fractured Rock

The overall sampling program goals or sampling objectives will drive how the sampling points are located, installed, and choice of sampling device. Likewise, site-specific hydrogeologic factors will affect these decisions. Sites with very low permeability formations or fractures causing discrete flow channels may require a unique monitoring approach. Unlike water supply wells, wells installed for ground-water quality assessment and restoration programs are often installed in low water-yielding settings (e.g., clays, silts). Alternative types of sampling points and sampling methods are often needed in these types of environments, because low-permeability settings may require extremely low-flow purging (<0.1 L/min) and may be technology-limited. Where devices are not readily available to pump at such low flow rates, the primary consideration is to avoid dewatering of

the well screen. This may require repeated recovery of the water during purging while leaving the pump in place within the well screen.

Use of low-flow techniques may be impractical in these settings, depending upon the water recharge rates. The sampler and the end-user of data collected from such wells need to understand the limitations of the data collected; i.e., a strong potential for underestimation of actual contaminant concentrations for volatile organics, potential false negatives for filtered metals and potential false positives for unfiltered metals. It is suggested that comparisons be made between samples recovered using low-flow purging techniques and samples recovered using passive sampling techniques (i.e., two sets of samples). Passive sample collection would essentially entail acquisition of the sample with no or very little purging using a dedicated sampling system installed within the screened interval or a passive sample collection device.

A. Low-Permeability Formations (<0.1 L/min recharge)

1. Low-Flow Purging and Sampling with Pumps

a. "portable or non-dedicated mode" - Lower the pump (one capable of pumping at <0.1 L/min) to mid-screen or slightly above and set in place for minimum of 48 hours (to lessen purge volume requirements). After 48 hours, use procedures listed in Part IV above regarding monitoring water quality parameters for stabilization, etc., but do not dewater the screen. If excessive drawdown and slow recovery is a problem, then alternate approaches such as those listed below may be better.

b. "dedicated mode" - Set the pump as above at least a week prior to sampling; that is, operate in a dedicated pump mode. With this approach significant reductions in purge volume should be realized. Water quality parameters should stabilize quite rapidly due to less disturbance of the sampling zone.

2. Passive Sample Collection

Passive sampling collection requires insertion of the device into the screened interval for a sufficient time period to allow flow and sample equilibration before extraction for analysis. Conceptually, the extraction of water from low yielding formations seems more akin to the collection of water from the unsaturated zone and passive sampling techniques may be more appropriate in terms of obtaining "representative" samples. Satisfying usual sample volume requirements is typically a problem with this approach and some latitude will be needed on the part of regulatory entities to achieve sampling objectives.

B. Fractured Rock

In fractured rock formations, a low-flow to zero purging approach using pumps in conjunction with packers to isolate the sampling zone in the borehole is suggested. Passive multi-layer sampling devices may also provide the most "representative" samples. It is imperative in these settings to identify flow paths or water-producing fractures prior to sampling using tools such as borehole flowmeters and/or other geophysical tools.

After identification of water-bearing fractures, install packer(s) and pump assembly for sample collection using low-flow sampling in "dedicated mode" or use a passive sampling device which can isolate the identified water-bearing fractures.

VI. Documentation

The usual practices for documenting the sampling event should be used for low-flow purging and sampling techniques. This should include, at a minimum: information on the conduct of purging operations (flow-rate, drawdown, water-quality parameter values, volumes extracted and times for measurements), field instrument calibration data, water sampling forms and chain of custody forms. See Figures 2 and 3 and "Ground Water Sampling Workshop -- A Workshop Summary" (U. S. EPA, 1995) for example forms and other documentation suggestions and information. This information coupled with laboratory analytical data and validation data are needed to judge the "useability" of the sampling data.

VII. Notice

The U.S. Environmental Protection Agency through its Office of Research and Development funded and managed the research described herein as part of its in-house research program and under Contract No. 68-C4-0031 to Dynamac Corporation. It has been subjected to the Agency's peer and administrative review and has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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Figure 2. Ground Water Sampling Log

Project _____ Site _____ Well No. _____ Date _____

Well Depth _____ Screen Length _____ Well Diameter _____ Casing Type _____

Sampling Device _____ Tubing type _____ Water Level _____

Measuring Point _____ Other Infor _____

Sampling Personnel _____

Time	pH	Temp	Cond.	Dis.O_2	Turb.	[ ]Conc			Notes

Type of Samples Collected

_____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi r^3$

Figure 3. **Ground Water Sampling Log** (with automatic data logging for most water quality parameters)

Project _____ Site _____ Well No. _____ Date _____
Well Depth _____ Screen Length _____ Well Diameter _____ Casing Type _____
Sampling Device _____ Tubing type _____ Water Level _____
Measuring Point _____ Other Infor _____

Sampling Personnel _____

Time	Pump Rate	Turbidity	Alkalinity	[ ] Conc	Notes

Type of Samples Collected

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi r^3$

QUALITY ASSURANCE PROJECT PLAN

DOVATRON INTERNATIONAL
ORDER ON CONSENT INDEX # B7-0516-97-05
SITE CODE #704024

Former Binghamton Plastics Site
498 Conklin Avenue
Binghamton, New York

Prepared by:

SHIELD ENVIRONMENTAL ASSOCIATES, INC.
Lexington, Kentucky
November 11, 1998

Job No. 395-0430

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1.0 QUALITY ASSURANCE PROJECT PLAN

This Quality Assurance Project Plan (QAPP) sets forth the minimum protocol necessary to achieve the data quality objectives (DQOs) during the remedial investigation and feasibility study (RI/FS). The RI/FS will be conducted by Shield Environmental Associates, Inc. (Shield) at the Former Binghamton Plastics site (the site) in Broome County, New York (#7-04-024). The QAPP prepared for The DII Group will detail quality assurance/quality control (QA/QC) procedures to be followed while conducting site field sampling and analysis tasks.

Shield is committed to the performance of field investigations using procedures that will produce data that are representative of field conditions. QA is of concern to the various agencies and contractors involved in this project. A major component of a QA/QC program is direct feedback from all staff, field and laboratory personnel involved in the project. Any concerns or questions regarding project QA/QC should be directed to the Project Manager or, if appropriate, the QA Officer. Periodic reports regarding QA/QC will be made during the course of the project. At a minimum, reports regarding each major task will be prepared that document the results of any QA/QC inspections or audits. This report will include a list of any specific QA problems encountered along with recommended solutions.

The QAPP has been developed in accordance with the following documents:

- New York State Department of Environmental Conservation (NYSDEC), *Guidance for the Development of Data Usability Summary Reports* (revised on September 1997)
- NYSDEC, *Analytical Services Protocol (ASP)* (1995 Revision Guideline)
- United States Environmental Protection Agency (USEPA), *Test Methods for Evaluating Solid Waste* (SW-846), Third Edition and subsequent updates (Update III)
- USEPA, *Region II CERCLA Quality Assurance Manual* (1989)
- USEPA, *Preparing Perfect Project Plans* (1989)
- USEPA, *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual* (1996)
- USEPA, *Technical Guidance Document: Construction Quality Assurance for Hazardous Waste Land Disposal Facilities* (1986)
- USEPA, *Data Quality Objectives Process for Superfund, Interim Final Guidance* (1993).

Also provided in this plan are the laboratory protocols for sample analyses.

1.1 Site Location and Description

The facility, located at 498 Conklin Avenue, Binghamton, Broome County, New York (Figure 1), is situated in an industrial/residential setting. The site is bounded by McIntosh Laboratories to the west, the Erie-Lakawanna Railroad, a public park and Susquehanna River to the north, and residential properties to the east and south.

1.2 Project Objectives

The scope of work (SOW) for this aspect of the project is to provide a detailed plan for the performance of the RI/FS as dictated by the Order on Consent prepared by the NYSDEC. The ultimate goal is to develop and evaluate the appropriate remedial activities, restrict further migration of the contaminant plume into soil and ground water, minimize potential risks to human health and environment, and/or remove the source contamination. To complete the RI/FS and refine the evaluation of the appropriate remedial alternative, sampling of different media is required at the site.

The general objectives for the sampling at the site are:

- To perform sampling such that the sample taken is truly representative of the material or medium being sampled.
- To use proper sampling, sample handling, preservation, and QC techniques.
- To properly identify the collected samples and document their collection in permanent field records.
- To maintain sample chain-of-custody forms.
- To protect the collected samples by properly packing and transporting (shipping) them to a laboratory for analysis.
- To confirm that laboratory protocols and QA/QC are consistent with SW-846 methods and protocols for the NYSDEC. NYSDEC ASP Category B deliverables reporting will be used for all investigative samples.
- To establish the extent of elevated constituents in subsurface soils.
- To characterize the ground water and the extent of ground water contamination.
- To assess the natural attenuation process.

The data collected will be used to:

- Establish the vertical and horizontal distribution of contamination in the surface/subsurface soil and sediment.
- Identify and establish the vertical and horizontal extent of ground water contamination.
- Identify and establish the contaminant mobility and the long-term contaminant disposition.

- Establish the extent and fate of any contamination in the nearby surface water for evaluation of possible future discharges and the degree of contamination reduction expected.
- To identify the possibility/occurrence of natural attenuation and the degradation rate.
- Verify the constituents and volume of ground water requiring treatment.
- Test the efficacy of the soil/ground water treatment and/or removal scenarios.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 Key Personnel And Quality Assurance Responsibilities

The project team at the site will work under the direction of the Project Director and Project Manager. Figure 2 provides a chart the showing project organization and lines of authority. Project personnel responsibilities are listed below.

- Project Director: Daniel V. Terrell III, will serve as the Project Director. Mr. Terrell will be responsible for assessing and monitoring the overall project progress, approving project plans and reports, making conclusions/recommendations, and leading major briefings/meeting negotiations.

- Project Manager: Michael E. Morris, P.G., will serve as the Project Manager. Mr. Morris' responsibilities will include project team management, being the focal point for day-to-day client interactions and conducting briefings and client regulatory meetings. Mr. Morris will also be responsible for project scheduling, budget monitoring, technical task integration and communications and coordination of team leaders and field efforts. He will also monitor the project for adherence to the QAPP. A resume is contained in Attachment 1.

- Quality Assurance Officer: Barbara H. Jones will serve as the Quality Assurance Officer. Ms. Jones has the primary responsibility for overseeing and implementing the quality assurance (QA) program. She reports directly to the Project Director. In her role as Quality Assurance Officer, Ms. Jones will provide independent oversight so that overall QA procedures are in place for the project. A resume is contained in Attachment 1.

- Site Supervisor: Kreg Mills will be designated as the Site Supervisor. Mr. Mills will be responsible for overseeing all on-site activities. He will also interact with other field personnel so that field efforts are successfully completed. The Site Supervisor will communicate regularly with the Project Manager concerning the project status, additional material and/or labor needs, etc., and keep a daily summary of all on-site activities.

- Site Health and Safety Officer: The Health and Safety Officer is responsible for proper operation of all safety equipment, monitoring activities during site work, selecting the necessary level of personal protection, and enforcing the HASP. Sarah Donaldson will act as the Health and Safety Officer for this project. The Health and Safety Officer will have the authority to stop work if conditions exceed allowable limits. The Health and Safety Officer will assist other members of the field team as needed to maintain the safe operation of the field program.

- Sample Custody Officer: Kreg Mills will be the Sample Custody Officer. Mr. Mills will be responsible for the proper completion of sample custody forms as well as packing and shipping samples. He will also be responsible for notifying the analytical laboratory of sample shipments including the number and types of samples that are being shipped.

- Sampling Personnel: Sampling personnel are responsible for helping the Site Manager

during sample collection. Specific responsibilities include proper sample collection, packaging, documentation, and chain-of-custody documentation until samples are released to another party for storage or transport to the analytical laboratory. Sampling personnel will also be responsible for the correct and complete decontamination of sampling equipment.

- Drilling/Excavation/Surveying Subcontractors: The drilling/excavation/surveying subcontractors are responsible for supplying all services (including labor), equipment and materials required to perform the excavation/drilling/surveying activities. The excavation subcontractors are further responsible for conducting necessary maintenance and QC of required equipment and for following decontamination procedures specified in the Field Sampling Plan (FSP), HASP, and QAPP. Upon completing the work, the subcontractors will be responsible for demobilizing all equipment, cleaning up any materials deposited on-site, and properly filling excavated/drilled areas as directed.

- Analytical Subcontractor: The analytical subcontractor for this portion of the project will be Quanterra Environmental Services, a full-service analytical laboratory. Quanterra will be responsible for the analysis of all waste, soil, sediment, and liquid samples collected from the site. The laboratory will also be responsible for the QA/QC implementation and documentation of all analyses performed on the samples.

Shield will require that Quanterra comply with the following:

- Provide access to USEPA personnel and USEPA-authorized representatives to assure the accuracy of laboratory results related to the site;

- Perform all analyses according to USEPA SW-846, Third Edition, Update III or other accepted methods.

- Accepted analytical methods will consist of those methods that are documented in the NYSDEC *Analytical Service Protocol* (1995 Revision Guideline), *Contract Lab Program Statement of Work for Inorganic Analysis* (Revision 11, 1994) and *the Contract Lab Program Statement of Work for Organic Analysis* (Revision 9, 1992), and any amendments thereto.

Quanterra participates in the New York State Department of Health's (NYSDOH) Environmental Approval Program (ELAP) QA/QC program and has analyzed samples that the NYSDOH submitted to ensure that they meet the approved QA/QC requirements. Quanterra's Quality Assurance Management Plan is contained in Attachment 2. They have passed their most recent performance evaluation. See Section 7.2 for additional detail.

While all project personnel and subcontractors are responsible for adherence to specific QA/QC aspects of the project, the following laboratory personnel will be responsible for laboratory QA/QC:

- General Manager: The General Manager is responsible for evaluating the information supplied by the Operations Director. This responsibility includes the commitment to provide the leadership and financial resources necessary so that the laboratory and staff are able to offer the highest quality, scientifically sound and legally defensible data and services to

clients. The General Manager reports directly to the Quanterra president.

- Operations Director: The Operations Director is responsible for planning the analytical growth and development of all laboratory sites. This individual is involved in productivity assessments for each facility and establishes the direction each will take to meet the analytical needs of the client. Additional responsibilities include seeing that all analytical programs comply with applicable regulatory requirements. The Operations Director reports to the General Manager.

- Quality Assurance Director: The QA Director establishes and directs the activities relating to analytical QA/QC at laboratory sites. This person represents the organization in all matters pertaining to QA/QC. The QA Director reports to the General Manager.

- Laboratory Director: The Laboratory Director oversees daily operations of the analytical laboratory. Responsibilities include interacting with group coordinators and project managers to coordinate the projects and workload. In addition, this person assumes responsibility for maintaining method compliance in the laboratory. The Laboratory Director interacts with the QA Manager in the laboratory and ensures the incorporation of all such requirements into daily operations. This person aids the QA Manager in addressing corrective actions and preparing the laboratory to meet certification and approval program requirements. The Laboratory Director reports to the Operations Director.

- Quality Assurance Manager: The QA Manager supervises QA/QC functions pertaining to laboratory analytical operations. These responsibilities include managing certification and approval programs, maintaining QA/QC objective data, conducting internal QA/QC audits, maintaining internal QA/QC data, and preparing and submitting any QA plans. The QA Manager is responsible for seeing that all final data meet the criteria of the QC program and reports directly to the QA Director and indirectly to the Laboratory Director.

- Project Manager: The Project Manager is responsible for the timely completion and reporting of all projects. This person ensures that the project QA objectives have been met and that project problems encountered with any facet of the laboratory have been adequately addressed. The Project Manager reports to the Laboratory Director and Customer Service Manager while coordinating activities with the Laboratory Business Development Director.

- Sample Custodian: The Sample Custodian ensures that all submitted samples are properly accepted into the laboratory in accordance with documented sample acceptance procedures and that associated sample instructions are entered into the laboratory data management system. This person examines each sample and reports on the condition, preservation, and documentation of each. The Sample Custodian reports to the Laboratory Director.

- Organic Manager: The Organic Manager implements and supervises all analytical activities pertaining to their respective analytical group. This individual is responsible for coordinating projects and associated workloads. This person also ensures that the proper QC requirements are incorporated into the daily operation of the group. This individual also participates on the Organic Technical Committee. The Organic Manager reports to the Laboratory Director.

- Inorganic Manager: The Inorganic Manager implements and supervises all analytical

activities pertaining to their respective analytical group. This individual is responsible for coordinating project and associated workloads. The Inorganic Manager also ensures that the proper QC requirements are incorporated into the daily operation of the group. The Inorganic Manager also participates on the Inorganic Technical Committee. The Inorganic Manager reports to the Laboratory Director.

- Analytical Group Coordinators: The Analytical Group Coordinators implement and supervise all analytical activities pertaining to their respective analytical groups (gas chromatogram [GC], gas chromatogram/mass spectometry [GC/MS], inorganics). They will coordinate projects and the workload while ensuring that proper QC requirements are incorporated into the daily operation. These people also review raw data and analytical results. The Analytical Group Coordinators report to their respective Group Managers.

3.0 QUALITY ASSURANCE OBJECTIVES

3.1 Data Quality Objectives

The DQO process is a "series of planning steps based upon the Scientific Method that is designed so that the type, quantity, and quality of environmental data used in decision making are appropriate for the intended application" (USEPA 1994). DQOs help to clarify study objectives, define types of data to collect, establish appropriate conditions from which to collect data, and specify levels of decision. Guidance for developing DQOs is contained in the NYSDEC's Division of Environmental Remediation's *Guidance for the Development of Data Usability Summary Reports* and the USEPA document entitled *Guidance for the Data Quality Objectives Process*, dated September 1994. This document revises and updates existing USEPA documents regarding DQOs.

DQOs are qualitative and quantitative statements that:

- Clarify the study objective.
- Define the most appropriate type of data to collect.
- Establish the most appropriate conditions from which to collect the data.
- Specify acceptable levels of decision errors that will be used as the basis for establishing the quantity and quality of data needed to support the decision.

The DQOs for soil sampling at the site are to collect additional data to define and further refine the areas with affected soil. Also, additional data will be collected during the soil sampling to identify if any of these soils are characteristically hazardous. These data will be used to verify the location of soils to be excavated/remediated and refine any estimates of affected soil volume. Visual observations will also be made during soil sample collection regarding subsurface conditions, the presence of ground water and the presence of stained and/or odorous soil.

The DQOs for ground water sampling are to collect representative ground water samples. Ground water level information will also be collected for use in constructing potentiometric surface maps as applicable. The quantitative ground water data will be used to verify the types of contaminants previously detected in ground water, the horizontal and vertical extent of contamination, the rate and extent of natural attenuation of organic compounds, and to evaluate natural attenuation parameters. These data will also be used to assess ground water treatment technologies and for the design of appropriate remedial technologies.

The DQOs for sediment sampling include the collection of data to estimate the extent of affected sediments and to evaluate the natural attenuation process at the site. The data will also be used to evaluate potential remedial options. The proposed sediment samples will be discrete samples.

The DQOs for surface water sampling will be to establish the extent and fate of any contamination in the on-site surface waters and to evaluate possible future discharges, natural attenuation processes, and potential remedial options.

The DQOs for air monitoring at the site consist of collecting qualitative data to evaluate the impacts of site activities on the surrounding air quality. Qualitative data will be used during field efforts to change or upgrade the levels of respiratory protection for site workers. Some of these data will also be used to develop specific FS documents.

The analytical DQOs for the site are summarized in Table 1. This table lists the tasks to be performed, data uses, and analytical levels.

3.2 Intended Use of The Data

The intended use of the data generated as a result of the RI at the site is summarized below.

3.2.1 Soil

- To further define the horizontal and vertical extent of soils with elevated concentrations of trichloroethene (TCE) and associated degradation products prior to site remediation activities.
- To assess the subsurface conditions along the utility lines (i.e., storm and sanitary sewer; electrical, gas and water lines; footer drains).
- To evaluate and design potential remedial options.

3.2.2 Ground Water

- To collect ground water level data for use in preparing potentiometric surface maps.
- To collect ground water contaminant concentration data for use in preparing isoconcentration surface maps for concerned compounds.
- To further assess the types of chemicals and their concentrations in ground water.
- To further assess the vertical and horizontal extent of the ground water contamination.
- To assess hydrogeological conditions and parameters through aquifer testing and to establish sufficient field data to simulate ground water modeling.
- To assess and evaluate the mobility and migration of the contaminant traveling along the flow path.
- To assess the potential ground water treatment scenarios.

3.2.3 Sediment

- To establish the presence or absence of contaminants in sediments downgradient of the site.
- To establish the degree of the contamination reduction expected, if present.
- To evaluate the natural attenuation process.

- To evaluate potential remedial options, if necessary.

3.2.4 Surface Water

- To assess water quality in nearby surface water.
- To establish the degree of contamination reduction along the flow path, if necessary.
- To evaluate potential remedial options, if necessary.

3.2.5 Air Monitoring

- To qualitatively assess the concentrations of VOCs present during site activities.
- To assess and evaluate the level of worker personal protective equipment (PPE) required.

3.3 Objectives For Accuracy, Precision, and Completeness

3.3.1 Accuracy

Accuracy measures the bias in a measurement system that is difficult to measure for the entire data collection activity. Sources of error are the sampling process, field contamination, preservation, handling, sample matrix, sample preparation and analysis techniques. Sampling accuracy may be assessed by evaluating the results of field/trip blanks. Analytical accuracy may be assessed through use of known and unknown QC samples and matrix spikes. The objective of the sampling will be to attempt to keep the trip and field blanks as close to nondetect levels as possible. For analytical data, the percent recoveries of surrogates, QC check standards and matrix spike analyses are used to evaluate the analysis accuracy. The data's accuracy will also be verified by the Quality Assurance Officer based on the NYSDEC's *Guidance for the Development of Data Usability Summary Reports*.

3.3.2 Precision

Precision is a measure of the mutual agreement among individual measurements of the sample parameters under prescribed similar conditions. The overall precision of measurement data is a mixture of sampling and analytical factors. Analytical precision is much easier to control and quantify than sampling precision. Sampling precision may be established by collecting and analyzing field replicate samples and then creating and analyzing laboratory replicates from one or more of the field samples. The analytical results from the field replicate samples provide data on overall measurement precision; analytical results from the laboratory replicates provide data on analytical precision. Subtracting the analytical precision from the measurement precision defines the sampling precision.

The analytical precision will be monitored using results from duplicate or replicate analyses of samples and from matrix spikes performed in duplicate on a given matrix. The Relative Percent Difference (RPD) is used to evaluate the precision of replicate analysis. All analytical procedures will be in compliance with the NYSDEC Analytical Services Protocol (ASP).

3.3.3 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions. Completeness is the percentage of data that remains valid after a precision and accuracy determination. Field measurement techniques (Level I and II) should have nearly 100 percent completeness since invalid measurements are to be repeated until valid. Laboratory analytical techniques will follow protocol and parameters of the NYSDEC ASP.

4.0 SAMPLING PROCEDURES

This section presents methods of environmental sampling. These activities, including collection, preservation, packaging, handling, shipping, and storage of samples, will be performed in general accordance with procedures described by the following guidance documents; USEPA *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual* (1996); USEPA *Compendium of ERT Waste Sampling Procedures* (January 1991); USEPA *Compendium of ERT Ground Water Sampling Procedures* (January 1991); USEPA *Compendium of ERT Surface Water and Sediment Sampling Procedures* (1991).

The following fundamental issues will be addressed during project planning:

- Site, adjacent property, and weather conditions
- Sampling personnel
- Health and safety
- Frequency of sampling
- Equipment decontamination
- Methods of sampling to be employed
- Matrix to be sampled
- QA objectives
- Number of samples to be collected
- Volume of samples to be collected
- Analyses to be performed in the field
- Equipment calibration
- Analyses to be performed by the laboratory
- Procedures and precautions to be followed during sampling
- Methods of sample preservation and shipment
- Disposal of sampling materials
- Recordkeeping
- Chain-of-custody documentation

The following general field procedures will be used for the field investigation to be conducted by Shield personnel:

- Visit and assess the site.

- Prepare a site map that shows the locations of sample monitoring stations and other features related to the field sampling.

- Record locations of roads, utility lines, property boundaries, sensitive receptors, etc.

- Establish the matrix to be sampled, become familiar with the applicable safety precautions and practices, obtain the necessary safety equipment, and prepare the sample collection program.

- Obtain the equipment and materials necessary to perform field sampling and analyses.

- Become familiar with the overall scope of the study, sampling equipment, QA objectives, sample handling procedures, and shipping requirements.

- Calibrate all field equipment prior to and during field work according to the manufacturer's instructions and calibration procedures described in Section 6.0.

- Perform field sampling in accordance with the FSP, HASP and QAPP.

- Complete all field logs prior to leaving the field location.

- Verify that all sample containers are labeled with appropriate information. This includes project number and name, sample number, location, sampling date and time, preservatives added, and sampler's signature.

- Complete chain-of-custody records that will accompany all samples during shipment.

All exploration and sampling activity information will be documented. Documentation of sampling activities includes photographic records, subsurface drilling or trench logs, test data forms, field data collection forms, and air monitoring forms. A listing of soil and sediment sampling equipment, including restrictions for the various construction materials, is contained in Table 2.

All sample bottles and containers will be precleaned and obtained from the laboratory. All sampling activities will be documented in the field logbook. Sample containers, volumes, preservation techniques, and holding times will be consistent with NYSDEC ASP guidelines or other applicable methods as listed in Table 3. Table 4 represents the target compound list/target analyte list (TCL/TAL) during preliminary investigation. Table 5 is a site-specific parameter list containing the nine compounds of concern. The order for sample collection at the site is as follows:

- In situ measurements (e.g., temperature, pH, conductivity, turbidity, dissolved oxygen [D.O.], and oxidation reduction potential [Redox]), if warranted

- TCL of VOCs or Site-Specific Parameter List (SSPL)

- TCL Semivolatile Organic Compounds (SVOCs)

- TCL Pesticides/Polychlorinated Biphenyls (PCBs)

- TAL of total metals

Analyses performed will be at or below the detection limits shown on Tables 4 and 5. Detailed sampling procedures are provided in the FSP prepared for this site. Table 6 provides a sampling checklist for field personnel.

4.1 Soil/Sediment Sampling Protocol

4.1.1 Soil/Sediment Sampling

Soil and sediment samples will be collected using the following equipment as appropriate:

- Stainless steel spoon
- Stainless steel scoop
- Stainless steel shovel

- Shelby tube
- Split-spoon sampler
- Direct-push sampler
- Glass or stainless steel bowls
- Coring device
- Backhoe or trackhoe

Soil and sediment samples will be analyzed for the SSPL. Other selected samples will be analyzed for TCL VOCs, TCL SVOCs, TCL Pesticides/PCBs, and TAL total metals.

4.1.2 Soil/Sediment Sampling Equipment Decontamination

Decontamination of soil, sediment, surface water, and ground water sampling equipment will be performed at a designated central staging area at the site. The soil and sediment sampling equipment will be decontaminated in the field using the following procedures:

- Upon arriving at the site, nondecontaminated equipment will be cleaned with potable water and a laboratory-grade soap solution using a brush to remove particulate matter/surface films. Water may be used from any municipal water treatment system.

- The equipment will then be rinsed thoroughly with potable water.

- The equipment will be rinsed with 10% reagent-grade nitric acid if sample will be analyzed for metals.

- The equipment will be rinsed with potable water.

- Pesticide-grade methanol rinse will be used if the sample will be analyzed for organics.

- The final rinse will consist of a distilled water rinse, and the equipment will be allowed to air dry as long as possible. Air drying will be conducted only when the presence of airborne contaminants and dust particles are not suspected.

- Each piece of equipment will be enclosed in a clean, high-density polyethylene container (smaller items) or in plastic bags (larger items) for storage or transportation. Aluminum foil also may be used to wrap decontaminated sampling equipment. However, foil will not be used on samples for metals and plastic will not be used on samples to be used for organics.

- If no further sampling is to be performed, the equipment will be decontaminated as described above prior to storage.

- All sample coolers will be pre-cleaned by the laboratory and delivered to the site.

- Soil and sediment sampling equipment that is heavily contaminated to the point where it can not be decontaminated will be properly discarded.

- Steam cleaning will be used for large equipment such as backhoes, trackhoes, or drill rigs.

Deviations from the above procedures will be documented and justified in the daily logs or a

logbook. Wastes generated during decontamination will be containerized for proper characterization and disposal, as appropriate.

4.2 Ground Water Sampling

As a part of the site activities, ground water will be sampled. Ground water samples will be collected from ground water monitoring wells during field work conducted at the site. Wells will be sampled from the least contaminated well to the most contaminated well. When sampling ground water, precautions need to be taken so that samples collected are representative of the aquifer. All sample containers will be obtained from the laboratory.

Low-flow purging and sampling technique (US. EPA 1996) will be used on all of the monitoring wells. Should it be evident that low-flow purging and sampling is not practical, then as a last resort, purging and sampling will be accomplished using either a submersible pump or disposable bailer. A minimum of three well volumes will be purged from wells prior to sampling for those wells not being sampled by low-flow purging. All samples will be collected immediately after the field parameters (i.e., pH, conductivity, D.O., turbidity, temperature, and redox) have stabilized. If wells require redevelopment prior to sampling, redevelopment will be conducted to assure that representative samples will be collected. Other equipment to be used during purging includes water level indicators; thermometers; and pH, conductivity, D.O., turbidity, and redox meters. Detailed sampling procedures are contained in the FSP.

4.3 Surface Water Sampling

Surface water samples will be collected in the shallow water from the catch basins and catch basin outfalls by submerging a disposable sample collection container. The container will be submerged by hand or by using a telescopic heavy-duty aluminum pole with an adjustable baker clamp attached to the end. During sample collection, the mouth of the jar will be positioned upstream, with sampling personnel standing downstream to avoid disturbing sediments, which could contaminate the sample. Water will be transferred from the collection container to the sample containers. Downstream samples will be collected prior to upstream samples to minimize disturbance of sediments at subsequent sampling locations. Detailed sampling procedures are contained in Field Sampling and Analysis Plan (FSAP).

4.4 Duplicate/Split Sampling Procedures

One duplicate sample will be collected for every 20 samples. Duplicate or split soil samples (except for VOC samples) will be collected from a glass or stainless steel bowl after the samples have been thoroughly mixed and homogenized. The sample will be transferred from the bowl with a stainless steel spoon to the duplicate sample containers in equal portions until the containers are full. This procedure will be conducted for each parameter group, except VOC samples, which will be collected directly from the soil or from the sampling device at approximately the same depth interval.

Duplicate soil samples will be handled the same as the other field samples and shipped to the contracted laboratory for analysis. All duplicate samples will be assigned a coded identification number that will be recorded on the Sample Tracking Log. Split samples, which will be collected upon the request of a regulatory agency, will be identified in the same way as the corresponding field sample and shipped to a separate laboratory for analysis as an external quality control check.

4.5 Trip Blank Protocol

A trip blank will accompany each cooler containing water samples to be analyzed for volatiles. The trip blank will be supplied by the laboratory and analyses of the water used will be available from the laboratory indicating that it is clean for all project parameters.

4.6 Rinsate Blank Protocol

A rinsate blank (equipment/rinsate) will be collected once per matrix sampling event (e.g., ground water sampling) upon completion of decontamination procedures. This blank will be a sample of laboratory pure water passed through the sampling equipment to test cleanliness. Analyses of the rinsate water used will be available from either the laboratory or manufacturer indicating that it is clean for all project parameters. The analytical results of the field blank are required to be below detection limits for the project as indicated in Tables 4 and 5.

4.7 Matrix Spike/Matrix Spike Duplicate Protocol

Matrix spike/matrix spike duplicate (MS/M.D.) samples will be analyzed at a frequency based on the NYSDEC ASP protocol.

5.0 SAMPLE CUSTODY

Samples will be stored in a cool place away from direct sunlight. As soon as samples are collected and preserved, they will be stored in an iced cooler at 4°C. Sample shipment will be designed to protect the integrity of and prevent damage to the samples. Properly identified, sealed sample containers will be placed in fiberboard containers or picnic-type coolers. Sufficient absorbent cushioning material will be used as needed to minimize the possibility of sample container breakage. Sample containers will have a completed sample identification tag. The outside of the container will be marked "water" or "soil" sample. The specific method of shipping the samples will be at the discretion of the Project Manager. Field personnel will make sure that sample container lids are tight and secure before storing. The coolers will be sealed with strapping tape and custody seals to prevent tampering during shipment. Samples will be promptly shipped (for overnight delivery) by personal delivery, local courier service or overnight delivery courier to the appropriate laboratory to abide by sample holding times. Samples will be shipped to the laboratory within 24 hours of collection.

5.1 Chain-of-Custody Procedures

Written procedures will be followed whenever samples are collected, transferred, stored, analyzed or destroyed. The primary objective of these procedures is to create an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis and its introduction as evidence.

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

- It is in one's actual possession; or
- It is in one's view, after being in one's physical possession; or
- It is in one's physical possession and then locked up so that no one can tamper with it; or
- It is kept in a secured area, restricted to authorized personnel only.

5.2 Sample Collection, Handling, and Identification

The number of persons involved in collecting and handling samples will be kept to a minimum. Guidelines established for sample collection, preservation and handling will be used. Field records will be completed at the time the sample is collected and will be signed or initialed, including the date and time, by the sample collector(s). Field records will contain the following information:

- Unique sampling or log number
- Date and time of sample collection
- Source of sample (including name, location, and sample type)
- Preservative used (if any)
- Analysis required
- Name of collector(s)
- Other pertinent field data

One member of the sampling team will be appointed Sample Custody Officer. Samples are turned over to the Sample Custody Officer by the team members who collected the samples. The Sample

Custody Officer documents each transaction, and the sample remains in his/her custody until it is shipped to the laboratory.

Each sample is identified by affixing a standardized sample label on the container(s). This label will contain the sample identification number, date and time of collection, source, preservative used, analysis required, and the collector's initials. If a sample label is not available, the same information will be recorded on the sample container in waterproof ink.

The sample container will then be placed in a cooler or transportation case, along with the chain-of-custody record, pertinent field records, and analysis request form as needed. The cooler or transportation case will be sealed or locked. A locked or sealed chest eliminates the need for close control of individual samples.

It is desirable to photograph the sample location to facilitate identification later. At the time the photo is taken, the photographer will record time, date, site location, and a brief description of the subject in the field logbook and in the photographic reporting data sheet as shown in Table 7. Photographs and written records will be handled in a way that chain of custody can be established.

5.3 Transfer of Custody and Shipment

When transferring the samples, the transferee must sign and record the date and time on the chain-of-custody record. Custody transfers made to a sample custodian in the field will account for each sample, although samples may be transferred as a group. Each person who takes custody must fill in the appropriate section of the chain-of-custody record. To minimize custody records, the number of custodians in the chain of possession will be minimized.

All packages sent to the laboratory will be accompanied by the chain-of-custody record and other pertinent forms. A copy of these forms will be retained by the originating office (either carbon or photocopy). Mailed packages can be registered with return receipt requested. For packages sent by common carrier, receipts will be retained as part of the permanent chain-of-custody documentation. Samples to be shipped must be packed so as not to break, and the package will be sealed or locked so that any tampering can be readily detected.

5.4 Laboratory Sample Custody

An integral part of the laboratory's QA/QC program is the establishment of and strict compliance with rigorous sample custody protocol. This protocol pertains to laboratory operations and guarantees the integrity of all samples processed and analyzed.

Upon receipt by the laboratory, the sample custodian executes the chain of custody and verifies the data contained in the sample custody records. In addition, the sample containers are checked so that the custody seal and the sample label are received in proper condition. Samples on the chain of custody are assigned one project number. Each sample of the chain of custody is assigned a unique laboratory identification number. The samples are then recorded in Quanterra's computerized Laboratory Information Management System.

Detailed laboratory sample custody procedures are contained in Attachment 2. Additional sample custody procedures are contained in Section 6.0 of the FSP.

6.0 CALIBRATION PROCEDURES

6.1 Field Calibration Procedures

The calibration of field equipment will be as specified in the operations manual for the particular piece of equipment. All equipment will be kept in good working order, and the Site Manager will be responsible for its maintenance and calibration.

Field instrument calibration, an activity that affects data quality assurance, is to be performed in accordance with the following procedures. Calibration will be performed in the field prior to each field event, at the end of each day, and following any unexpected, unusual, or suspect instrument readings. Calibration activities will occur in the support zone and upwind of field activities. Copies of the manufacturer's calibration guidance is maintained with the respective instruments.

Calibration activities will be documented in the project calibration logbook. A copy of a typical air calibration log is provided in Table 8. The calibration data will include date, time, type and name of equipment, identification or serial number, results of calibration measurements, and name(s) of personnel conducting calibration. If the calibration schedules are not maintained or the specified accuracy cannot be attained, the instrument will be withdrawn for maintenance.

The primary field measurement equipment to be used at the site includes:

- Photoionization detector (PID)
- Particulate Monitor (Miniram)
- Combustible gas indicator (CGI)
- Water level indicator
- YSI multiparameter sonde (temperature, pH, conductivity, D.O., redox, turbidity)

Procedures for equipment calibration are described in each of the manuals for the various equipment and specific calibration requirements will accompany each instrument. Table 9 lists QA targets for field measurements (screening methods). These targets will be used to assess the precision and accuracy of field measurements to establish when corrective actions are necessary. Table 10 indicates corrective actions to be undertaken if the acceptable criteria are not met.

6.2 Laboratory Calibration Procedures

The calibration and upkeep of laboratory equipment will be the responsibility of the Laboratory Manager or other designated, qualified personnel. All equipment and instruments used in laboratory operations for quantitative measurements are controlled by a formal calibration program.

Calibrations may be periodic or operational. These calibrations are described in operation-specific and laboratory standard operating procedures. At a minimum, these procedures will include:

- Instrument to be calibrated.
- Reference standards used for calibration.
- Calibration technique (e.g., linear, quadratic).

- Acceptable performance tolerances and corrective actions required if specifications are not met.

- Frequency of calibration.

- Calibration documentation requirements.

Whenever possible, recognized procedures such as those published by the American Society of Testing and Materials (ASTM), the USEPA, the NYSDEC ASP or procedures provided by manufacturers will be adopted. If established procedures are not available, a procedure will be developed considering the type of equipment, stability characteristics of the equipment, required accuracy, and the effect of operation error on the quantities measured. Additional calibration procedures are specified in the laboratory QA manual (see Attachment 2).

7.0 ANALYTICAL PROCEDURES

7.1 Field Analytical Procedures

QA procedures for field analysis and field analytical and test instrumentation calibration are an essential part of standard operating procedures. To satisfy QA/QC procedures, all field analyses will be conducted in duplicate at least 10 percent of the time. A record of these duplicate analyses will be kept in field logbooks. A significant difference in the replicate analyses will result in recalibration of the instruments used, reexamination of the analytical methodology being used, or reexamination of the sampling procedures and locations.

All field analyses must be traceable to the specific individual performing the analyses and to the specific equipment used. This information will be entered into the field logbooks for all field analyses. Time records will be kept in local time and will be recorded to the nearest 5 minutes.

A specific calibration and/or standardization plan for all field analytical equipment is presented in this subsection and includes the following information: calibration and maintenance intervals; a listing of required calibration standards; environmental conditions requiring recalibration; and use of a logbook to record calibration and maintenance data for each piece of field analytical equipment.

7.1.1 Temperature

Temperature will be measured in the field by using the YSI multiparameter sonde, and/or thermometer, thermistor, or a mechanical dial-type thermometer. The YSI 6 multiparameter sonde is equipped with precision thermistors to assure accurate temperature measurement. The temperature range for the YSI 600 multiparameter probe is -5 to +50 degrees centigrade, with 0.15 degrees centigrade of accuracy. Calibration procedures are not necessary for the thermistors in the YSI 600 unit probe. The water temperature at the sampling location will be recorded first, before measuring other water quality parameters. Temperature data will be reported to the nearest 0.5 °C.

The thermometers will be initially calibrated against a National Bureau of Standards (NBS) certified thermometer or one traceable to NBS certification. Each glass, mercury-filled thermometer will be inspected before each field trip to see that it is not cracked and does not have air spaces in the mercury column. If a mechanical, dial-type thermometer is used, it will not have a broken face cover or otherwise show damage. A cross-check with a calibrated NBS certified thermometer will be made at least semiannually. Thermistors and electronic readout units will be calibrated in the same manner. Recording thermometers will be checked for recording accuracy before each use. The recorder time scale accuracy will be checked semiannually. Before using a thermometer in the field, a visual observation will be made to verify that it has not been damaged. If a thermistor is used, the instrument will be checked against a thermometer before field use. Cross-checks and duplicate field analyses will agree to within ± 0.5°C.

All calibration information, the names of individuals making the calibrations, and dates of calibration will be recorded. Each field calibration will be noted in the field logbook indicating the temperature readings observed. Temperature data will be reported to the nearest 0.5 °C.

7.1.2 pH

Electronic (portable) meters with provisions for temperature compensation will be used. Temperature-resistant combination electrodes will be used in conjunction with the meters. Test paper will be used only for establishing pH ranges or approximate pH values.

The pH meter or the YSI multiparameter sonde will be checked before each field trip for any mechanical or electrical failures, weak batteries and cracked or fouled electrodes. They will be checked initially with three fresh standard buffer solutions (e.g., 4, 7 and 10). All pH recorders will be checked for recording and time scale accuracy. While in the field, the meters will be calibrated daily before use with two buffers bracketing the expected sample pH. Prior to each sample collection, or in case of an apparent pH anomaly, the electrode will be checked with pH 7.0 buffer and recalibrated to the closest reference buffer. The sample will then be retested. Duplicate analyses will agree to within 0.1 standard units.

A logbook will be maintained and will contain the property number of each pH meter, all calibrations and repairs made, the name of the person making repairs, and calibration records. Measurements of pH will be reported to the nearest 0.1 standard unit.

7.1.3 Specific Conductance

A portable specific conductance meter or the YSI multiparameter sonde will be used. Each conductivity meter will be checked before every field trip. Batteries will be checked, and conductivity cells will be cleaned periodically. Before use in the field, the instrument will be checked daily with known standards. The instrument instructions will be referred to for temperature conductance calculations. Duplicate field analyses will agree to within ±3 percent.

All repairs and calibrations will be noted in the field calibration logbook. The logbook will include all calibrations and repair information along with the name of the person making the repair.

Results will be expressed in micromhos/centimeter (umhos/cm), or in microseconds/centimeter (mS/cm) for YSI sonde, corrected to 25°C. Results will be reported to the nearest ten units for readings under 1,000 umhos/cm and the nearest 100 units for readings over 1,000 umhos/cm.

7.1.4 Dissolved Oxygen

The D.O. probe of the YSI sonde will be placed in approximately one-eighth inch of water or a wet sponge in the bottom of the calibration cup. Ten minutes will be needed for the air in the calibration cup to become water saturated and for the temperature and D.O. probe to equilibrate. The current barometric pressure will be entered in mm of Hg. (Inches of Hg x 25.4 = mm Hg.) When the interface screen shows no significant change in the percent D.O. readings, the probe will be calibrated.

Prior to field use, the membrane of the D.O. meter/YSI sonde will be inspected for air bubbles and/or holes. If either exists, the membrane will be replaced. If the membrane is dry prior to use, it will be soaked in analyte-free water prior to calibration. The D.O. meter will be calibrated prior to use according to the manufacturer's instructions.

When making field measurements, care will be taken to make sure the instrument and all parts are functioning properly. The temperature and salinity compensators (if equipped) will be adjusted. The D.O. meter will be read to the nearest 0.1 ug/L. Whenever possible, D.O. will be measured in situ with a field probe. Duplicate field analysis will agree within 10%.

7.1.5 Redox Potential

Redox potential is measured electrometrically using a platinum electrode and a reference potential. Redox readings are affected by exposure to atmospheric oxygen; therefore, flow-through cells will be used.

Prior to field use, the electrode will be inspected for damage or breakage. The electrode will be calibrated at least once a day prior to use according to the manufacturer's instructions. Duplicate field analysis will agree to within ±10 mv.

7.1.6 Turbidity

The YSI multiparameter sonde or a portable turbidity meter, Hereby Water Quality Checker U-10 or equivalent, will be used to obtain measurements of turbidity. The meter will be checked prior to every trip to the field. Each check will include cleaning the turbidity cell, checking the battery charge, and checking the instrument for calibration. Prior to its initial use, the equipment will be calibrated in the field with three known standards in accordance with the procedures stated in the equipment's instruction manual. A two-point equipment calibration will be performed daily to maintain the accuracy of the tested parameter. Duplicate field analysis will agree to within ±10%.

A section in the calibration logbook will be maintained for the turbidity meter. The logbook will contain recordings of the serial numbers for the turbidity meters used, meter-specific repairs, if necessary, and all daily calibration reports. Results are expressed in Nephelometric Turbidity Units (NTUs) corrected to 25°C to the nearest whole number.

7.1.7 Ground Water Level Measurements

An electric water level indicator will be used for measuring potentiometric surface ground water levels at the site. This instrument consists of a spool of dual conductor wire with a probe attached to the end and an indicator. When the probe comes into contact with the water, the circuit is closed and a light or buzzer signals the contact. Three measurements will be averaged to the nearest 0.01 foot.

Prior to use, the probe will be inspected for damage and the instrument will be tested in a bucket of water. Batteries will be checked also. If the instrument has not been decontaminated, decontamination procedures will be followed as indicated in the FSP.

7.2 Laboratory Analytical Procedures

Analytical methods to be used during the course of this project are listed in Tables 4 and 5. Analytical procedures for these methods will be consistent with *Test Methods For Evaluating Solid Waste, USEPA SW-846, Third Edition* and subsequent updates, the NYSDEC *Analytical Laboratory Services* (1995 Revision Guideline) and the NYSDOH's ELAP protocol.

Quanterra (North Canton, Ohio) will provide chemical analytical services for this project. Quanterra offers conventional laboratory services with a particular emphasis on providing full-service analytical capabilities. The laboratory maintains a number of analytical programs designed to fulfill the needs of its clients in the technical aspects of environmental control and regulatory compliance.

Quanterra has passed the performance evaluation (PE) testing and was an active participant in the NYSDEC's ASP and the NYSDOH's ELAP. A copy of the Quanterra QA Management Plan is provided in Attachment 2. This document provides detailed information on laboratory procedures including standard operating procedures, analytical methods, detection limits, QA procedures, and QC methods used in the laboratory.

8.0 DATA REDUCTION, VALIDATION AND REPORTING

Throughout the course of the field activities at the subject site, additional samples (soil, sediment, and ground water) will be collected and analyzed to verify and validate that sampling procedures and methods generate quality, reproducible results. It is anticipated that approximately 10 percent of the field samples collected will be used for QA/QC purposes. QA/QC samples will include field blanks, trip blanks, duplicate samples as appropriate and as indicated in the SOW for this site.

An appropriate training program will also occur so that field personnel are thoroughly familiar with all sampling, decontamination, and recordkeeping procedures for the project. Personnel will be familiar with the use and calibration of all equipment. In addition to field QA/QC procedures, the laboratory will also follow a QA/QC program to maintain sample validation. QC checks are performed on a routine basis in all laboratories.

All analytical data received from the laboratory by the QA Officer will be checked for completeness and consistency with chain-of-custody documentation. Any obvious errors will be checked with field and laboratory personnel. The QA Officer will also review data to compare with field observations and measurements and investigate any obvious inconsistencies or errors. The following narrative outlines the data reduction, validation, and reporting methods to be used by Shield personnel.

8.1 Data Reduction

Field instruments for establishing pH, temperature, conductivity, D.O., redox, turbidity, flow, and total organic vapors are direct reading displays requiring no data reduction or use of equations. Laboratory data will not require data reduction; however, both field and laboratory data will be summarized in tabular format for ease of review, and duplicate analyses compared for inconsistencies.

8.2 Data Validation

8.2.1 Field Data Integrity

It is the duty of the project QA Officer to verify the integrity of the field reportable data. This involves reviewing all field logs, reviewing and checking raw data entries and calculations, checking calibration procedures, and verifying the custody integrity of all samples collected.

8.2.2 Field Data Validation

Validation of the field data will be performed by the project QA Officer and will consist of reviewing the raw data entries and the precision and accuracy of the data to establish if the field testing is within the established control limits. Corrective actions will be performed when the precision and accuracy results fall outside of the control limits.

8.2.3 Laboratory Data Validation

The principal criteria used to validate data integrity during sample collection are the following:

- Reagent blank results
- Method preparation blank results
- Calibration verification
- QC check sample results
- Surrogate spike recoveries

These measurements are made by the analyst using specific acceptance criteria. The analyst either proceeds with the analyses or takes correction action. The analyst who generates the data has the primary responsibility for the correctness and completeness of the data. The data reduction and validation steps are documented, signed, and dated by the analyst.

All data are reviewed by the senior analyst or group coordinator whose function is to provide an independent review of the data package. The review is structured so that all calibration and sample results are reviewed and 10% of the analytical results are checked back to the bench. All SW-846 recommended criteria for preparation and analysis methods will be followed.

Additional information on laboratory data validation procedures is contained in Attachment 2.

8.2.4 Project Data Validation

The Project Manager will have the responsibility of reviewing the overall project data prior to submittal to the client. The QA Officer will be responsible for reviewing and checking all field logs and chain-of-custody forms for errors in the raw data entries and calculations and for establishing if sample custody procedures were followed. The Site Manager will be responsible for checking the calibration integrity of all field instruments.

The QA Officer will be responsible for reviewing the laboratory analytical reports and validating the data contained in those reports. Each report will contain sample results, the chain-of-custody, and quality control samples including trip, field and/or rinsate blanks, laboratory method blanks and laboratory control samples, MS/M.D. analyses and surrogate recovery data. Data validation will follow the NYSDEC's Division of Environmental Remediation's *Guidance for the Development of Data Usability Summary Reports*. The validation will establish whether:

- Sample holding times have been met.
- Duplicate sample concentrations were within acceptable limits.
- Equipment rinse blanks, trip blanks, and field blanks were analyte-free or below a concentration of concern.
- Detection limits were acceptable.
- Laboratory blanks were analyte-free or below a concentration of concern.
- Laboratory matrix spike recoveries were within acceptable limits.
- Obvious anomalous values were identified and addressed.

The following documents will be used for project data validation:

- NYSDEC, 1995 Revision Guideline. *Analytical Service Protocol.*
- USEPA, February 1994. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.* USEPA/540/R-94-013.
- USEPA, Region III. June 1995, *Innovative Approaches to Data Validation.*
- USEPA, September 1994. *Region III Modifications to National Functional Guidelines for Organic Data Review Multi-Media, Multi-Concentration.* (OLM01.0 - OLM01.9).
- USEPA, April 1993. *Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses.*
- USEPA, February 1993. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review.* EPA/540/R-94-012.
- USEPA, July 1, 1988. *Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses.*

Shield will classify the data as valid, useable, or unusable. Data classified as valid will have met all data quality objectives, the sample custody and field logs will be in order, the results of the analyses of the field and laboratory QC blanks will be acceptable, and other laboratory performance criteria will be acceptable.

Data classified as useable will not have met all the QA/QC. For example, sample custody may have been broken, holding times may have been slightly missed, a QC blank may have been contaminated, or the detection limit may have been elevated. These are a few examples of situations that may cause analytical data to be questionable but still useable, providing the data are used with caution.

Data that have been classified as unusable are invalid and will not be used for any purpose. Unusable data may be the result of gross laboratory error, strong analytical interferences, or other major problems associated with the data.

8.3 Data Storage

Data will be stored on electronic and hard copies within project files in Shield's offices. Individually labeled files will also be maintained for segregation of the field data, laboratory data, and assessment reports. Data will be maintained for at least 3 years and, in some instances, as long as 7 years.

Data will be indexed by client name and project number both in hard copy and within the computer system. Data files will be archived to in-house project files on computer diskettes approximately bi-annually.

9.0 INTERNAL QUALITY CONTROL

9.1 Field Quality Control

QC sampling and associated frequencies are described below.

- Trip blanks - Trip blanks are defined as samples created from analyte-free water in the laboratory, taken to the sampling site and returned unopened to the laboratory along with any volatile organic analysis (VOA) samples. The laboratory is responsible for providing and monitoring the quality of the analyte-free water. One trip blank will be placed in each cooler containing liquid samples to be analyzed for volatiles.

- Field duplicates - Field duplicates will be collected at a frequency of 5% for all matrices. The duplicates for soils/sediments will be collected, composited and then subsampled into the primary and duplicate sample containers. Soil/sediment samples for volatile analysis will be collected and placed undisturbed into sample containers.

- Equipment rinsates - Equipment rinsates are samples of the final analyte-free water rinse from equipment cleaning and are collected at the end of decontamination procedures. These samples will be collected at least once per matrix sampling event and will be analyzed for the same constituents as the samples collected that day.

- Matrix spike/matrix spike duplicate - When required by the analytical protocol, additional sample volume for the matrix spike/matrix spike duplicate will be obtained at the same sample location and collected in the appropriate sample containers as the field duplicate.

9.2 Laboratory Quality Control

The QC control samples and frequency of analysis specified in the NYSDOH- approved methods will be used as a guideline. The following QC samples will be analyzed as appropriate:

- Method blanks
- Blanks/spikes
- Surrogates
- Matrix spikes and matrix spike duplicates
- Laboratory duplicates
- Initial and continuing calibration checks

In addition, the raw data and QA/QC samples will be reviewed by the Laboratory Project Manager to identify any inconsistencies. Laboratory verification of any apparent discrepancies will be required prior to data submittal to the NYSDEC.

10.0 PERFORMANCE AND SYSTEMS AUDITS

10.1 Systems Audits

The submission to and full cooperation with systems audits by the USEPA and the NYSDEC is required if requested by the regulating agency. Such audits may include evaluation of the various components of the measurement systems to establish their proper selection and use and the evaluation of field QC procedures.

Systems audits are the responsibility of the QA Officer. A systems audit will be conducted semi-annually by reviewing selected projects that as a group use all the employed measurement systems. The audit will include supervision of drilling and sampling activities in the field. It will examine:

- A list of equipment used and the QC procedures followed.
- The use of equipment and related procedures such as decontamination, sampling, documentation, sample handling, etc., to establish if each element within an activity is functioning appropriately and according to the guidelines of appropriate methodology, and the approved QA/QC procedures.
- Calibration of field instruments.
- A list of deficiencies to correct/improve/modify the system.
- The use of qualified personnel to operate the systems.
- The field notebooks and field observations to confirm proper equipment and QC procedure compliance.
- The sample custody documentation to verify proper tracking and handling procedures.
- The corrective actions undertaken during the audit period.

Negative and inadequate responses to the audit will be discussed with the field members and correction action will be implemented.

Shield also has a Corporate QA Program Plan that establishes the general procedures, methods, and performance for field investigations so that the data collected will be representative of field conditions that are verifiable and commensurate with the objectives of each project. This document, along with site-specific QAPPs, sets for minimum protocol for field investigations. The designated QA Officer in each office maintains QA standards and verifies appropriate procedures are followed and that the staff has been adequately trained. The Corporate QA Program Plan is reviewed on an annual basis and updated as appropriate. QA officers review QA procedures on a project basis.

10.2 Performance Audits

Regular audits of field sampling and operations will be conducted by the Site Manager throughout the project to maintain the highest QA/QC standards for the project. In addition, field audits will

be performed at the beginning of various site activities (e.g., media sampling, source removal, treatability studies) to verify that field procedures are being performed in a manner consistent with QA/QC standards and that documentation of these activities is being performed. A written report of the audit will be completed, and any items in noncompliance will be dealt with immediately by the Project Manager or Site Manager. In addition, NYSDEC personnel may periodically visit the site to verify that procedures are being followed. The Project Manager will be responsible for maintaining the day-to-day procedures and methods specified in the SOW.

11.0 PREVENTIVE MAINTENANCE

Preventive maintenance is another portion of the overall QA program for field and laboratory equipment. As previously stated, the Site Manager will have responsibility for all field equipment. At a minimum, the field equipment will be checked prior to field activities to verify that all equipment is functioning properly. At this time, the Site Manager will also verify that calibration gases, liquids, etc., are stocked as appropriate and that all sampling logs and forms are available. Equipment to be used at the site will include, at a minimum, an FID or PID; an oxygen/combustible gas meter; water level meter, pH, temperature, conductivity, D.O., turbidity, and redox meters; a YSI multiparameter sonde; and a submersible pump.

Preventive maintenance will be performed and documented by the Site Manager or other field personnel with the oversight of the Site Manager. A schedule of preventive maintenance activity and frequency for all field equipment is contained in Table 11. Field instruments, sampling equipment, and accessories will be maintained in accordance with the manufacturer's recommendations and specifications, and established field practices. Maintenance will be documented in an equipment maintenance logbook that will be kept at the site and maintained by the Site Manager. It will contain the following documentation:

- List of all field instruments used by field personnel.
- Preventive maintenance schedule for each instrument (Table 11).
- Record of routine (preventive) maintenance to equipment.
- Record of nonroutine repairs to equipment.

If a field screening instrument is damaged/unusable for the proposed sampling event, the Project Manager and Site Manager will discuss and decide on a course of action from several options including:

- Postpone and reschedule sampling event until equipment is repaired.
- Delay completion and rent or purchase another piece of equipment.
- Use backup equipment.

In the event that equipment must be borrowed or rented in an emergency situation, it will be calibrated and maintained as described in this plan and in accordance with the manufacturer's instructions.

At the laboratory, preventative maintenance will be as outlined in the laboratory QA/QC manual. Laboratory instruments are monitored on a regular basis to verify that they are operating properly. Many of the instruments will undergo routine cleaning and replacement of parts by trained, qualified laboratory personnel. Larger pieces of laboratory equipment (such as chromatographs, analytical balances, Gas Chromatograph/Mass Spectrometer [GC/MS]) are maintained by commercial maintenance contracts on a regular basis. In addition, regular QA/QC checks help to identify instruments that are not working properly. Additional information on preventive maintenance for the laboratory is provided in Attachment 2.

12.0 DATA ASSESSMENT PROCEDURES

Data are assessed on a continuous basis throughout the project so that high standards are met. Precision and accuracy are maintained in the laboratory through regular analysis of QA/QC samples to verify that they fall within accuracy and precision reporting standards. All laboratory analytical data will be assessed for accuracy, precision, and completeness by the laboratory before submission of the data to Shield. Routine internal checks also will verify that samples are logged in properly, chain-of-custody forms are completed, sample holding times are not exceeded, and the appropriate documentation is being completed. Additional information on laboratory data assessment is contained in Attachment 2.

Once sample results are available, the QA Officer will review the data to assess its completeness and consistency with previous laboratory reports and procedures. Duplicate and spiked samples will be reviewed for consistency and any "outliers". If problems develop, data will be checked first for any calculation errors and, if necessary, the samples rerun.

Data will be organized in tables and figures for presentation and reporting. Senior personnel will check these data for transcription errors and accuracy. Any data calculations, modeling, etc., will be accomplished using approved methods or models. Some statistical methods may be used on the laboratory data received. Assessments and recommendations derived from the data will be reviewed and approved by senior personnel.

In addition, field data will be reviewed for completeness and accuracy by the Site Manager. As appropriate, field data will be cross checked with analytical data for consistency.

13.0 CORRECTIVE ACTIONS

Failure to meet QA/QC standards and goals will result in corrective action. If corrective action is necessary, it will be on a case-by-case basis and may take several forms including the following:

- Additional review of data
- Additional analysis of duplicate samples
- Audit of field and/or laboratory procedures
- Additional sampling or resampling effort
- Communication with site and/or laboratory personnel

Identified deficiencies will be readily corrected by the appropriate personnel, and the Project Manager will recheck the problem the next day to verify it has been corrected. The following steps will be taken if deficiencies or irregularities exist in the field and during sampling.

13.1 Field Data

Corrective actions will be performed when field precision and accuracy results are outside of the control limits listed in Table 10. If the instrument continues to perform outside of the control limits, it will be taken out of service and replaced with a backup unit. Corrective actions performed on equipment will be documented in writing and kept in an equipment maintenance file.

If split samples or audits indicate a variance from the field measurement of greater than 20%, the field instrument will be checked against an off-site instrument via a common calibration standard. Appropriate corrective action will be taken depending upon the results. These actions may include those listed in Table 10 or removing the instrument from service. The field representative conducting the field measurements will be responsible for assessing each QC measure and initiating corrective actions under the general supervision of the Site Manager. Any corrective action recommended as a result of systems audits, analysis of split samples/data, or data validation review will be initiated with the determination that the actions are scientifically justifiable.

13.2 Sampling Procedures

If deficiencies in procedures are found from internal or external audits or data validation reviews, Shield will immediately implement corrective action. The QA Officer is responsible for discussing the deficiency with the appropriate parties and implementing the appropriate corrective action before the next sampling event. The QA Officer document the corrective action implemented by a written memorandum describing the corrective action. The memorandum will be stored in a file to be maintained by the QA Officer. The Project Manager and Site Manager will each receive a copy of all corrective action memoranda.

13.3 Contracted Laboratory Corrective Action

If Shield establishes through internal or external audits or during the data validation process that a contracted laboratory has not performed according to its approved plan, it will initiate corrective actions by contacting the Laboratory Director. The analyses will be rerun to correct a deficiency, if possible. In the event that data are established invalid due to laboratory errors, the sampling will be repeated, if required, to meet the project objectives.

In the event that the laboratory fails to meet the established analytical controls, prompt corrective action will be undertaken. Whenever corrective actions are necessary, a nonconformance memo will be initiated by the Laboratory Project Manager. This memo will be approved by the QA Manager and the Laboratory Project Manager documenting the problem and the corrective action performed. The corrective action will be summarized in the project narrative of the laboratory report. This corrective action will be undertaken by the Laboratory Project Manager assigned to this project.

14.0 QUALITY ASSURANCE REPORTS

A QA report on the performance of measurements, systems, and data quality will be prepared by the QA Officer for the project. The report will involve all the work conducted by Shield and, at a minimum, it will include:

- Assessment of measurement data accuracy.
- Results of system audits.
- Significant QA problems and recommended solutions.
- Outcome of any corrective actions.

Copies of such reports will be maintained in the project files and will be available for regulatory agency review.

Reports prepared for the project will summarize the quality of data collected for each aspect of this phase of the project (e.g., media sampling, treatability study). The written summaries will include QA activities performed, deficiencies identified, and corrective actions implemented. At a minimum, QA reports will be prepared after the following sampling events:

- Preliminary soil sampling
- First ground water sampling event
- Sediment sampling
- Second ground water sampling event
- Confirmatory sampling (soil and sediment)

15.0 REFERENCES

New York State Department of Environmental Conservation, September 1997 Revision, *Guidance for the Development of Data Usability Summary Reports.*

New York State Department of Environmental Conservation, 1995 Revision Guideline, *Analytical Services Protocol (ASP).*

U.S. Environmental Protection Agency, 1986. 1992. 1993. 1994. 1995. *Test Methods for Evaluating Solid Waste*, Updates I, IIA, II, IIB. SW-846. (Third Edition).

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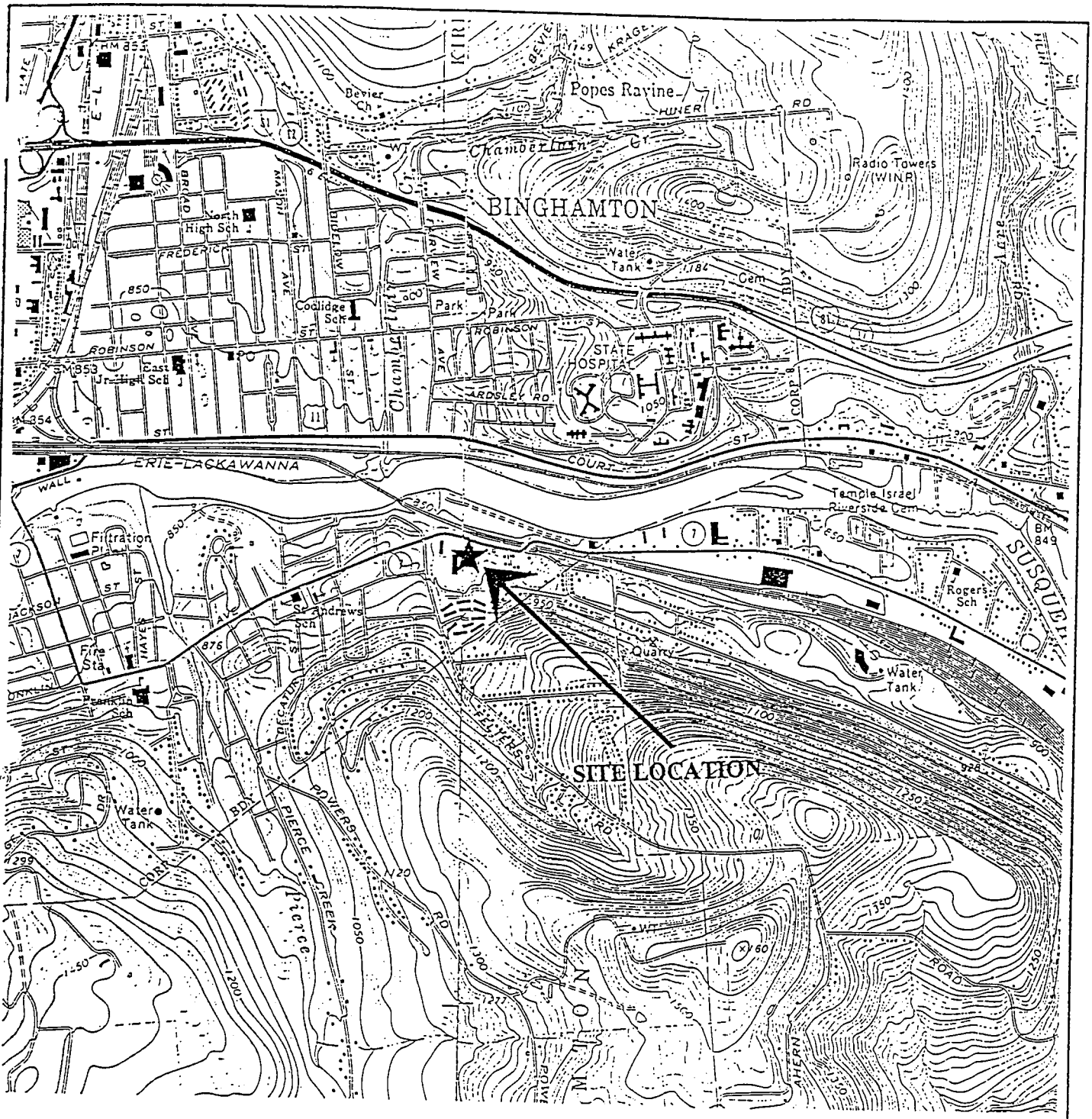


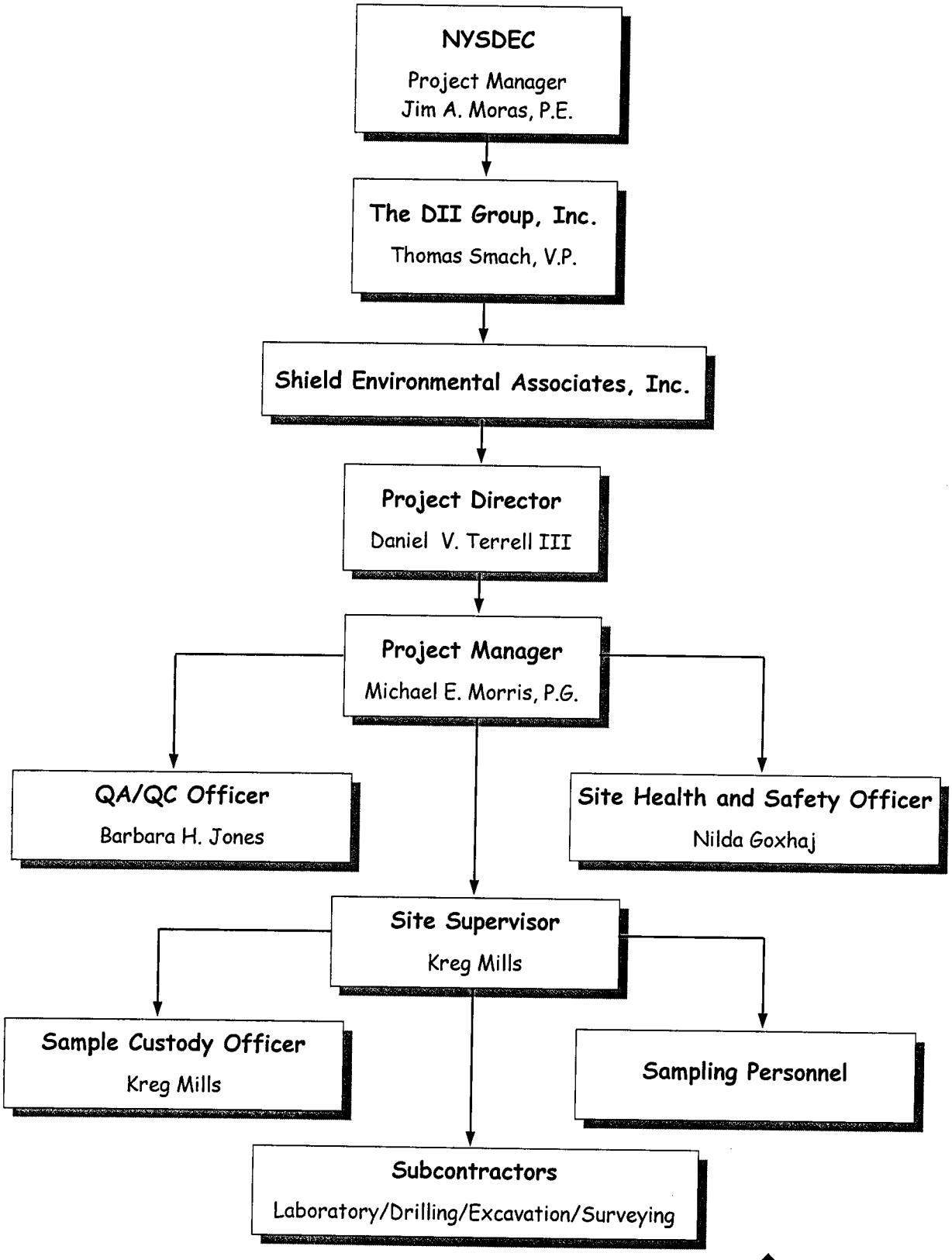
SOURCE: USGS Topographic Quadrangle Maps
Binghamton East, New York
1968 – Photoinspected 1976
Binghamton West, New York
1968 – Photoinspected 1976

-N-

0 1,000' 2,000'
SCALE

DATE: 12/2/97	FIGURE 1	**SHIELD**
DRAWN BY: P.D.H.	SITE LOCATION MAP DII – BINGHAMTON PLASTICS CONKLIN AVENUE BINGHAMTON, NEW YORK	ENVIRONMENTAL ASSOCIATES, INC.
APPROVED BY: M.M.		LEXINGTON, KENTUCKY
CLIENT NO.: 396-0460		

FIGURE 2
FORMER BINGHAMTON PLASTICS SITE
ORGANIZATION CHART



SHIELD
ENVIRONMENTAL ASSOCIATES, INC.

TABLE 1
DATA QUALITY OBJECTIVES

Task	Data Uses	Analytical Level
Air monitoring	Site characterization, monitoring	I
Soil/sediment sampling		
-screening	Monitoring, site characterization	I, II
-quantitative sample*	Site characterization, engineering design	III, IV
Ground water/surface water sampling		
-screening	Monitoring, site characterization	I
-quantitative sample*	Site characterization	IV

Level I - Total organic/inorganic vapor detection using portable instruments, field test kits, field instruments

Level II - Variety of organics by GC; inorganics by AA, XRF tentative ID; analyte-specific

Level III - Organics/inorganics using EPA procedures other than CLP can be analyte-specific RCRA characteristic tests

Level IV - TCL organics/inorganics by GC/MS; AA; ICP (CLP deliverables will be provided if the analyses are questionable.)

* - During the preliminary investigation, a full list of TCL organics/ inorganics will be analyzed. The list will be reduced in specific compounds as presented in Table 5.

AA - Atomic absorption
ASTM - American Society of Testing and Materials
CLP - Contract Laboratory Program
DRI - Direct reading instrument
GC/MS - Gas chromatograph/mass spectrometer
ICP - Inductively coupled plasma
ID - Identification
TCL - Target compound list
XRF - X-ray diffraction fluorescence
RCRA - Resource Conservation and Recovery Act

TABLE 2
SAMPLING EQUIPMENT - RESTRICTIONS, MATERIALS AND APPROPRIATE USE

Equipment Use	Intended Use	Parameter Groups	Restrictions/ Precaution
SOLIDS SAMPLING - Sediments/Soils			
1. Trowel, scoop, spoon or spatula	Sampling and mixing	Inorganics, general chemistry	none
		VOCs and extractable organics	1, 2
		PCB/Pesticides	none
2. Mixing tray or bowl	Compositing or homogenizing	Inorganics, general chemistry	none
		Extractable organics	1
		PCB/Pesticides	none
3. Shovel	Sampling	Inorganics, general chemistry	none
		VOCs and extractable organics	2, 3
		PCB/Pesticides	none
4. Hand auger	Sampling	Inorganics, general chemistry	none
		VOCs and extractable organics	2, 3
		PCB/Pesticides	none
5. Split spoon	Sampling	Inorganics, general chemistry,	none
		VOCs	2, 3
		Extractable organics	3
		PCB/Pesticides	none
6. Shelby tube	Sampling	Inorganics, general chemistry,	none
		VOCs	2, 3, 4, 5
		Extractable organics	3, 5
		PCB/Pesticides	none
7. Sediment corer	Sampling	Inorganics, general chemistry,	none
		VOCs	2, 3
		Extractable organics	3
		PCB/Pesticides	none
8. Backhoe/trackhoe	Sampling	Inorganics, general chemistry,	6
		VOCs	2, 3, 6
		Extractable organics	3, 6
		PCB/Pesticides	none
LIQUIDS SAMPLING			
1. Bailer	Purging, sampling	VOCs	1, 2
		Semivolatiles	1
		Metals	1
		Inorganics, general chemistry	1
		PCB/Pesticides	none
2. Submersible Pump	Purging	VOCs	3
		Semivolatiles	3
		Metals	3
		Inorganics, general chemistry	3
		PCB/Pesticides	none
LIQUIDS SAMPLING - Surface Water			
1. Dipper	Sampling	VOCs	1, 2
		Semivolatiles	1
		Metals	1
		Inorganics, general chemistry	1
		PCB/Pesticides	none

TABLE 2 (Cont.)

Equipment Use	Intended Use	Parameter Groups	Restrictions/ Precaution
2. Kemmerer	Sampling	VOCs	2
		Semivolatiles	1
		Metals	1
		Inorganics, general chemistry	1
		PCB/Pesticides	none

Notes:

1	Will be constructed of stainless steel, Teflon® PVC, or polyethylene (tubing).
1 a	Will be constructed of internal silicon tubing and exterior polyethylene tubing.
2	Samples for volatile organics will not be taken from a composite (mixed) sample.
3	Will be constructed of stainless steel or brass.
4	When samples are sealed in the liner for transport to the laboratory, the sample for VOC analysis will be taken from the interior of the core.
5	Liners will be constructed of stainless steel or Teflon®.
6	Samples will be collected from center of bucket such that bucket does not compromise the sample.
VOCs	Volatile organic compounds
PCB	Polychlorinated Biphenyls

TABLE 3
SUMMARY OF CHEMICALS, CONTAINERS, PRESERVATION METHODS AND SAMPLE VOLUMES

Compound	Matrix	Container	Preservation	Amount Required	Holding Time
VOCs	solid	G, TFE	cool 4°C	2 x 60 ml	7 days
	aqueous	G, TFE	cool 4°C	3 x 40 ml	7 days
SVOCs	solid	G, TFE	cool 4°C	120 ml	5 ex 40 anl
	aqueous	G, TFE	cool 4°C	2 x 1 L	5 ex 40 anl
Metals	solid	P, G	cool 4°C	120 ml	6 months
	aqueous	P, G	HNO_3 to pH<2	1 L	6 months
Sulfate	aqueous	P, G	cool 4°C	1 L	28 days
Nitrate	aqueous	P, G	cool 4°C	1 L	48 hrs
Chloride	aqueous	P,G	cool 4°C	1 L	28 days
Total Organic Carbon	aqueous	G	cool 4°C	2 x 40 ml	28 days

ex days to extraction
anl days to analysis
G glass
TFE Teflon®
P plastic
VOCs volatile organic compounds
SVOCs semivolatile organic compounds

TABLE 4
TARGET CHEMICALS, ANALYTICAL METHODS DETECTION LIMITS

Target Compounds	Method Number	Detection Limit		Unit	
		Solid	Aqueous	Solid	Aqueous
TCL VOCs					
Chloromethane	SW-846 8260A+10 TICs	10	10	ug/kg	ug/L
Bromomethane	SW-846 8260A+10 TICs	10	10	ug/kg	ug/L
Vinyl chloride	SW-846 8260A+10 TICs	10	10	ug/kg	ug/L
Chloroethane	SW-846 8260A+10 TICs	10	10	ug/kg	ug/L
Methylene chloride	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
Acetone	SW-846 8260A+10 TICs	20	20	ug/kg	ug/L
Carbon disulfide	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
1, 1-Dichloroethene	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
1, 1- Dichloroethane	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
1, 2- Dichloroethene (total)	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
Chloroform	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
1, 2 - Dichloroethane	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
2- Butanone	SW-846 8260A+10 TICs	20	20	ug/kg	ug/L
1,1, 1- Trichloroethane	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
Carbon tetrachloride	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
Bromodichloromethane	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
1, 2 - Dichloropropane	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
cis-1, 3-Dichloropropene	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
Trichloroethene	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
Dibromochloromethane	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
1,1,2-Trichloroethane	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
Benzene	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
trans-1,3-Dichloropropene	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
BromoForm	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L

TABLE 4 (CONTINUED)
TARGET CHEMICALS, ANALYTICAL METHODS DETECTION LIMIT

Target Compounds	Method Number	Detection Limit		Unit	
		Solid	Aqueous	Solid	Aqueous
4-Methyl-2-pentanone	SW-846 8260A+10 TICs	20	20	ug/kg	ug/L
2-Hexanone	SW-846 8260A+10 TICs	20	20	ug/kg	ug/L
Tetrachloroethene	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
1,1,2,2-Tetrachloroethane	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
Toluene	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
Chlorobenzene	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
Ethylbenzene	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
Styrene	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
Xylenes (Total)	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
TCL SVOCs					
Phenol	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
bis(2-Chloroethyl) ether	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
2-Chlorophenol	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
1,3-Dichlorobenzene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
1,4-Dichlorobenzene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
1,2-Dichlorobenzene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
2-Methylphenol	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
2,2'-Oxybis(1-Chloropropane)	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
4-Methylphenol	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
N-nitrosodi-n-propylamine	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Hexachloroethane	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Nitrobenzene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Isophorone	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
2-Nitrophenol	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
2,4-Dimethylphenol	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
bis(2-Chloroethoxy) methane	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
2,4-Dichlorophenol	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
1,2,4-Trichlorobenzene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L

TABLE 4 (CONTINUED)
TARGET CHEMICALS, ANALYTICAL METHODS DETECTION LIMIT

Target Compounds	Method Number	Detection Limit		Unit	
		Solid	Aqueous	Solid	Aqueous
Naphthalene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
4-Chloroaniline	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Hexachlorobutadiene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
4-Chloro-3methylphenol	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
2-Methylnaphthalene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Hexachlorocyclopentadiene	SW-846 8270B+20 TICs	1600	50	ug/kg	ug/L
2,4,6-Trichlorophenol	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
2,4,5-Trichlorophenol	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
2-Chloronaphthalene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
2-Nitroaniline	SW-846 8270B+20 TICs	1600	50	ug/kg	ug/L
Dimethyl phthalate	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Acenaphthylene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
2,6-Dinitrotoluene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
3-Nitroaniline	SW-846 8270B+20 TICs	1600	50	ug/kg	ug/L
Acenaphthene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
2,4-Dinitrophenol	SW-846 8270B+20 TICs	1600	50	ug/kg	ug/L
4-Nitrophenol	SW-846 8270B+20 TICs	1600	50	ug/kg	ug/L
Dibenzofuran	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
2,4-Dinitrotoluene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Diethyl phthalate	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
4-Chlorophenyl phenyl ether	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Fluorene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
4-Nitroaniline	SW-846 8270B+20 TICs	1600	50	ug/kg	ug/L
4, 6-Dinitro-2-methylphenol	SW-846 8270B+20 TICs	1600	50	ug/kg	ug/L
N-Nitrosodiphenylamine	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
4-Bromophenyl phenyl ether	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Hexachlorobenzene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Pentachlorophenol	SW-846 8270B+20 TICs	1600	50	ug/kg	ug/L

TABLE 4 (CONTINUED)
TARGET CHEMICALS, ANALYTICAL METHODS DETECTION LIMIT

Target Compounds	Method Number	Detection Limit		Unit	
		Solid	Aqueous	Solid	Aqueous
Phenanthrene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Anthracene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Carbazole	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Di-n-butyl phthalate	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Fluoranthene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Pyrene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Butyl benzyl phthalate	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
3,3'-Dichlorobenzidine	SW-846 8270B+20 TICs	1600	50	ug/kg	ug/L
Benzo(a)anthracene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Chrysene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
bis(2-Ethylhexyl) phthalate	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Di-n-octyl phthalate	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Benzo(b) fluoranthene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Benzo(k) fluoranthene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Benzo (a) pyrene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Indeno (1,2, 3-od) pyrene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Dibenzo (a,h) anthracene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
Benzo (ghi) perylene	SW-846 8270B+20 TICs	330	10	ug/kg	ug/L
TCL Pesticides/PCBs					
alpha-BHC	SW-846 8080A	1.7	0.025	ug/kg	ug/L
beta-BHC	SW-846 8080A	1.7	0.025	ug/kg	ug/L
delta-BHC	SW-846 8080A	1.7	0.025	ug/kg	ug/L
gamma-BHC (Lindane)	SW-846 8080A	1.7	0.025	ug/kg	ug/L
Heptachlor	SW-846 8080A	1.7	0.025	ug/kg	ug/L
Aldrin	SW-846 8080A	1.7	0.025	ug/kg	ug/L
Heptachlor epoxide	SW-846 8080A	1.7	0.025	ug/kg	ug/L
Endosulfan I	SW-846 8080A	1.7	0.025	ug/kg	ug/L
Dieldrin	SW-846 8080A	3.3	0.05	ug/kg	ug/L

TABLE 4 (CONTINUED)
TARGET CHEMICALS, ANALYTICAL METHODS DETECTION LIMIT

Target Compounds	Method Number	Detection Limit		Unit	
		Solid	Aqueous	Solid	Aqueous
4, 4'-DDE	SW-846 8080A	3.3	0.05	ug/kg	ug/L
Endrin	SW-846 8080A	3.3	0.05	ug/kg	ug/L
Endosulfan II	SW-846 8080A	3.3	0.05	ug/kg	ug/L
4, 4'-DDD	SW-846 8080A	3.3	0.05	ug/kg	ug/L
Endosulfan sulfate	SW-846 8080A	3.3	0.05	ug/kg	ug/L
4,4'-DDT	SW-846 8080A	3.3	0.05	ug/kg	ug/L
Methoxychlor	SW-846 8080A	17	0.25	ug/kg	ug/L
Endrin ketone	SW-846 8080A	3.3	0.05	ug/kg	ug/L
Endrin aldehyde	SW-846 8080A	3.3	0.05	ug/kg	ug/L
alpha-Chlordane	SW-846 8080A	1.7	0.025	ug/kg	ug/L
gamma-Chlordane	SW-846 8080A	1.7	0.025	ug/kg	ug/L
Toxaphene	SW-846 8080A	83	1.25	ug/kg	ug/L
Aroclor 1016	SW-846 8080A	17	0.25	ug/kg	ug/L
Aroclor 1221	SW-846 8080A	17	0.25	ug/kg	ug/L
Aroclor 1232	SW-846 8080A	17	0.25	ug/kg	ug/L
Aroclor 1242	SW-846 8080A	17	0.25	ug/kg	ug/L
Aroclor 1248	SW-846 8080A	17	0.25	ug/kg	ug/L
Aroclor 1254	SW-846 8080A	33	0.5	ug/kg	ug/L
Aroclor 1260	SW-846 8080A	33	0.5	ug/kg	ug/L
TAL Total Metals					
Aluminum	SW-846 6010A	20	0.2	mg/kg	mg/L
Antimony	SW-846 6010A	6	0.06	mg/kg	mg/L
Arsenic	Sw846-6010A	1.0	0.01	mg/kg	mg/L
Barium	SW-846 6010A	20	0.20	mg/kg	mg/L
Beryllium	SW-846 6010A	0.5	0.005	mg/kg	mg/L
Cadmium	SW-846 6010A	0.5	0.005	mg/kg	mg/L

Target Compounds	Method Number	Detection Limit		Unit	
		Solid	Aqueous	Solid	Aqueous
Calcium	SW-846 6010A	500	5.0	mg/kg	mg/L
Chromium	SW-846 6010A	1	0.01	mg/kg	mg/L
Cobalt	SW-846 6010A	5	0.05	mg/kg	mg/L
Copper	SW-846 6010A	2.5	0.025	mg/kg	mg/L
Iron	SW-846 6010A	10	0.1	mg/kg	mg/L
Lead	SW846-6010A	0.3	0.003	mg/kg	mg/L
Magnesium	SW-846 6010A	500	5.0	mg/kg	mg/L
Manganese	SW-846 6010A	1.5	0.015	mg/kg	mg/L
Mercury	SW846-7470	100	0.2	mg/kg	ug/L
Nickel	SW-846 6010A	4	0.04	mg/kg	mg/L
Potassium	SW-846 6010A	500	5	mg/kg	mg/L
Selenium	SW846-6010A	0.5	0.005	mg/kg	mg/L
Silver	SW-846 6010A	1	0.01	mg/kg	mg/L
Sodium	SW-846 6010A	500	5	mg/kg	mg/L
Thallium	SW846-6010A	1.0	0.010	mg/kg	mg/L
Vanadium	SW-846 6010A	5	0.05	mg/kg	mg/L
Zinc	SW-846 6010A	5	0.05	mg/kg	mg/L
General Chemistry					
Nitrate	EPA 353.2	N/A	1	N/A	mg/L
Sulfate	EPA 375.4	N/A	5	N/A	mg/L
Chloride	EPA 325.2	N/A	1	N/A	mg/L
Total Organic Carbons	EPA 415.1	N/A	1	N/A	mg/L

Notes: SW-846 Test method for evaluating solid waste, physical, chemical methods
PCBs Polychlorinated Biphenyls
TIC Tentatively Identified Compounds

TABLE 5
SITE-SPECIFIC PARAMETER LIST

Target Compounds	Method Number	Detection Limit		Unit	
		Solid	Aqueous	Solid	Aqueous
VOCs					
Chloroethane	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
1,1-Dichloroethane	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
1,1-Dichloroethene	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
Ethylbenzene	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
1,1,1-Trichloroethane	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
Trichloroethene	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
Tetrachloroethene	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
1,2-Dichloroethene (Total)	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L
Vinyl Chloride	SW-846 8260A+10 TICs	5	5	ug/kg	ug/L

Notes: SW-846 Test method for evaluating solid waste, physical, chemical methods
TIC Tentatively Identified Compounds

TABLE 6
SAMPLING CHECKLIST

_____ Sampling equipment decontaminated

_____ Heavy equipment decontaminated

_____ Rinse blank(s) collected (if appropriate)

_____ Equipment calibrated, recorded in logbook

_____ PPE check

_____ Air quality check, recorded

_____ Sample collected (see Table 3 for sample container and volume), sealed, labeled, and placed in cooler with a completed chain of custody. Sample composited and homogenized as appropriate.

_____ Duplicates collected (if applicable)

_____ Matrix spike/matrix spike duplicates collected (if applicable)

_____ Notes and photographs recorded

_____ Marked and recorded sample location in field and map

_____ Move to next sample site

TABLE 7
PHOTOGRAPHIC REPORTING DATA SHEET

Name _____

Date _____

Time _____

Signature _____

Section No. _____
Revision No. _____
Revision Date _____

Weather Conditions

_____

_____

_____

_____

Photo Description _____

_____

Photo Location _____

_____

Notes _____

_____

_____

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TABLE 8
AIR CALIBRATION LOG

Instrument	Serial No.	Calibration Date	Time	Calibration Gas	Name(s)	Result/Notes

Note: Check hydrogen on flame ionization detector

TABLE 9
QA TARGETS FOR SCREENING METHODS

Measurement Parameter (Field)[1]	Matrix[2]	Precision[3]	Accuracy[3]	Equivalent EPA Method No.
Conductivity*	GW/SW	±0.5%	±0.5%	120.1
Organic Vapors[4]	Soil/Air	±25%	±25%	none
Miniram Particulate Monitor	Air	±0.02 mg/m^3	±0.02 mg/m^3	none
pH*	GW/SW	±0.2 pH	±0.2 pH	150.1
Temperature*	GW/SW	±0.15°C	±0.15°C	170.1
Combustible Gas Indicator	Air	±0.1% oxygen ±1% LEL	±1.2% oxygen in 5-30% range ±0.7% oxygen in 6-23% range ±3% 0-30% LEL ±10% 30-100% LEL	none
D. O.*	GW/SW	±0.2mg/e	±0.2 mg/e	none
Redox*	GW/SW	±20mv	±20mv	none
Turbidity*	GW/SW	±5%	2 NTV	none

1 Parameters and data in this table are for point measurements in the field using field instruments.
2 GW/SW - ground water/surface water
3 Instrument manufacturer's reported degree of precision and accuracy.
4 Organic vapor measurement of soils with a flame ionization detector (FID) or photoionization detector (PID) as described in EPA document 540/2-88-005 entitled *Field Screening Method Catalog*.

* YSI Model 6920
D.O. Dissolved oxygen
LEL Lower explosive limit
NTV Nephelometric Turbidity Units

TABLE 10
CORRECTIVE ACTIONS FOR PRECISION OF FIELD MEASUREMENTS

QC Activity	Acceptable Criteria	Corrective Action
Duplicate sample pH	±0.1 pH units variance	Recalibrate instrument, remeasure
Duplicate sample temperature	±0.5^{0}C variance	Check calibration, remeasure
Duplicate sample conductivity	±3% of scale variance	Recalibrate instrument, remeasure
Duplicate sample D.O.*	±10%	Recalibrate instrument, remeasure
Duplicate sample redox	±10 mV of reading	Recalibrate instrument, remeasure
Duplicate sample turbidity	±10% of reading	Recalibrate instrument, remeasure

* Dissolved oxygen

TABLE 11
PREVENTIVE MAINTENANCE ACTIVITY AND FREQUENCY

Instrument	Activity	Frequency
pH meter	Rinse electrode with tap water, shake dry	Monthly during storage and following each use
	Place KCL solution in protective cap	After each use
	Replace protective cap	After each use
	Refill KCL solution	When needed
	Battery check	After each use
	Clean probe	Daily
	Clean unit	After each use
Thermometer	Clean unit	After each use
Conductivity Meter	Rinse electrode with distilled water, shake dry	After each field use
	Store away from high voltage and transformers	
	Replantinization of probe	When needed
	Battery check	After each use
	Clean probe	Daily
	Clean unit	After each use
FID/PID	Clean unit	After each use
	Battery check	Before and after each use
	Fill hydrogen cylinder	Before each use
	Replace filter	Quarterly or more frequently in a dusty wet environment
Miniram Particulate Monitor	Clean unit	After each use
	Battery check	Before and after each use
Combustible Gas Indicator	Clean unit	After each use
	Battery check	Before and after each use
PPE (e.g., respirators, etc.)	Clean and restock supplies as needed	After each use
D.O. Meter	Clean probe	After each reading
	Battery check	Start and end of each day
Redox Meter	Rinse probe with distilled water, dry	Start and end of each day
	Clean probe	After each reading
	Battery check	Start and end of each day
Turbidity Meter	Rinse probe with distilled water, dry	Start and end of each day
	Clean probe	After each reading
	Battery check	Start and end of each day

Note: Malfunction of field instruments can often be attributed to weak batteries, improper measurement technique, or loose connections. Refer to individual instrument manuals for detailed maintenance information.

D.O. dissolved oxygen
FID flame ionization meter
PID photoionization meter
PPE personal protective equipment

ATTACHMENT 1

PROJECT MANAGER AND QUALITY ASSURANCE OFFICER RESUMES

MICHAEL E. MORRIS, P.G.
PROJECT GEOLOGIST

Summary of Capabilities

- Conducted Phase I Environmental Site Assessments for State Agencies and Private Industry
- Designed and Conducted Numerous Phase II Environmental Site Assessments in Soil and Groundwater Media
- Designed and Implemented Groundwater Monitoring Plans at Various Landfill Sites
- Prepared Groundwater Protection Plans for Private Industry
- Performed Aquifer Evaluations at Numerous Locations Throughout the State
- Experienced in All Phases of Underground Storage Tank Compliance Including Closures, Site Checks, Site Investigations, and Corrective Actions
- Experienced at Providing Detailed Descriptions of Soil and Rock Cores

Education

B.S. Geology
University of Kentucky, 1989

B.A. Geography
University of Kentucky, 1987

Graduate Studies, Geology
University of Kentucky, 1989-1991

Professional Registrations

Professional Geologist - Tennessee and Kentucky
KPSTEAFC Certified Contractor
Kentucky Department of Housing and Building Construction - Certified UST Remover
Kentucky Groundwater Association
Geological Society of Kentucky
40-Hour OSHA Hazardous Waste Operations Site Worker
First Aid and CPR Training

Professional Experience

Mr. Morris' professional experience includes conducting numerous Phase I and Phase II environmental site assessments, underground storage tank (UST) closures, and corrective actions for state agencies and private industry.

Mr. Morris has developed quality assurance guidance, manuals, and training for subsurface investigations. In addition, Mr. Morris has developed and implemented groundwater monitoring plans for active and inactive landfills in Kentucky.

Mr. Morris is certified by the KPSTEAFC and the Kentucky State Fire Marshall as an UST contractor. He is also knowledgeable regarding recent changes in Kentucky's UST regulations. At Shield Environmental Associates, Inc., Mr. Morris is a project geologist for the Lexington, Kentucky, office. He manages a variety of projects dealing with the investigation, monitoring, and remediation of subsurface contaminants.

BARBARA H. JONES

SENIOR PROJECT MANAGER

EDUCATION

M.S. Environmental Health Engineering, Montana State University, 1984
B.S. Microbiology, Montana State University, 1974
40-hour OSHA training for hazardous waste site activities, with 8-hour refresher current through October 1999

PROFESSIONAL HISTORY

Shield Environmental Associates, NE Inc., 1998 to present
Remediation Technologies, Inc. (RETEC), 1990 to June 1998
International Technology Corp. (IT), 1989 to 1990
Montana Department of Health and Environmental Sciences, 1984 to 1989
Montana State University Department of Civil Engineering, 1982 to 1984
City of Billings, MT: Water and Wastewater Program, 1979 to 1982

FIELDS OF EXPERTISE

Development and evaluation of monitored natural attenuation programs at sites where groundwater has been impacted by chlorinated solvents or other organic constituents.

Management of assessment, investigation and remedial action programs for manufactured gas plant sites (MGPs).

Application of innovative analytical methods and risk-based approaches for establishing clean-up goals at sites impacted by total petroleum hydrocarbons (TPH).

Planning and evaluation of laboratory treatability studies.

Resource Conservation and Recovery Act (RCRA) facility permitting and closure activities.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) feasibility studies.

REPRESENTATIVE PROJECT EXPERIENCE

Natural Attenuation:

Currently participating in the implementation and evaluation of a monitored natural attenuation program at an active manufacturing facility where the use of chlorinated solvents has impacted groundwater quality. Monitored natural attenuation is being used in combination with source removal and active groundwater and soil treatment to meet cleanup goals. The natural attenuation monitoring program includes the monitoring and evaluation of chlorinated solvent breakdown products, and physical and chemical indicators of microbial activity.

Helped to develop a multi-site natural attenuation monitoring program for seven MGP sites which combined microbial assessment as well as evaluation of field and laboratory parameters. Preliminary results indicated that natural attenuation processes in several cases were limiting the migration of dissolved phase constituents in groundwater.

Manufactured Gas Plant Sites:

Project manager for implementing a remedial action plan to address site impacts at a utility service center that was formerly a manufactured gas plant site. The strategy, which was approved by the state agency, involved the removal of pumpable residuals from the subsurface, in situ stabilization, and containment of seepage areas along a creek using a subsurface vertical barrier that extended for approximately 900 linear feet, which was constructed from a combination of HDPE panels and bentonite/cement grout. With the approval of the state environmental agency, the property has since been sold for nonresidential redevelopment.

Project manager for oversight of a major removal action for a utility client. The first phase of the action involved the removal of 45,000 gallons of contaminated water and 35,000 gallons of residual tar from an underground tank,

followed by the manned entry of the tank and removal of an additional 10,000 gallons of tarry sludge. The tar was reclaimed at a tar manufacturing facility and the water was treated as hazardous waste at a commercial facility.

Project manager for performance of 22 preliminary assessments (PAs) and 15 follow-up site inspections (SIs) for a midwestern utility company. All of the sites were historically the location of manufactured gas plant (MGP) facilities, and were potentially impacted by tar and oil residues. Field work included the installation of an average of five monitoring wells and 15 soil borings per site, and analysis of 30 to 40 environmental samples. To complete the work within the required time frame, three field teams of drillers and geologists were dispatched simultaneously during the field investigation phase.

Treatability and research programs:

Task manager for vapor extraction and slurry treatment studies of materials from a Superfund industrial waste site. The results of the laboratory screening tests convinced the U.S. EPA to consider more cost-effective treatment approaches for this site than had originally been planned.

Project manager for a treatability study for manufactured gas plant wastes. Treatment approaches that were evaluated were slurry biological treatment, enhanced oil recovery from soils using steam, incorporation of contaminated soils into asphalt, and the evaluation of the compatibility of residuals with subsurface barrier materials.

Project manager for two related research projects for the Association of American Railroads. The first project evaluated innovative analytical methods to be used in the risk characterization of diesel-impacted soils, and the second phase of the project applied these characterization and evaluation methods to four field sites.

Project manager for conducting an extensive literature review of the biodegradability and biotreatability of pentachlorophenol (PCP) in environmental media for a utility research group.

HONORS AND AWARDS

Selected as Project Manager of the Year (1991, 1993) in RETEC's Pittsburgh office.

Received a 1989 award for Outstanding Contribution to Environmental Protection, presented by U.S. EPA Region VIII, Denver, CO. The award was based on the performance of the State of Montana hazardous waste facility permitting group.

PUBLICATIONS AND PRESENTATIONS

Okin, M.B., Flaherty, J., Tuomi, E., and Jones, B.H., 1997. *A Risk-Based Approach to Evaluate Environmentally-Acceptable Endpoints for Total Petroleum Hydrocarbons in Soil at a Natural Gas Compressor Station Site.* Presented at the Institute for Gas Technology Seminar, "Gas, Oil, and Environmental Biotechnology and Site Remediation Technologies," Orlando, Florida.

Flaherty, J.M., Jones, B.H., Nakles, D.V., Andes, R.P., and Barkan, C.P.L., 1997. *Comparison of Analytical Methods for Use in Evaluating the Risk from Petroleum Hydrocarbon in Soils.* In "Principles and Practices for Diesel Contaminated Soils, Volume VI," by the Association of American Railroads and Amherst Scientific Publishers, Amherst, MA.

Burson, B., Baker, A.C., Jones, B., and Shailer, J., 1997. *Development and Installation of an Innovative Vertical Containment System,* 1997. Presented at Geosynthetics 97 Conference, San Diego, California.

Vernieri, L.A., Jones, B.H., Neuhauser, E., and Pedersen, S., 1992. Study of the Comparative Biodegradability of Tar Contaminated Soils. Presented at the Hazardous Waste/Groundwater Symposium, 65th Annual Conference, Water Pollution Control Federation, September, 1992.

RETEC, 1992. *The Biodegradability of Pentachlorophenol in the Environment: A Literature Review.* Published by the Electric Power Research Institute, Pal Alto, California.

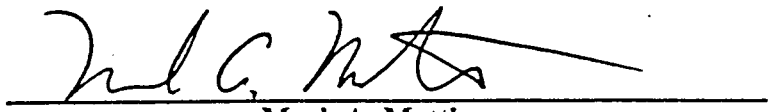
ATTACHMENT 2

QUANTERRA'S QUALITY ASSURANCE MANAGEMENT PLAN

Quanterra®

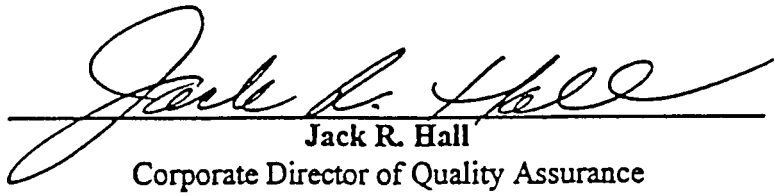
Quality Assurance Management Plan

Approved by:



Mark A. Matthews
Chief Operating Officer

Chris M. Lee
Vice President of Operations Services



Jack R. Hall
Corporate Director of Quality Assurance

Revision 2
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Controlled Copy Number: _____

Preface

The purpose of the Quanterra® Quality Assurance Management Plan (QAMP) is to provide internal quality assurance (QA) guidance to Quanterra® operating units. This guidance allows Quanterra® to operate under a standardized, rigorous quality management system (QMS) and ensures that our clients are consistently provided with data that are of known and documented quality and are legally defensible. The QAMP outlines the purpose, policies, organization, responsibilities, and operations related to ensuring high quality performance in all Quanterra® activities. The QAMP also fulfills the requirement of our clients and of government programs to document our QMS.

The QAMP contains many references to other essential Quanterra® quality documents. These quality documents, including the QAMP, Policy Documents, and Standard Operating Procedures (SOPs), both corporate and laboratory-specific, help ensure the quality of our products and intertwine to produce a strong QMS within Quanterra®. This system is the foundation that provides our operations with guidance and ensures consistently-produced quality deliverables. The project-specific requirements delineated in project plans may supersede the general quality requirements described in this manual.

The document is designed to follow the basic outline required for a quality management plan as described by the United States Environmental Protection Agency (EPA). Table 2.3-1 cross-references the narrative sections of the QAMP to the appropriate sections of the EPA document and other nationally recognized quality standards.

There are two basic types of information included in the QAMP. General information is applicable to all Quanterra® operating units. Operation-specific information, provided in the Facility-Specific Appendix, describes the quality control (QC) requirements that apply only to a specific laboratory. The Facility-Specific Appendix includes information such as method detection limits (MDLs), performance evaluation (PE) studies, and laboratory SOPs that cannot be standardized throughout the Quanterra® laboratory network due to client-specific, laboratory-specific, or instrument-specific nature.

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Acronyms and Initialisms

A2LA	American Associatio for Laboratory Accreditation
AA	Atomic Absorption
ANSI	American National Standards Institute
AR/COC	Analysis Request/Chain-of-Custody
ASQC	American Society for Quality Control
ASTM	American Society for Testing and Materials
BFB	Bromofluorobenzene
BLK	Blank
BOD	Biochemical Oxygen Demand
CCC	Calibration Check Compound
CEO	Chief Executive Officer
CF	Calibration Factor
CFR	Code of Federal Regulations
CHP	Chemical Hygiene Plan
CLP	Contract Laboratory Program
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act (Superfund)
COC	Chain-of-Custody
COD	Chemical Oxygen Demand
CRDL	Contract Required Detection Limit
CRQL	Contract Required Quantitation Limit
CSM	Customer Service Manager
CSRM	Certified Standard Reference Material
CST	Customer Service Team
CUR	Condition Upon Receipt
CV	Coefficient of Variation
CVAA	Cold Vapor Atomic Absorption (Spectroscopy)
DFTPP	Decafluorotriphenylphosphine
DOC	Dissolved Organic Carbon
DOE	Department of Energy
DOT	Department of Transportation
DQO	Data Quality Objective

Acronyms and Initialisms (continued)

MDA	Minimum Detectable Amount
MDL	Method Detection Limit
MS	Matrix Spike
MSA	Method of Standard Additions
MSD	Matrix Spike Duplicate
MSDS	Material Safety Data Sheet
NCM	Nonconformance Memo
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards Technology
NMOC	Non-Methane Organic Compounds
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NRM	National Reference Material
PAH	Polynuclear Aromatic Hydrocarbons (or PNA)
PC	Personal Computer
PCB	Polychlorinated Biphenyls
PDS	Post Digestion Spike
PE	Performance Evaluation
PEM	Performance Evaluation Mixture
PM	Project Manager
PQL	Practical Quantitation Limit
PSRL	Project-Specific Reporting Limit
PUF	Polyurethane Foam
QA	Quality Assurance
QAMP	Quality Assurance Management Plan
QAPP	Quality Assurance Project Plan or Quality Assurance Program Plan
QAS	Quality Assurance Summary
QC	Quality Control
QMS	Quality Management System
QuantIMS	Quanterra® Laboratory Information Management System
QRI	Quality-Related Item

1.0 Management Commitment and Organization

1.1 Vision Statement

Quanterra®'s vision is to be a world-class, profitable analytical services company providing high-value, compliant, innovative problem solutions and state-of-the-art products wherever they are required.

1.2 Statement of Management Commitment to Quality

Quanterra®'s management is committed to providing quality services that meet the requirements of our clients and satisfy applicable regulatory requirements. Management is dedicated to providing an environment that encourages the achievement of excellence, demands integrity in all aspects of its operations, and requires active participation of all associates and vendors in meeting its quality goals.

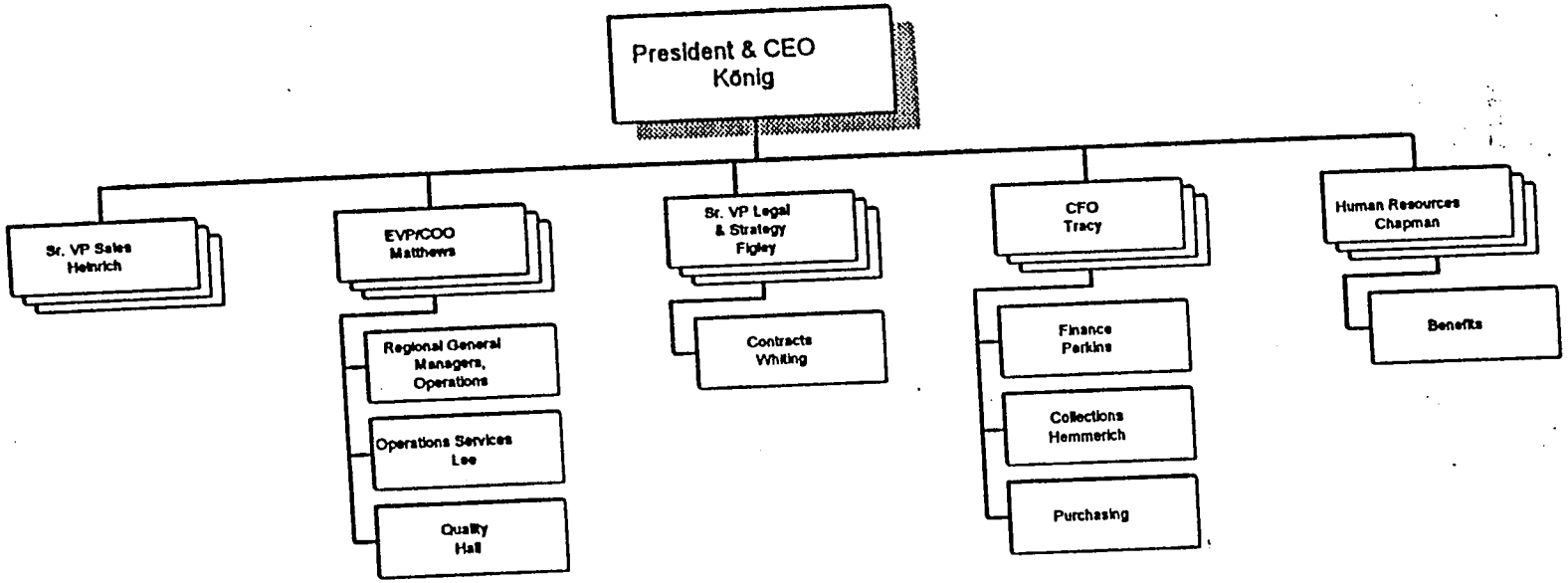
A comprehensive Quality Management System (QMS) has been developed to ensure that Quanterra®'s clients receive high-quality analytical and environmental services that are timely, reliable, and meet their intended purpose in a cost-effective manner. The QMS provides the organizational structure that ensures quality in its work processes, products, and services. The Quanterra® QMS is described in this Quanterra® Quality Assurance Management Plan (QAMP) and applies to all technical, business, and administrative functions at Quanterra®. The principles and practices described in this QAMP apply to all Quanterra® associates at every level and are fundamental to the services we provide and to the way we do business.

The Quanterra® QAMP provides the foundation for planning, implementing, and assessing the Quanterra® QMS. It is an overall statement of quality policy as well as a plan used to implement quality programs throughout the company. Each business function of the organization shall put in place plans, policies, and procedures that will meet the requirements of the QAMP. The QAMP provides guidance to Quanterra®'s associates in fulfilling their responsibilities and serves as a statement to clients, agencies, and associates of Quanterra®'s commitment to quality.

Implementation of the QAMP is the responsibility of all Quanterra® associates. Management at every level has the responsibility and authority to lead the development and implementation of a structured management system that supports the quality programs. Management must ensure that the principles and practices of the

FIGURE 1.3-1

QUANTERRA ORGANIZATIONAL CHART



as of 3/10/97

1.4.6 Quality Assurance (QA) Manager

- Reports directly to the Laboratory Manager and indirectly for all QA matters to the Corporate Director of Quality Assurance
- Approves the Facility-Specific Appendix to the Quanterra® QAMP
- Approves operation-specific SOPs
- Responsible for assessing and maintaining the QAMP within the facility operations
- Responsible for ensuring and improving quality within facility operations
- Recommends resolutions for ongoing or recurrent nonconformances within the laboratory
- Supervises and provides guidance and training to laboratory QA staff
- Suspends sample processing when significant quality requirements are not met
- Assists in maintaining regulatory analytical compliance
- Serves as the in-house client representative on all project inquiries involving data quality issues
- Monitors data quality measures via statistical methods to verify that the laboratory routinely meets stated quality goals
- Performs QA assessments
- Tracks and closes external and internal findings of QA audits
- Reviews and approves corrective action plans for nonconformances, trends nonconformances to detect systematic problems, and initiates additional corrective actions as needed.
- Assists in the preparation of and approves Quality Assurance Project Plans (QAPPs)
- Coordinates laboratory certification and accreditation programs
- Maintains controlled quality documents
- Prepares a monthly quality report to management
- Responsible for approving reference data and changes on LIMS.

1.4.7 Customer Service Managers (CSMs)

- Reports directly to the Laboratory Manager
- Defines customer requirements through project definition
- Assesses and assures customer satisfaction
- Provides feedback to management on changing customer needs
- Brings together resources necessary to ensure customer satisfaction.

- Responsible for meeting quality requirements.

1.4.12 Project Manager

- Monitors analytical and QA project requirements
- Acts as a liaison between the client and the laboratory staff
- Prepares Quality Assurance Summary (QAS) or equivalent summary form and communicates project-specific requirements to all parties involved
- Assists the laboratory staff with interpretation of work plans, contracts, and QAPP requirements
- Reviews project data packages for completeness and compliance to client needs
- Keeps the laboratory and client informed of project status
- Together with the QA Manager, approves customer requested variances to methods and to standard laboratory protocols
- Monitors, reviews, and evaluates the progress and performance of projects
- Reports client inquiries involving data quality issues or data acceptability to the facility QA Manager and to the operations staff
- Conducts project reviews to assess the laboratory's performance in meeting customer requirements
- Prepares reissue requests for project data
- Responsible for meeting quality requirements.

1.4.13 Group Leader or Team Leader

- Reports directly to either the Systems Manager, or Operations Manager or Laboratory Manager depending on specific laboratory organization.
- Supervises daily activities of analyses within the group
- Supervises QC activities performed as a part of routine analytical operations
- Implements data review procedures
- Supervises the preparation and maintenance of laboratory records
- Evaluates instrument performance and supervises the calibration, preventive maintenance, and scheduling of repairs
- Oversees or performs review and approval of all analytical data
- Reports nonconformances to the appropriate managers
- Responsible for meeting quality requirements.

1.4.14 Analyst

- Performs analytical methods and data recording in accordance with documented procedures

2.0 Quality System and Description

Quanterra® has defined Quality as meeting the requirements of our clients, both internal and external. The QMS provides the structure to achieve the total quality management goals necessary to obtain world class standards of performance and quality in all areas.

2.1 Quality Management System

The purpose of the QMS is to ensure the quality of products and services. The QMS is a structured management system of principles, objectives, policies, responsibilities, and implementation plans at the organizational and project-specific levels. At the organizational level, the QMS provides the framework within which project-specific planning, implementation, and performance assessment may occur. The QAMP documents the QMS and describes both the organizational and project-specific principles, goals, controls, and tools of the QMS. The QMS is described in detail in this QAMP, Quality Policy Documents, and SOPs.

The QMS steering committee is comprised of the Quanterra® President and CEO and his staff. This committee establishes the Quanterra® Vision and its strategic plan and provides leadership and support for the achievement of all quality goals and objectives. It is the responsibility of all Quanterra® directors and managers to implement the QMS elements by setting goals and objectives which lead to the achievement of the Quanterra® Vision.

2.2 Quality Assurance

Quality Assurance (QA) is defined as a system of activities which ensures a process, product, or service that meets the needs and expectations of the customer. QA is an integral part of Quanterra® 's QMS.

The organizational and project-specific systems of the Quanterra® QMS, discussed in Section 2.1, are used to define QA goals. Controls at the organizational level regulate activities that support common or standardized functions such as associate qualifications and training, document control, and material procurement. Controls at the project level regulate the definition and implementation of customer requirements to produce the desired type and quality of product. Some specific examples of quality controls are:

- Measuring lab and instrument performance on a daily basis to ensure that the measurement systems are in statistical control
- Demonstrating lab capability through data quality assessments which document the

generation of environmental analytical data. The QAMP provides QC criteria for standard procedures and facility-specific instrumentation as well as method detection limit (MDL) information.

2.3.2 Quality Policy Documents

Quality Policy Documents provide further detail to the QAMP. They describe the requirements for a specific program on a corporate-wide level. Quality Policy Documents use the concepts and requirements contained in the QAMP and provide sufficient detail so that corporate or facility-specific SOPs can be developed.

2.3.3 Standard Operating Procedures

Standard Operating Procedures (SOPs) describe step-by-step instructions for performing a method or activity. In addition, there are SOPs which relate to other support services performed in the company. In general, SOPs will be corporate or operation specific. Corporate SOPs specify procedures that are standard across Quanterra®. Operation-specific SOPs detail procedures that pertain to a specific facility operation only. SOPs specify procedures, methods, corrective action requirements, documentation, review, and verification requirements. SOP format and document control are described in Quanterra® Policy Number QA-001, "Standard Operating Procedures." SOPs that are performed by each Quanterra® operating unit are listed in Section 3 of the Facility Appendix to this QAMP. SOPs are living documents and may supersede some requirements in this document until the QAMP update every two years.

2.3.4 Quality Assurance Project or Program Plans (QAPPs)

Regulations and contracts may contain QA requirements which are different from Quanterra® 's QAMP. To address unique or project requirements, Quality Assurance Project Plans (QAPP) may be prepared and implemented. The requirements documented in a QAPP take precedence over the Quanterra® QAMP for that project.

Similarly, some regulatory programs such as Florida Department of Environmental Protection (FDEP) and Florida Department of Health (FDH) require QA Plans specific to their program. The FDEP and FDH require that each laboratory certified in the state submit and maintain a Comprehensive QA Plan. Many state certifying agencies have reciprocal certification agreements with Florida. In these situations, the QA Plan submitted for regulatory programs takes precedence over the Quanterra® QAMP.

If requested and approved by the client, project-specific requirements may be less stringent than the Quanterra® quality program.

3.0 Associate Qualification and Training

All activities performed by Quanterra® shall be accomplished by qualified associates. The following definitions are relevant to the discussion of associate qualification and training presented in this section:

- Qualification - The characteristics or abilities gained through education, training, or experience that enable an individual to perform a required task.
- Orientation - The act or process of acquainting individuals with an existing situation, environment, or condition.
- Training - In-depth instruction to develop proficiency in the application of requirements, methods, and procedures. Instruction may be internal or external classroom sessions, courses, or on-the-job training.

Employee orientation and training must be performed in compliance with Quanterra® Corporate SOP Number CORP-QA-0013, "Employee Orientation and Training".

3.1 Associate Qualifications

Each operating unit shall have job descriptions for all positions. These job descriptions must specify the minimum qualifications for education and experience, knowledge, and skills which are necessary to perform at a satisfactory level. An associate's performance shall be compared with the requirements of his/her job description at least annually, in conjunction with the associate's annual performance review.

Quanterra® expects the necessary knowledge, experience, and skills to be demonstrated by formal academic training. Qualifications of professional associates shall be documented by resumes which include academic credentials, employment history, experience, and professional registrations. A copy of the resume will be placed in the associate's training file or may be maintained in electronic format.

3.2 Orientation and Training of Laboratory Staff

Associates receive internal, external, formal, and informal training. Training is performed to maintain and develop proficiency, and to promote improvement. Training is performed by individuals knowledgeable in the subject matter.

Quanterra® associates are qualified based on the experience and training documented in the individual's training file, and are assigned duties within their experience and training.

3.2.3 Health and Safety Orientation and Training

Each newly hired Quanterra® associate, contract worker, or working visitor is required to go through health and safety orientation and training as per the laboratory Chemical Hygiene Plan (CHP). The orientation must be performed as soon as possible after the associate's report-to-work date and before chemicals are handled. Quanterra® associates and contract workers shall be given comprehensive health and safety training within ninety days of the start-to-work date. Documentation is maintained in the associate's training file.

3.2.4 QA Manager Training

All QA Managers shall receive training so that they are proficient in the requirements of the Quanterra® QAMP. Continued proficiency of QA Managers shall be maintained through active participation in QA audits and the preparation and review of QA documents.

3.3 Training Files

Each Quanterra® associate has an individual training file maintained by the QA Manager or designee. The types of training documents included in the training file are the following:

- Associate's resume
- Quality
- Health and Safety
- Technical
- Professional Development
- Regulatory/Compliance.

Information is filed in the training file as training is received. Not all associates will have training records for all areas depending upon their job function or tenure with the company.

3.3.1 Associate Resumes

A copy of the associate's current resume will be placed in the associate's training file or maintained in electronic format. Quanterra® has developed a standard format for resumes. Qualifications of associates, as documented on resumes, include academic credentials, employment history, experience, and professional memberships and registrations.

3.3.2 Individual Training Records for the Areas of Quality, Health and Safety, and Technical

Training of each associate shall be summarized and documented on training forms. These include documentation of participation in orientation training, one-on-one training, on-the-job training, or

4.0 Procurement of Items and Services

This section defines the Quanterra® requirements for the procurement of items and services. Controlling the quality of items and services procured by Quanterra® will help us meet the needs of our customers. The Quanterra® procurement program requires:

- Assurance that purchased items and services meet Quanterra® -established requirements and perform as expected
- Definitions and descriptions of the documentation levels required for the applicable technical and administrative requirements
- Evaluation and qualification of vendors.

4.1 Selection of Vendors

Prospective vendors are selected based upon criteria appropriate to the materials or services provided. For national vendors and contracts, the vendor is selected through either a competitive proposal/bid process, strategic business alliance or negotiated vendor partnership. Vendors are evaluated on the following criteria as appropriate:

- The vendor's history of providing identical or similar products that perform satisfactorily in actual use
- The vendor's service record and ability to provide a complete product line and commensurate service
- The vendor's ability to administer inventory at Quanterra® facilities through a fully developed inventory management system that will ensure correct stocking levels as well as shelf-life tracking
- Software systems that will integrate with Quanterra® systems
- Objective evaluation of the vendor's current quality records supported by documentation
- Ability of the vendor to provide service agreements for instruments that meet Quanterra® specifications
- Evaluation of the vendor's business strategy and the ability of that strategy to complement Quanterra®'s quality program
- Results of audits by Quanterra® of the vendor's technical and quality capability.

A Quanterra® quality representative shall determine the appropriate level of evaluation criteria for the item or service being purchased. Vendors that provide test and measuring equipment, solvents, standards, instrument-related service contracts, or subcontracted laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items. For the procurement of testing and measuring

4.2.1 Role of Quanterra® Purchasing

Quanterra® Purchasing supports the laboratory by:

- Maintaining, issuing, and negotiating contracts
- Identifying potential vendors and subcontractors
- Identifying vendors for unique or scarce materials
- Maintaining a system to facilitate purchases made by each facility
- Maintaining lists of available items through catalogs or contract agreements with approved vendors
- Preparing and communicating corporate policies regarding purchasing and procurement
- Developing and implementing a review of the purchasing program as it pertains to procurement of QRIs.

In order to enhance the quality and consistency of the product within the laboratory network, the Director of Purchasing shall pursue national contracts for laboratory supplies, standards, and instruments of known quality and proven reliability.

4.2.2 Procurement Procedures

The specifications for standards, chemical reagents, solvents, gases, water, and other QRIs shall be documented in SOPs. In addition, each laboratory must have SOPs that cover the following:

- Checking purity of standards, reagents, reagent grade water, and other chemicals as appropriate versus intended use
- Preparation, storage and expiration of standards, reagents, and other chemicals as appropriate
- Requirements for lab containers (e.g., volumetric glassware).

Corporate SOPs will be developed for these processes where appropriate. Operation-specific SOPs shall be in place if a corporate SOP does not exist.

Corrective actions for failure of an item to meet required specifications are as follows:

- Review current supplies and eliminate from use; this must include communication to the Quanterra® laboratory network and corporate purchasing to avoid additional problems in other facilities
- Return to vendor
- Evaluate a new lot or alternate supplier

4.2.4 Special Requirements for Standard Reference Materials

For all standard reference materials (SRMs), Quanterra® will use materials of known quality for the intended use. Where available, SRMs will be traceable to the National Institute of Standards Technology (NIST), the American Association for Laboratory Accreditation (A2LA), or to an equivalent source. If the traceability is not commercially accessible, the best available standard for the material or isotope shall be used. Certificates for Certified Standard Reference Materials (CSRMs) shall be procured from the supplier. Documentation received with each standard shall include the following information as appropriate:

- Traceability to an approved source (where available) or other certificate of analysis
- Radionuclide identification with activity and error
- Reference Material Certificate
- Certification Report that will include pertinent information such as:
  - Starting material characteristics including purity and traceability
  - Expiration date
  - Lot number
  - Preparation date
  - Methods of measurement and associated uncertainty
  - Actual weights and measurements determined by gravimetric or volumetric measurement
  - Unique identifying number
  - Formula weight
  - Density
  - Half-life of radionuclide(s)
  - Mass and volume of standards
  - Percent of impurities

Receipt, storage, evaluation, use, control, and disposal of all standards as well as documentation of these activities are described in operation-specific SOPs. Additional discussion of standards can be found in section 8.5.4.

4.3 Procurement of Subcontract Laboratory Services

A subcontract laboratory is defined, for the purposes of this QAMP, as a laboratory external to the Quanterra® laboratory network. However, for certain federal programs, a branch location of the Quanterra® laboratory network may also be defined as a subcontractor and require client and agency

5.0 Documentation and Records

5.1 Quality Documents and Records

Quality documents are those which define the objectives, policies, and procedures that ensure the quality of items and services provided by Quanterra®. A system has been designed to revise, distribute, and control quality documents. Quanterra® quality documents are listed in Table 5.1-1 along with their approval requirements.

Records are completed documents that provide objective evidence of the performance of an item or process. Records are discussed in Sections 5.4 through 5.6.

5.2 Document Review and Revision

Quality documents have multiple levels of review and approval appropriate for the document. These reviews are demonstrated by the signature of the reviewer on the document. Quality documents are required to be periodically reviewed and, if necessary, revised. The frequency of this review is dependent upon the type of document and upon regulations and client requirements. In addition to periodic review and revision, quality documents must be revised when the activity, policy, or procedure they describe changes in a significant manner. Table 5.2-1 lists the Quanterra® quality documents along with their required frequency of review and the individuals responsible for performing those reviews.

5.3 Document Control and Distribution

Document control is necessary to ensure that associates have access to current policies and procedures at all times. Quality documents that are placed under a controlled distribution include, but are not limited to this QAMP, Quality Policy Documents, and SOPs. Format and control of SOPs are described in Quanterra® Policy Number QA-001, "Standard Operating Procedures." QAPPs are also placed under a controlled distribution when that document is generated by Quanterra®.

Quality documents are controlled by initially distributing them to the associates who need to be aware of or follow the contained information or procedures. All subsequent revisions or updates to the document are also distributed to the associate. A controlled copy distribution list is maintained with the name of each associate who received a copy along with their controlled copy number. Records of controlled distribution are maintained by

- Internal and external audit reports
- Nonconformance memos.

These records may apply to one or more projects, but in general they are applicable to many projects. Quality records must be properly maintained in the facility files.

5.4.2 Project Records

Project records are documents which are specific to a project or a group of samples within an ongoing project. Examples of project records are the following:

- Chain-of-custody forms
- Raw analytical data
- Final data reports with case narrative and cover letter
- QC and calibration results
- Project-specific nonconformance memos
- Project correspondence.

Project records shall be properly maintained.

5.5 Validation of Records

When records, as contained in files, are transferred to a records storage area or off-site storage area, they shall be placed in suitable containers and an inventory sheet prepared by the person submitting the records. The contents of each container will be compared to the inventory sheet and labeled. If there are any discrepancies, the container and inventory sheet shall be returned to the supervisor or Group/Team Leader submitting the records for resolution.

5.6 Retention and Disposal of Records

Quanterra® shall maintain and dispose of records according to the Quanterra® Policy Number LEG-004, "Record Retention".

5.7 Data Confidentiality

Quanterra® considers the data and associated information for a project to be confidential and the property of the client. In order to preserve client confidentiality, reports and supporting records are only released to third party persons or organizations after consultation with the direct client and laboratory management. If however directed by courts-of-law or other competent authorities, such as regulatory agencies, Quanterra® will provide required records and notify its clients and provide information as to the identification of the requester and the records that will be released.

When confidentiality clauses are contained in contractual documents, no information or records are released without first obtaining written approval from the client.

6.0 Computer Hardware And Software

The purpose of defining controls for computer hardware and software is to protect the integrity of computer-resident data. SOPs shall be put in place to ensure that computer-resident data and programs are accurate, controlled, and secure. The required SOPs and their scope will be presented in the Quanterra® Software Quality Assurance Plan.

Quanterra®'s commitment to meeting good automated laboratory practices is presented in the Quanterra® Corporate Policy Number CORP-IT-013, Software Quality Assurance.

6.1 Use of Hardware

Computer hardware used in the generation, measurement, or assessment of client data shall be of appropriate design and of adequate capacity to function according to specifications. Computer hardware shall be suitably located for operation, inspection, cleaning, and maintenance. The computer shall be installed in accordance with the manufacturer's recommendations. Any changes to the equipment shall be approved by the laboratory Information Technology (IT) representative.

6.2 Security

Procedures shall be in place to insure the integrity of client data. These may include both physical and logical protection and will ensure that access is limited to authorized persons.

Data files will have backup copies made at regular intervals to protect data against accidental loss through a hardware or software failure.

6.3 Use of Software

If computer software is used to acquire, process, or report client data, that software will be tested to ensure that it correctly performs its intended function. Software may be validated or verified, depending upon its complexity, size, and whether it was purchased or developed by Quanterra®. The following definitions are used by Quanterra®:

- Validation - the process of establishing documented evidence which provides a high degree of assurance that a specific process will consistently produce a product meeting predetermined specifications and quality attributes. This process

processed, as previously discussed, to verify added performance. If software revision changes the basic operation of the program, complete revalidation of the program may be required.

Spreadsheets and unprotected software used to acquire, process, or report client data must be documented and reverified when changes are made. The test problems used to provide initial verification shall be reprocessed and the results compared to demonstrate that performance of the software is unchanged.

Laboratory operations is responsible for the generation of the validation and verification data for instrument level software. QA will maintain the necessary documentation. Corporate Information Technology is responsible for generation and maintenance of documentation relating to verification and validation of LIMS system. This is described in the Quanterra® Corporate Policy Number CORP-IT-013, Software Quality Assurance.

6.4 Documentation

Documentation shall be established for system development, change control, validation, verification, and security. Documentation will be retained according to the Quanterra® Records Retention Policy No. LEG-004.

6.5 Computer Viruses

Quanterra® shall employ the use of anti-virus software to detect and remove viruses from software.

7.0 Planning

The generation of environmental analytical data is an intricate process. Success is dependent upon the timely execution of interrelated steps, many of which may be project-specific. Quanterra® has an organizational system in place to ensure that all projects are properly planned prior to project initiation, and are monitored for conformance to project requirements during the course of the project. This system ensures that Quanterra®'s clients receive quality deliverables, as well as quality service.

Quanterra® communicates with its clients to identify the client's needs. Project Managers (PMs) work together with Customer Service Managers (CSMs), or designee, to assess and coordinate Quanterra®'s resources. Each client is assigned a single point of contact, usually a PM, to ensure that there is a strong line of communication between the client and Quanterra®. Projects receive technical and QA support at the laboratory or corporate level as needed to ensure that project DQOs are achievable.

7.1 Data Collection Process

The sample collection and data generation processes are designed to produce analytical data that accurately reflect the nature of the site or sampling point. Figure 7.1-1 shows the sample collection and data collection processes. To ensure our services meet client and project requirements, communication and planning with the client are emphasized. The organization described in Section 7.2 is in place to ensure that these goals are achieved.

7.2 Organizational Responsibilities

Project planning is normally performed within Quanterra® by the operational units. Each operating unit also has the responsibility for customer service within their operating unit. CSMs or designee, Account Managers (AMs), PMs, Operations Managers, and Laboratory Managers play an integral part that will collectively ensure that all projects are thoroughly planned and communicated to all appropriate personnel.

Successful project planning and communication of project requirements ensures that samples will be handled appropriately and that analytical data will be reported in compliance with project requirements. CSMs or designee, AMs, PMs, Lab Managers, and Operations Managers work together to ensure that the following will occur prior to receipt of samples at the laboratory:

- Samples are scheduled for arrival at the laboratory
- All unique project requirements have been identified and communicated to all appropriate personnel
- Standardized client, state, federal, or Quanterra® programs are appropriately selected
- Fully-qualified subcontract laboratories have been selected if needed
- A review has been performed on all pre-project documents such as proposals, contracts, and/or QAPPs to identify unique project-specific requirements
- All appropriate and required preparations have been made at the laboratory to accommodate or meet project requirements as described in proposals, contracts, and/or QAPPs
- It has been determined that the laboratory has the capability and the capacity to analyze the samples
- The laboratory has been determined to be able to meet the required sample holding times and is able to report the resulting data within the time line specified by the client
- All safety hazards associated with the samples have been communicated to all appropriate personnel.

7.3 Determination of Project QC Requirements

A system must be in place to review project documents (e.g., Request for Proposals (RFP), Request for Quote (RFQ), QAPPs, technical Statements of Work (SOW), and other contractual materials) before a project begins. For larger projects this can involve an inter-laboratory Customer Service Team (CST) (see Section 7.5). Within the laboratory it generally involves the CSM or designee working in conjunction with staff from laboratory operations, QA, IT, and management. The goal of the evaluation process is to ensure that client needs and expectations are properly understood, and that the laboratory can meet those requirements. Internal and external communications should be in writing to avoid misunderstandings. The CSM or designee, with support of others in the laboratory, will work with our client to ensure that project requirements are properly aligned with laboratory capabilities.

When QC requirements are not specified by a client, Quanterra® will follow the requirements given in Corporate Policy Number QA-003, "Quanterra® Quality Control Program".

7.4 Communication of Project-Specific Requirements

Each operating unit shall use a Quality Assurance Summary (QAS) (example shown in Figure 7.4-1) or an equivalent summary form to document all project-specific requirements. This document is prepared by the PM for all projects prior to sample receipt

FIGURE 7.4-1 (Page 2 of 2)
Example Quanterra® Quality Assurance Summary

Client: _____
Project Code: _____
QAS No.: _____ Revision No.: _____

Number of Samples Expected by Matrix:
____ Air (A) ____ Water (W)
____ Soil (S) ____ Other (O): _____

Analysis/Product Code	Matrix (circle)	Method Prep/Analysis	QC Samples		Required Reporting Limit/Units/ Report as*	Holding Time (Days)	TAT** (Days)	Radiochemical-Specific	
			Type (circle)	Frequency				Count Time	Sample Size
	A W S O		B LCS DUP MS MSD	per					
	A W S O		B LCS DUP MS MSD	per					
	A W S O		B LCS DUP MS MSD	per					
	A W S O		B LCS DUP MS MSD	per					
	A W S O		B LCS DUP MS MSD	per					
	A W S O		B LCS DUP MS MSD	per					
	A W S O		B LCS DUP MS MSD	per					

* A = "As Is" or D = Dry Weight Basis

**TAT = Turn Around Time

SAFETY HAZARDS: Chemical? ____ No ____ Yes: Define: _____
Radioactive? ____ No ____ Yes:
Isotopes Expected: _____ RSO Approval (sign/date): _____

Special Instructions: _____

Comments: _____

- Preventive Maintenance - Quanterra®'s preventive maintenance program is designed to minimize analytical instrument malfunctions, permit simple adjustments, and to ensure fewer and shorter breakdowns of critical analytical equipment. (See Section 8.11, "Preventive Maintenance and Service".)

- Network Laboratories & Subcontractor Laboratories - To support the laboratory during peak periods or in the event of a critical instrument malfunction, Quanterra® has the capability to arrange the use of other network laboratories or qualified analytical laboratories as subcontractors for short-term backup analytical support. Through an extensive process, QA personnel evaluate, identify, and select qualified analytical laboratories before an analytical contract is awarded. In order to qualify, a subcontractor laboratory must pass this evaluation. Furthermore, any use of a subcontractor laboratory is approved by the client prior to award of a contract or sample shipment for existing contracts.

- Uninterruptable Power Supply - An Uninterruptable Power Supply (UPS) system which provides line conditioning and backup power to the LIMS computer system/server. This contingency plan allows sufficient time for the main computer system to be shut down and for data archival. All electronically generated data that are stored on the main computer system and on the individual personal computer (PC) hard drives are backed up at regular intervals. In the event that the main laboratory computer system fails, the analytical data can be retrieved from the PC hard drives.

8.0 Work Processes and Operations

Much of the environmental project activity is planned and designed externally to the laboratory or field operation and presented in the form of a contract, work plan, or QAPP. Laboratory and field activities are in turn planned, implemented, and assessed to meet client requirements according to approved procedures and methodologies. The QAMP provides the systems to document and implement these activities. The execution and assessment of the implemented operational systems are detailed in Quanterra® corporate or operation-specific SOPs. The entire process is assessed on a regular basis for conformance to prescribed requirements.

Standard practices for Quanterra® operations are detailed in this section. Specific project or program requirements which differ from those described here can be met. These must exist in approved contracts, work plans, or QAPPs.

8.1 Standard Operating Procedures

SOPs are required in all Quanterra® operating units for analytical and administrative activities from the receipt of samples in the laboratory through analysis, reporting, and subsequent sample disposition. Training, health and safety procedures, QC, method procedures, and instrument and equipment calibrations are included in SOPs. Preprinted forms, either standardized across Quanterra® through a Corporate SOP requirement, or shown as an example form when not standardized, are included in SOPs as appropriate. Standard SOP formats for all activities related to the generation and reporting of data are discussed in the Quanterra® Quality Policy Document No. QA-001, "Standard Operating Procedures". SOPs shall be reviewed by technically-qualified associates. SOPs are controlled documents and are distributed and maintained as described in this policy. SOP requirements for approval and frequency of review are given in Tables 5.1-1 and 5.2-1.

8.2 Analytical Methods

Whenever possible, Quanterra® operations use industry- and regulatory agency-recognized analytical methods from source documents published by agencies such as the Environmental Protection Agency (EPA), Department of Energy (DOE), the American Society for Testing and Materials (ASTM), and the National Institute for Occupational Safety and Health (NIOSH) as described in Quanterra®'s SOPs. The analytical methods

blanks, field duplicates, and performance evaluation (PE) samples are received from the client as unknown samples. Analytical laboratory QC samples for inorganic, organic, and radionuclide analyses may include calibration or instrument blanks, method blanks, background, duplicates, replicates, laboratory control samples (LCSs), calibration standards, matrix spikes (MSs), matrix spike duplicates (MSDs), surrogate spikes, and yield monitors.

8.3.1 Precision And Accuracy

Precision is an estimate of variability, that is, it is an estimate of agreement among individual measurements of the same physical or chemical property, under prescribed similar conditions. The precision of a measurement system is affected by random errors. Precision is expressed either as relative standard deviation (RSD) for replicate measurements greater than two or as relative percent difference (RPD) for duplicate measurements. Table 8.6-1 illustrates the formulae used to calculate units of precision (i.e., RSD and RPD).

Accuracy is the degree of agreement between a measurement and the true or expected value, or between the average of a number of measurements and the true or expected value. Systematic errors affect accuracy. For chemical properties, accuracy is expressed either as a percent recovery (R) or as a percent bias (R - 100).

The precision and accuracy DQOs that are to be used in evaluating inorganic, organic, and radionuclide constituents at Quanterra® are provided in Tables 8.4-5, 8.4-6, and 8.4-7, method-specific SOPs, and in the documentation for the analytical method of interest.

Precision and accuracy are determined, in part, by analyzing data from matrix spike and matrix spike duplicates, unspiked duplicates, LCSs, and single blind audit samples. For radiochemical determinations, counting statistics can also provide an estimate of uncertainty. A description of these QC samples is provided in Section 8.4.

8.3.2 Completeness

Completeness is a measure of the percentage of measurements that are judged to be valid measurements. At a minimum, the objective for completeness of data is 90% for each constituent analyzed.

8.3.3 Representativeness

Representativeness is the degree to which data accurately and precisely represent a

(CERCLA) activities or when the USEPA CLP SOW protocol is required. The requirement for this procedure is described in the Quanterra® Policy Number QA-014, "Determination of Instrument Detection Limits."

IDL samples are introduced at a later stage of the analytical process so that the IDL is a more direct indication of instrument sensitivity. The primary distinction is that the IDL estimates the detection limit of the instrument under ideal conditions, whereas the MDL estimates the detection limit in more-practical terms by subjecting a known concentration matrix to the total method process. IDLs are not required by the SW-846 methods, except for method 6020 where the IDLs are a requirement.

When required, IDLs will be performed in accordance with the procedures defined in the applicable USEPA SOW, ILMO3.0 or subsequent versions, and Quanterra® Policy Number QA-014, Determination of Instrument Detection Limits.

Prior to acceptance and use for reporting purposes, all data from detection limit studies and reporting limits must undergo technical review and approval by the laboratory management and QA staff.

8.3.7 *Reporting Limits*

Two reporting limit conventions are used within Quanterra®: the Reporting Limit (RL) and the Project-Specific Reporting Limit (PSRL). The RL is a uniform, Quanterra®-wide, reporting limit based on an evaluation of the Practical Quantitation Limits (PQLs) at Quanterra® laboratories and the expected method performance in routine water and soil matrices. The PQL is the lowest concentration a method can reliably achieve within limits of precision and accuracy and is derived from empirical, matrix-free method performance studies. The Quanterra® RLs and PSRLs are maintained in the LIMS.

Reporting limits are established and modified within Quanterra® according to the Corporate SOP Number QA-009, "Reporting Limits."

PSRLs are used when project data quality objectives (DQO) require a reporting limit other than the RL. PSRLs tailor Quanterra®'s product to meet customer requirements.

For radiochemistry, whether the net result is negative, zero, or positive, the actual calculated result is reported with its associated propagated uncertainty. The minimum detectable amount (MDA) is affected by many factors, such as the length of count, chemical yield, half-life, background of the instrument,

contaminants through the septum of the sample vial. Trip blanks, also referred to as travel blanks, are analyzed to monitor for possible sample contamination during shipment for volatile organics only. Trip blanks are prepared by filling preserved VOA vials (with no headspace) with organic-free water. Trip blanks accompany the sample bottles during collection and shipment to the laboratory and are stored with the samples.

8.4.1.2 Rinsate Blank

A rinsate blank or equipment blank is a volume of rinse solution (deionized, distilled water or organic solvent) used to rinse a sampling tool. The rinse solution is collected after the sampling equipment has been cleaned in order to demonstrate that there is no residual contamination remaining on the tool that would carry over into the next sample.

8.4.1.3 Field Blank

A field blank is a contaminant-free volume of water or soil that is provided by the sample collector to demonstrate the absence of contamination introduced during sampling. Deionized, distilled water or previously-prepared solid material (e.g., Ottawa sand) is placed into sample containers by the sample collection crew, packaged, and shipped with the other field samples.

8.4.1.4 Field Duplicate

A field duplicate sample is a replicate taken from the same sampling event for that location. The field duplicate sample is submitted to the laboratory as a separate sample by the sample collection personnel. Results of field duplicate samples can provide a measure of sampling precision.

8.4.1.5 Field Matrix Spike

A field matrix spike sample is created by spiking target analytes into a sample in the field at the point of sample acquisition. These sample results provide information on the target analyte stability after collection and during transport and storage.

8.4.1.6 Collocated Samples

Collocated samples are independent samples collected in such a manner that they are equally representative of the variable(s) of interest at a given point in space and time. Examples of collocated samples include: samples from two air quality analyzers, sampling from a common sample manifold, or two water samples collected at the same time and from the same point in a lake.

reference method for inorganic methods, organic methods, and the USEPA CLP Statements of Work respectively. The following sections provide descriptions of laboratory QC samples and their frequency of use. Quanterra® Policy Number QA-003, "Quanterra® Quality Control Program", describes in detail the QC data evaluation process.

8.4.2.1 Quality Control (QC) Batch

The QC batch consists of a set of up to 20 field samples that behave similarly (i.e., same matrix) and are processed using the same procedures, reagents, and standards within the same time period. This definition of a QC batch is utilized by Quanterra® unless there is clear regulatory guidance, contract specifications, or differing client requirements that are explicitly documented. Further details and requirements for the application of the definition of QC batch are described in QA Policy Number QA-003.

8.4.2.2 Method Blank

The method blank (MB) is a QC sample that consists of all reagents specific to the method and is carried through every aspect of the procedure, including preparation, cleanup, and analysis. The method blank is used to identify any interferences or contamination of the analytical system that may lead to the reporting of elevated analyte concentrations or false positive data. Potential sources of contamination include solvent, reagents, glassware, other sample processing hardware, or the laboratory environment. In general, the method blank is a volume of deionized laboratory water for water samples, or a purified solid matrix for soil/sediment samples, that is processed as a sample. In the event that no appropriate solid matrix exists, deionized water may be used. The volume or weight of the method blank must be approximately equal to the sample volume or sample weight processed. A method blank shall be prepared with each group of samples processed.

8.4.2.3 Instrument Blank

The instrument blank is an unprocessed aliquot of reagent used to monitor the contamination of the analytical system at the instrument. System contamination may lead to the reporting of elevated analyte concentrations or false positive data. The instrument blank does not undergo the entire analytical process and generally consists of an aliquot of the same reagent(s) used for a sample dilution. Instrument blanks are also referred to as continuing calibration blanks.

to determine the sample homogeneity and the precision of the analytical process.

8.4.2.8 Surrogates

Surrogates are organic compounds that are similar in chemical composition and behavior to the target analytes but that are not normally found in environmental samples. Surrogates are added to all appropriate samples and QC samples being tested for organic analytes to monitor the effect of the sample matrix and the procedure on the accuracy of the process.

8.4.2.9 Analytical Spike

An analytical spike is created by spiking target analytes into a prepared portion (i.e., post digestion) of a sample just prior to analysis. It provides information on matrix effects encountered during analysis such as suppression or enhancement of instrument signal levels. It is most often used in elemental analysis involving various forms of atomic emission or atomic absorption spectroscopy. A single analytical spike serves as a single point application of the "method of standard additions" or MSA.

8.4.2.10 Interference Check Sample

An interference check sample (ICS) is a solution containing known concentrations of both interfering and analyte elements. Analysis of this sample can be used to verify background and interelement correction factors.

8.4.2.11 Internal Standards

An internal standard (IS) is a compound or element with similar chemical characteristics and behavior in the analysis process to the target analytes, but is not normally found in environmental samples. The internal standard is usually added after sample preparation. The primary function of the internal standard is quantitation, however, it also provides a short-term indication of instrument performance. For isotope dilution methods, internal standards are added during sample preparation and are used for quantitation.

8.4.2.12 Radiological QC Samples

The primary QC sample type used for radiological testing to monitor recovery is the yield monitor. The two types of yield monitors are tracers and carriers. A tracer is a radioisotope, usually of the same element and having the same mode of decay as the analyte. A carrier is a non-radioactive solution added to assist in isolating the specific isotope of an element. When

laboratory custody, and disposal must be documented to accomplish this. Figure 8.5-1 shows an example Chain-of-Custody (COC) form that is used by the Quanterra® laboratory network to document this evidence. Field personnel are responsible for initiating the COC form.

The prompt shipment of samples to the laboratory is necessary to ensure that required holding times are met. Samples should be shipped by an overnight carrier, be hand-delivered, or transported in a manner that assures prompt delivery to the laboratory.

Some sites require an extensive radioactive screening process before a sample may be shipped. In these cases, it is imperative for the Project Manager to maintain good communications with the client to assure proper staffing of the laboratory in response to a decreased holding time.

Radioactive samples that are shipped to Quanterra® radiochemistry operations must be screened upon receipt and found not to contain radioactivity that exceeds the level stated in the laboratory's operation license. Samples received by a Quanterra® facility containing radioactivity exceeding their license limit will immediately be returned to the project site.

8.5.2 Sample Containers, Shipping Containers, Preservatives, and Holding Times

8.5.2.1 Sample Containers

A sample container is defined as the sealed enclosure, usually made of plastic or borosilicate glass that the sample is collected in and stored in until analysis. All sample containers provided by Quanterra® operations for environmental sampling are new, with the exception of some air sampling canisters, which must be recertified before reuse, and demonstrated to be clean for their appropriate use. All documentation certifying sample container cleanliness must be maintained by the laboratory or the vendor and can be provided to the client upon request. The sample containers to be supplied are listed in Tables 8.5-1 through 8.5-5. Sample containers provided to the client by Quanterra® are transmitted under custody.

8.5.2.2 Shipping Containers

Shipping containers are defined as the sealed enclosure in which the sample containers are stored during shipment from the sample collection site to the analytical laboratory. Shipping containers must be of sufficient number and size to accommodate the samples in an upright condition. Shipping containers must also meet all requirements for the

shipment of environmental and/or radioactive samples.

Packaged samples must be shipped to the analytical laboratory in a safe manner that preserves the integrity of the samples. The most common method of sample shipment employs coolers or ice chests that are sealed with custody tape and shipping tape. These coolers must be durable and resistant to crushing during shipment. All coolers must be well maintained and cleaned to prevent cross-contamination of the samples. It is the ultimate responsibility of the person collecting and packaging the sample for shipment to ensure that the shipping containers are clean and functional.

To help prevent sample breakage during shipment, additional consideration must be given to providing shock absorbency to all samples packaged inside the shipping container. Use of bubble-wrap around each sample container is the best way to provide this protection. Foam packing materials and vermiculite are also successfully used.

8.5.2.3 Sample Preservatives

Most analytes have a finite holding time in a given sample matrix. Sample preservation is the chemical or physical means by which samples are treated during and/or following sample collection to aid in the stability of the analytes of interest in that matrix. Sample holding times are also adversely affected when samples are improperly preserved, or shipped unpreserved. The preservation of samples at the time of sample collection will follow the requirements of the analytical methods used. This preservation includes the addition of reagents to deter chemical and biochemical degradation and the maintenance of refrigeration during transit and ultimate storage in the laboratory. The required preservatives for the analysis to be performed on each matrix are included in Tables 8.5-1 through 8.5-5.

8.5.2.4 Sample Holding Times

Holding time is defined as the maximum allowable time a sample can be stored after sample collection and preservation (or laboratory receipt for CLP) until appropriate processing occurs (preparation or analysis). The holding time may vary according to method or client requirements. Tests designated with holding times as "analyze immediately or ASAP" are considered parameters that should be tested by field personnel or on-site. Each operation has a system in place to ensure that holding times are monitored by each group within the operating unit. It is the responsibility of each Quanterra® associate processing the sample to

storage.

A CUR is generated by sample control during the sample log-in process to document anomalies identified upon the receipt of samples in the laboratory. These anomalies are outside of laboratory control and do not require corrective actions to be taken within the laboratory. The affected client shall be notified by the PM or designee of all CURs generated for their samples. The PM is responsible for resolving with the client how to proceed with the samples. CURs must be resolved prior to sample preparation and analysis. The completed CUR form shall be stored the project file. An example CUR is shown in Figure 8.5-2.

8.5.3.2 Sample Log-in

Sample log-in activities at Quanterra® operating units are fully documented in operation-specific SOPs. The following is a general description of the log-in process:

- Enter the samples in the laboratory sample log-in book, and/or the LIMS which contains the following information at a minimum:
  - Project identification number
  - Sample numbers (both client and laboratory)
  - Type of samples
  - Required tests
  - Date received at the laboratory
- Assess sample holding times
- Notify the PM and appropriate Group/Team Leader(s) of sample arrival
- Place the completed COCs, waybills, and any additional documentation in the project file.

8.5.3.3 Sample Storage

The primary considerations for sample storage are:

- Maintenance at the prescribed temperature, if required
- Maintenance of sample integrity through adequate protection from contamination from outside sources or from cross-contamination of samples. Low-level and high-level samples, when known, must be stored separately. Samples and standards must be stored in separate refrigerators or freezers. Storage areas for volatile organic test requests should be monitored twice per month by the analysis of a holding blank (an aliquot of contaminant-free water stored in a VOA vial)
- Security of samples within the laboratory.

The requirements listed in Tables 8.5-1 through 8.5-5 for temperatures and holding times shall be used. Placing of

FIGURE 8.5-2
Example Quanterra® Condition Upon Receipt Anomaly Report (CUR)
Page 2 of 2

Legend:

Cooler:
1a Not received, COC available
1b Leaking
1c Other: _____

Temperature:
2a Temp. Blank: _____
2b Cooler Temp: _____
(cooler temp should only be used if there is no Temp. Blank)

Containers:
3a Leaking
3b Broken
3c Extra
3d No labels
3e Headspace (VOA only)
3f Other: _____

Samples:
4a Samples received but not on COC
4b Samples not received but on COC
4c Holding Time Expired
4d Sample Preservative: _____
4e Other: _____

Custody Seals:
5a None
5b Not intact
5c Other: _____

Chain of Custody (COC):
6a Not relinquished by client
6b Incomplete information
6c Other: _____

Container Labels:
7a Doesn't match COC
7b Incomplete information
7c Marking smeared
7d Label torn
7e Other: _____

Other (8): _____
_____
_____

SIGNED ORIGINAL MUST BE RETAINED IN THE PROJECT FILE

8.5.3.5 *Sample Disposal and Return Chain-of-Custody*

After the requested analyses on the samples have been completed, any remaining portions of the samples will be maintained by the sample custodian until the samples are disposed of or returned to the client. The disposal of each sample is recorded on the client's COC form or referenced in the project file. Sample disposal procedures and documentation are described in operation-specific SOPs. Quanterra®'s routine sample retention period is at least thirty days after the analytical report is issued to the client, unless otherwise specified by the client.

For Nuclear Regulatory Commission (NRC) or state licensed laboratories, a real-time inventory of all radioactive isotopes contained in the laboratory (including radioactive samples), as required by the NRC or state, is maintained by the Radiation Safety Officer (RSO). If the quantities of radioactive materials in-house approach the limits stipulated by the laboratory NRC or state license, appropriate action must be taken to ensure the licensed level is not exceeded. This may involve returning samples to clients immediately.

If samples are returned to the client rather than disposed of by the laboratory, the original COC is used to document custody transfer back to the client from the laboratory. A copy of the completed COC is retained in the laboratory project file.

8.5.4 *Calibration Procedures and Criteria*

All equipment and instruments used at Quanterra® operations for quantitative measurements are controlled by a formal calibration program. Calibrations may be periodic or operational. These are described in operation-specific and corporate SOPs. At a minimum, these procedures shall include:

- Instrument to be calibrated
- Reference standards used for calibration
- Calibration technique (e.g., linear, quadratic)
- Acceptable performance tolerances and corrective actions required if specifications are not met
- Frequency of calibration
- Calibration documentation requirements.

Whenever possible, recognized procedures such as those published by ASTM or the USEPA or procedures provided by manufacturers shall be adopted. If established procedures are not available, a procedure shall be developed considering

Prior to use, the laboratories must confirm that the lot they received from the vendor was approved. Special standards that are obtained from another source must be independently verified at the lab.

Stock and working standards are checked regularly for signs of deterioration, such as discoloration, formation of precipitates, or change in concentration. Care is exercised in the proper storage and handling of standard solutions. Standards are always stored separately from samples.

An independent standard is used to verify initial calibrations. An independent standard is defined as a standard composed of the same target constituents as, but from a different source than those used in the standards for the initial calibration. An independent standard may be a laboratory-prepared or a certified independent standard solution(s). Independence of reference material can be achieved by: (1) purchasing reference materials from two separate vendors, (2) using a different lot, or (3) having two separate individuals prepare the calibration and verification standard solutions if independent sources are not available for neat standards.

Records for all purchased standards and reagents shall include the date of receipt, the date opened, and, where applicable, the expiration date.

8.5.4.4 Periodic Calibration

Periodic calibration is performed at prescribed intervals. In general, equipment which can be calibrated periodically is a distinct, singular purpose unit and is relatively stable in performance. These include balances, micropipettors, counters, thermometers, refrigerators, freezers, and ovens. Equipment employed at Quanterra® operations requiring periodic calibration are listed along with their respective calibration requirements in Table 8.5-6. Each Quanterra® operating unit has SOPs in place for the calibration of this equipment if in use at their location.

8.5.4.5 Operational Calibration

Operational calibration is routinely performed as part of instrument usage, such as the development of a standard calibration curve. Initial calibrations must be verified and documented for each constituent by the analysis of laboratory-prepared certified independent standard solutions. Detailed requirements for operational calibration are contained in method-specific SOPs. A summary of the various operational calibrations performed at Quanterra®

are precision, accuracy, and completeness (relative to analytical testing results).

Precision and accuracy assessments are made as part of the evaluation of laboratory QC data generated during sample preparation and analysis. The QC samples employed at Quanterra® as part of routine sample analysis are summarized in Section 8.4 of this document. Table 8.6-1 shows the precision and accuracy measurements employed by Quanterra®. Analytical method SOPs and Quanterra® Policy Number QA-003, "Quanterra® Quality Control Program", include information on requirements for the type of QC samples, frequencies, and acceptance criteria. Additionally, the SOPs and Policy describe the appropriate actions to be taken when a QC sample result does not meet acceptance criteria.

8.6.2 *Statistical Evaluation of Data*

In-house limits for all QC data must be evaluated at least annually and compared to the limits published in the methods for applicable matrices. Method limits will be employed until sufficient QC data are acquired. A minimum of 20 to 30 data points are recommended to establish the limits. QC limits are normally in-house limits unless they exceed method limits, which are then adopted. Calculated results of these QC samples are evaluated by comparing against control limits or creating control charts to spot trends. Facility-wide data are accumulated for evaluation and limit determination.

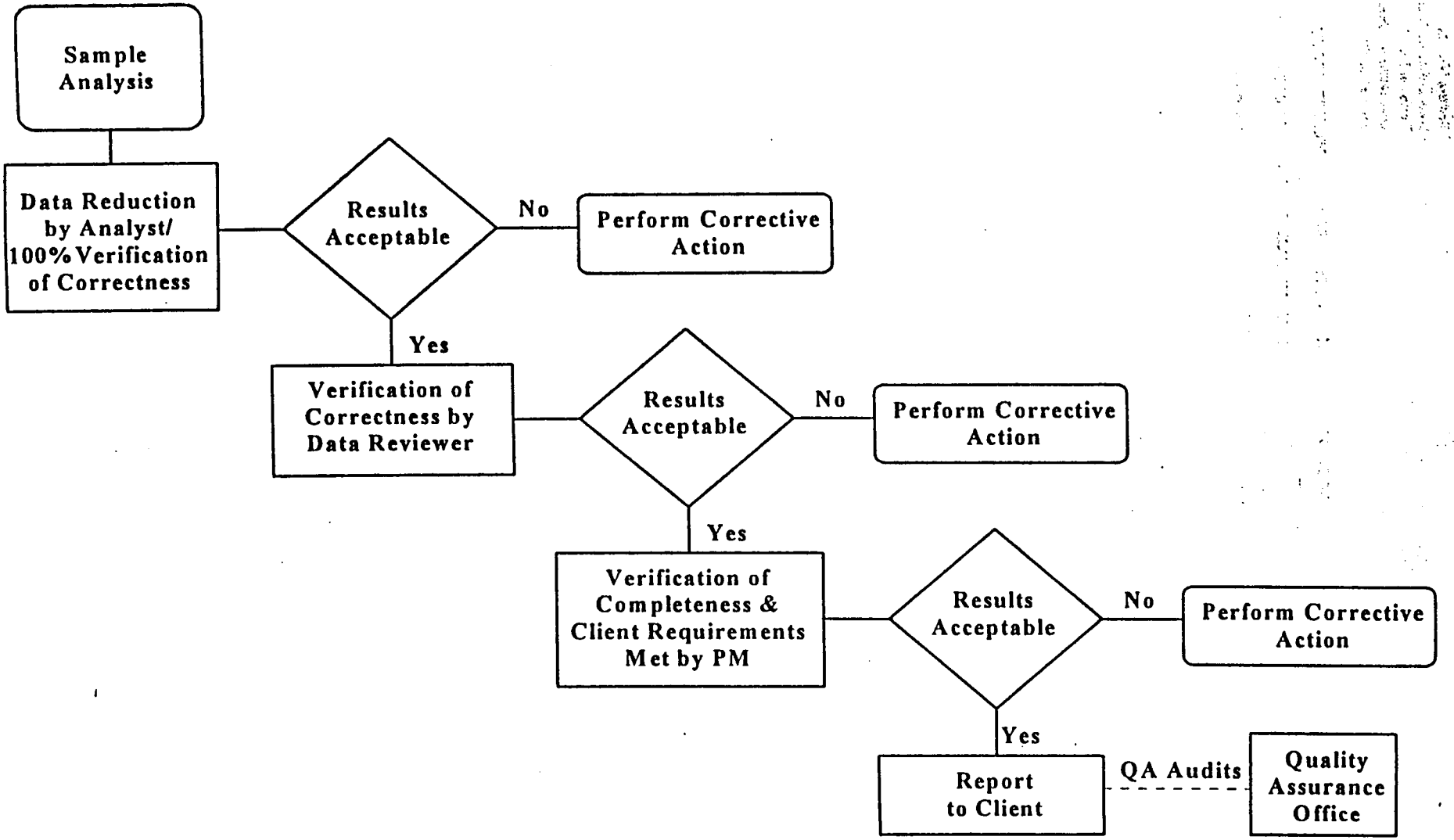
Program-specific data analysis requirements for control charts are followed as required for data generated under those programs. These additional requirements shall be documented in a QAPP or QAS. It is the responsibility of each analyst to update any client-required control charts or control tables as a part of routine data reduction.

Precision and accuracy measurements employed by Quanterra® are shown in Table 8.6-1. Calculated results of these QC samples are evaluated using control tables or control charts. Facility-wide data are accumulated in the laboratory LIMS and are accessed from the database for further evaluation and limit determination.

8.7 *Data Recording Procedures*

To ensure data integrity, all documentation of data and records generated or used during the process of data generation must be performed in compliance with Quanterra® Corporate SOP Number QA-008, "Data Recording Requirements".

FIGURE 8.8-1
Data Reduction, Verification, and Reporting



signed by the analyst. This review includes an evaluation of all items required in the raw data package. Any exceptions noted by the analyst must be reviewed. Included in this review is an assessment of the acceptability of the data with respect to:

- Adherence of the procedure used to the requested analytical method SOP
- Correct interpretation of chromatograms, mass spectra, etc.
- Correctness of numerical input when computer programs are used (checked randomly)
- Correct identification and quantitation of constituents with appropriate qualifiers
- Numerical correctness of calculations and formulas (checked randomly)
- Acceptability of QC data
- Documentation that instruments were operating according to method specifications (calibrations, performance checks, etc.)
- Documentation of dilution factors, standard concentrations, etc.
- Sample holding time assessment.

This review also serves as verification that the process the analyst has followed is correct in regard to the following:

- The analytical procedure follows the methods and specific instructions given on the project QAS or equivalent summary form
- Nonconforming events have been addressed by corrective action as defined on a nonconformance memo
- Valid interpretations have been made during the examination of the data and the review comments of the initial reviewer are correct
- The package contains all of the necessary documentation for data review and report production and results are reported in a manner consistent with the method used for preparation of data reports.

The specific items covered in the second stage of data verification may vary according to the analytical method, but this review of the data must be documented by signing the same checklist.

8.8.3 Completeness Verification

A third-level review is performed by the PM. This review is required before results are submitted to clients. This review serves to verify the completeness of the data report and to ensure that project requirements are met for the analyses performed. The items to be reviewed are:

- Analysis results are present for every sample in the analytical batch, reporting

be clearly identified as "Preliminary" results. The client must understand that the data have not undergone the required levels of review and may change.

8.9.3 Reporting Analytical Results

Sample results are reported according to analytical method SOPs or client specifications. Normally, the laboratory uses the Quanterra® Reporting Limit (RL) at which any analyte of interest detected at or above that level is reported as a positive value and any analyte of interest not detectable or detected below that level is reported as "not detected" at the RL. The laboratory will normally report results within the calibration, however, any reported results outside of the calibration range will be documented in the final report.

In some cases a contract, QAPP, or documented client request may require the laboratory to report sample results in a specified manner. Some examples are given below:

- The laboratory may be requested to report all analytes of interest that are less than the laboratory's RL but are greater than the MDL. This data will be flagged with an appropriate qualifier.
- The laboratory may be requested to report any tentatively identified compounds (TICs). This data will be flagged with an appropriate qualifier.
- The laboratory may be requested to report sample results using a RL that is higher than their normal level. In this case, only the analytes of interest found at or above that level would be reported as positive values. In this case, the laboratory will state the PSRL rather than the RL. All analytes of interest not detected or detectable below that level would be reported as "not detected" at the PSRL.

In these types of cases, the laboratory must include documentation in the project file that supports the reporting procedure employed.

It is the responsibility of the laboratory to provide for a reporting system that assures that any problems associated with an analysis are properly documented on a nonconformance memo, communicated to the appropriate Quanterra® associates, and addressed appropriately in the data report. If, after issuance of a report, Quanterra® observes any mistake that affects the results reported or the QC interpretation of those results, the client will be notified.

8.10 Data Validation

Data validation for Quanterra® refers to data reviews conducted in accordance with the USEPA CLP "Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses" and "Laboratory Data Validation

temperatures, waste disposal, and a source of stable power.

The maintenance and use of these facilities and proper operations are described in the Quanterra® Chemical Hygiene Plan (CHP). The Laboratory Manager, through a facilities maintenance staff, has responsibility for ensuring a properly maintained facility. The Laboratory Manager also has the responsibility for ensuring that samples are stored properly without contamination, work areas are equipped with adequate bench, hood and operational space, and the areas are free from chemical and radiological contamination that may affect analytical results.

8.11.3 Frequency of Maintenance

The frequency of maintenance must consider manufacturer's recommendations and previous experience. Schedules of preventive maintenance along with the recommended frequency are given in Tables 8.11-1 through 8.11-27 for analytical instrumentation and equipment. Frequency of maintenance for the facility systems is documented in the Quanterra® CHP.

8.12 Other Requirements

8.12.1 Water

High purity water (i.e., ASTM reagent grade or equivalent water) will be used in all metals, radiological, wet chemistry, and organic analyses. Proof of contaminant-free water is shown through the use of the reagent waters as method blanks which are analyzed on a daily basis for the analyte of interest. This water is obtained by the use of either a commercial ion-exchange deionizing, distillation, or reverse osmosis unit plus an appropriate polishing unit. The resulting water has a maximum conductivity of 1.0 umho-cm at 25°C or a minimum resistivity of 1.0 Mohm at 25°C. Conductivity and/or resistivity will be monitored and documented daily or on each day that water is dispensed for analytical use.

For volatile analyses the water may be further purified by purging with an inert gas before use to remove potential traces of organic solvents.

Water monitoring procedures used by Quanterra® operating units are detailed in operation-specific SOPs.

8.12.2 Compressed Air and Gases

Ultra high-purity compressed gases from preapproved vendors or in-house gas generators will be used when required for instrumentation. These air and gases must meet the requirements and specifications of the analytical methods performed. In-line filters

9.0 Quality Assessment and Response

9.1 Nonconformance and Corrective Action

9.1.1 Nonconformance

A nonconformance is an unplanned deviation from an established protocol or plan. The deviation may be the result of Quanterra's® actions, then termed a deficiency, or the result of events beyond the control of Quanterra®, then termed an anomaly.

9.1.2 Corrective Action

Corrective actions are measures taken to rectify conditions adverse to quality and, where possible, to prevent their reoccurrence. Corrective actions should be timely, determine the root cause, and evaluate any propagation of the error or problem. Whenever a systematic error is discovered that affects the accuracy or defensibility of results reported to Quanterra®'s clients, client notification will be part of the corrective action. Corrective actions should be implemented with an understanding of the technology and work activities associated with the quality element, with appropriate training of Quanterra® associates and vendors, and should be monitored for progress and success.

9.1.3 Responsibilities

The responsibilities associated with nonconformance and corrective action, as well as the procedures to be followed, are described in the Quanterra® Corporate SOP Number CORP-QA-0010, "Nonconformance and Corrective Action."

9.1.4 Nonconformance Memo

As defined in the SOP, deficiencies and anomalies for all activities other than sample log-in or matrix related incidents shall be documented on a nonconformance memo. A log or computerized data base will be maintained for all nonconformances determined to be deficiencies. Deficiencies will be examined for trends periodically, and this evaluation will be documented and reported to management. The original or copy of the nonconformance memo will be kept in the project files along with the data it refers to. The original form or a copy shall also be kept in the quality files.

9.2 Audits

Audits of Quanterra® laboratories are performed to assess the degree of adherence to policies, procedures, and standards. These assessments are conducted internally by Quanterra® personnel, who are independent of the area being evaluated, and externally by clients and regulatory agencies. Audits can

any problems detected regarding quotes, bids, and invoicing are brought to the attention of the PM and to the finance/accounting department, as appropriate.

The results of each performance audit shall be reported to laboratory management. All performance audit results which are identified as unacceptable must be investigated. The findings of the investigation and corrective action taken must be documented.

9.2.2 *Systems Audits*

A systems audit assesses fulfillment of the QAMP and the state of the QMS. Each laboratory undergoes numerous systems audits performed by external parties, including certifying agencies and clients.

9.2.2.1 *Internal Systems Audits or Evaluations*

An annual systems evaluation will be performed under the direction of the Corporate Director of Quality Assurance and according to Corporate SOP Number, CORP-QA-0014. This evaluation is performed to assess each laboratory's adherence to the requirements of the QAMP, SOPs, internal policies, and to assess the status of corrective actions from other audits at that facility.

The Corporate Director of Quality Assurance shall appoint a lead auditor to conduct the systems evaluation. A corporate audit outline shall be used. The lead auditor has the authority to lengthen the evaluation, revise the scope of the evaluation, stop work, or specify an accelerated schedule for re-evaluation. The lead auditor shall be responsible for preparing a report detailing the results of the evaluation. The report shall be submitted to the audited Laboratory Manager, Regional General Manager, and Laboratory QA Manager within five weeks of the audit. A copy of the report shall be distributed to the Corporate QA Director. The audit report shall provide a summary of the audit results with the auditor's comments and the findings that were determined by the lead auditor.

The evaluated laboratory must respond in writing within four weeks of receiving the evaluation report. The QA Manager is responsible for coordinating the response to the evaluation report. The Laboratory Manager must approve all responses to internal evaluation reports prior to submittal to the auditor.

The evaluation may result in findings, areas needing improvement, and notable practices. Each term will be defined as such:

- Findings - are defined as those noncompliant practices or policies which have significant adverse impact on data quality, technical defensibility, or

manager of the closure of all deficiencies from the audit.

9.2.3 Data Audits

Data audits are routinely performed and documented to ensure that project records meet project requirements as described in method SOPs, project plans, or other documented requirements. The data audit is used to identify any lab errors that may have occurred. The laboratory QA Manager or designee is responsible for performing data audits as specified in Quanterra® SOP Number CORP-QA-0004, "QA Data Review".

9.2.4 Spot Assessments

Spot assessments are conducted to monitor or observe a process or activity in order to verify conformance to the SOP requirements for that activity. The frequency, normally monthly, for performing these assessments is determined by the facility QA Manager. The scope of the assessment is also determined by the QA Manager and may be directed based on information obtained from client inquiries, trends in recorded nonconformances, performance audits, or other sources. A spot assessment may be used to assess a procedure performance relative to the documented SOP. This assessment identifies deviations from requirements that may not be detected in a detailed review of the data package alone. Such an assessment is conducted by observation of the associates performing the task compared with the documented SOP. In some cases, the assessment may be conducted through interviews with the associate when observation of a task is not possible. Review of relevant documentation for the completed procedure is included in such an assessment. A checklist may be used in conducting the assessment. The results of the assessment are documented, as are the corrective actions. All deficiencies noted as a result of a spot assessment must be corrected by the responsible staff in a timely manner.

9.3 Client Inquiries and Complaints

Client inquiries are generally received through the PM or a member of the CST. Typically, the PM communicates with the client to determine the details of the inquiries, including technical data problems, deliverable issues, turn-around-time problems, etc. Technical and deliverable issues are coordinated by the PM and usually involve input from operations, QA, and management staff. A formal written response to the client is coordinated by the PM, but may on occasion be delivered by the CSM or the Account Manager.

9.4 Quality Reports to Management

The QA Manager and Corporate Director of

10.0 Quality Improvement

Quality improvement at Quanterra® is a critical element of our quality strategy as well as our business strategy. Quanterra® will become a world class organization through a commitment to continuous quality improvement. Every Quanterra® associate must understand that continuous improvement is a guiding principle pertinent to all aspects of our business.

The key elements of quality improvement are:

- Standardization of procedures
- Continuous quality improvement
- Benchmarking
- Quality assessment
- Understanding the clients' needs
- Quality measures and standards.

10.1 Standardization of Procedures

Due to the vast number of methods that have been introduced into the environmental analytical field, as well as revisions and proposed updates to currently promulgated methods, many methodologies contain conflicting requirements. It is through the generation and use of standard operating procedures, which contain Quanterra®'s best technical interpretation of published methods, that Quanterra® succeeds in providing quality standardized analytical testing to our clients. This standardization is achieved through the implementation of standardized or corporate SOPs and policies. Quanterra® will generate and implement new SOPs and policies as the need arises, and will train associates in their importance and use.

The standardization of procedures, as they are implemented throughout Quanterra®, result in improved quality of our services and deliverables provided to our clients at some level at all operations.

10.2 Continuous Quality Improvement

The continuous improvement of processes throughout Quanterra® is the responsibility of each Quanterra® associate. Processes are followed in every operating unit, group, and by each individual, and each of these processes is applicable to this discussion. All associates are empowered and encouraged to bring suggestions for process improvement changes to the attention of laboratory management, as well as the

programs, processes, or projects, as appropriate.

KRIs measure performance in areas considered critical to achieving world class Quality in customer satisfaction and business performance. KRIs focus quality measures on the customer as well as the processes that our customers value. KRIs are intended to demonstrate continuous improvement and focus on the "vital few" issues for the business. Quanterra® KRIs include:

- On-time delivery
- Holding time violations
- Reissued reports
- Turn-around-time
- Safety.

Measurements of performance include internal and external audits, performance evaluations, and double-blind evaluations which are further described in Section 9.0. Improved results from these measurements show successfulness of process improvements.

Tables

Quanterra®
Quality Assurance Management Plan

Table Section

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TABLE 2.3-1

Quanterra® Quality Assurance Management Plan Requirements Matrix

EPA QA/R-2	Quanterra QAMP (Rev 2)	ANSI/ASQC E4-1994	NQA-1[1]	5700.6C[2]	ANSI N 13.30	ANSI/ASQC Q2-1991[3]
1 Management and Organization	1.0 Management Commitment and Organization	2.1 Management and Organization	1 Organization	9.a. General	1.1 Introduction 1.2 Purpose 1.3 Scope	5.0 Management Responsibility
2 Quality System and Description	2.0 Quality System and Description	2.2 Quality System and Description	2 Quality Assurance Program	1 Program	2.1 Special Word Usage 2.2 Specific Terms 5.1 Quality Assurance 5.2 Quality Control	5.2 Quality System
3 Personnel Qualification and Training	3.0 Associate Qualification and Training	2.3 Personnel Training and Qualification	2 Quality Assurance Program	2 Personnel Training and Qualification	3.2 Personnel Preparation	14.0 Personnel
4 Procurement of Items and Services	4.0 Procurement of Items and Services	2.4 Procurement of Items and Services	4 Procurement Document Control 7 Control of Purchased Items and Services	7 Procurement	N/A	7.0 Quality in Procurement 13.0 Subcontracting
5 Documentation and Records	5.0 Documentation and Records	2.5 Documents and Records	6 Document Control 17 Quality Assurance Records	4 Documents and Records	3.6 Direct Bioassay-Record Retention 4.5 Indirect Bioassay-Record Retention	8.4 Quality Documentation and Records
6 Computer Hardware and Software	6.0 Computer Hardware and Software	2.6 Computer Hardware and Software	3 Design Control 11 Test Control	N/A	N/A	ISO 9000-3[4]

TABLE 2.3-1
Quanterra® Quality Assurance Management Plan Requirements Matrix
(Continued)

EPA QA/R-2	Quanterra QAMP (Rev 2)	ANSI/ASQC E4-1994	NQA-1[1]	5700.6C[2]	ANSI N 13.30	ANSI/ASQC Q2-1991[3]
8 Implementation of Work Processes (Continued)		3.2 Design of Data Collection Operations	10 Inspection 12 Control of Measuring and Test Equipment 14 Inspection, Test, and Operating Status	8 Inspection and Acceptance Testing		
9 Assessment and Response[5]	9.0 Quality Assessment and Response	2.9 Assessment and Response 3.4 Assessment and Response 3.5 Assessment and Verification of Data Usability	2 Quality Assurance Program 13 Handling, Storage, and Shipping 15 Control of Non-conforming Items 16 Corrective Action 18 Audits	9 Management Assessment 10 Independent Assessment	3.3 Direct Bioassay-Interpretation of Measurements 3.5 Direct Bioassay-Reporting Results 4.4 Indirect Bioassay-Reporting Results 6.1 Direct Bioassay Measurements 6.2 Indirect Bioassay Measurements	16.0 Nonconformity 17.0 Corrective Action 18.0 Auditing the Quality System
9 Quality Improvement[5]	10.0 Quality Improvement	2.10 Quality Improvement	N/A	3 Quality Improvement	N/A	N/A

TABLE 4.2-1
List of Quanterra® Quality-Related Items that Require Evaluation Prior to Use

Quality-Related Item	Standard Operating Procedure for Quality Testing
Acetone	CORP-QA-0001
Dichloromethane	CORP-QA-0001
Hexane	CORP-QA-0001
Hydrochloric acid	CORP-QA-0001
Freon	CORP-QA-0001
Methanol	CORP-QA-0001
Nitric acid	CORP-QA-0001
Sulfuric acid	CORP-QA-0001
Toluene	CORP-QA-0001

TABLE 5.2-1
Quanterra® Quality Document Review Requirements

Document Type	Frequency of Review	Responsible Party
Quality Assurance Management Plan (QAMP)	Every Two Years	Corporate Director of Quality Assurance
Quality Assurance Management Plan (QAMP) Facility Appendix	Annual	Quality Assurance Manager
Corporate Standard Operating Procedures (SOP)	Every Two Years	Corporate Technology/QA
Operation-Specific Standard Operating Procedures (SOP)	Every Two Years	Laboratory Staff
Quality Policy Documents	Every Two Years	Corporate Director of Quality Assurance

TABLE 8.2-1
Analytical Methods Routinely Performed by Quanterra®
(Continued)

Method Number	Approved by[1]	Version Number	Version Date[2]	Source/Document Number[3]	Method Title
200.7	NPDES	N/A	December 1982	MCAWW	"Inductively Coupled Plasma-Atomic Emission Spectrometric Method for Trace Element Analysis of Water and Wastes"
200.8	USEPA	4.4	May 1994	EPA/600/R-94/111	"Determination of Trace Metals in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry"
202.1	NPDES	N/A	1978	MCAWW	"Aluminum" (Atomic Absorption, direct aspiration)
202.2	NPDES	N/A	1978	MCAWW	"Aluminum" (Atomic Absorption, furnace technique)
204.1	NPDES	N/A	1978	MCAWW	"Antimony" (Atomic Absorption, direct aspiration)
204.2	NPDES	N/A	1978	MCAWW	"Antimony" (Atomic Absorption furnace technique)
206.2	NPDES	N/A	1978	MCAWW	"Arsenic" (Atomic Absorption furnace technique)
206.3	NPDES	N/A	1974	MCAWW	"Arsenic" (Atomic Absorption-gaseous hydride)
206.4	NPDES	N/A	1974	MCAWW	"Arsenic" (Spectrophotometric-SDDC)
206.5	NPDES	N/A	1978	MCAWW	"Arsenic" (Sample Digestion Prior to Total Arsenic Analysis by Silver Diethyldithiocarbamate or Hydride Procedures)
208.1	NPDES	N/A	1974	MCAWW	"Barium" (Atomic Absorption, direct aspiration)
208.2	NPDES	N/A	1978	MCAWW	"Barium" (Atomic Absorption furnace technique)
210.1	NPDES	N/A	1974	MCAWW	"Beryllium" (Atomic Absorption, direct aspiration)
210.2	NPDES	N/A	1978	MCAWW	"Beryllium" (Atomic Absorption furnace technique)
212.3	NPDES	N/A	1974	MCAWW	"Boron" (Colorimetric, Curcumin)
213.1	NPDES	N/A	1974	MCAWW	"Cadmium" (Atomic Absorption, direct aspiration)
213.2	NPDES	N/A	1978	MCAWW	"Cadmium" (Atomic Absorption furnace technique)
215.1	NPDES	N/A	1971	MCAWW	"Calcium" (Atomic Absorption, direct aspiration)
215.2	NPDES	N/A	1978	MCAWW	"Calcium" (Titrimetric, EDTA)
218.1	NPDES	N/A	1978	MCAWW	"Chromium" (Atomic Absorption, direct aspiration)
218.2	NPDES	N/A	1978	MCAWW	"Chromium" (Atomic Absorption, direct aspiration)
218.3	NPDES	N/A	1978	MCAWW	"Chromium" (Atomic Absorption, chelation-extraction)
218.4	NPDES	N/A	1978	MCAWW	"Chromium, Hexavalent" (Atomic Absorption, chelation-extraction)
218.5	NPDES	N/A	December 1982	MCAWW	"Chromium, Dissolved Hexavalent" (Atomic Absorption, Furnace Technique
219.1	NPDES	N/A	1978	MCAWW	"Cobalt" (Atomic Absorption, direct aspiration)
219.2	NPDES	N/A	1978	MCAWW	"Cobalt" (Atomic Absorption furnace technique)
220.1	NPDES	N/A	1978	MCAWW	"Copper" (Atomic Absorption, direct aspiration)
220.2	NPDES	N/A	1978	MCAWW	"Copper" (Atomic Absorption furnace technique)

TABLE 8.2-1
Analytical Methods Routinely Performed by Quanterra®
(Continued)

Method Number	Approved by[1]	Version Number	Version Date[2]	Source/Document Number[3]	Method Title
270.2	NPDES	N/A	1978	MCAWW	"Selenium" (Atomic Absorption furnace technique)
270.3	NPDES	N/A	1974	MCAWW	"Selenium" (Atomic Absorption, gaseous hydride)
272.1	NPDES	N/A	1978	MCAWW	"Silver" (Atomic Absorption, direct aspiration)
272.2	NPDES	N/A	1978	MCAWW	"Silver" (Atomic Absorption furnace technique)
273.1	NPDES	N/A	1974	MCAWW	"Sodium" (Atomic Absorption, direct aspiration)
273.2	NPDES	N/A	December 1982	MCAWW	"Sodium" (Atomic Absorption, furnace technique)
279.1	NPDES	N/A	1978	MCAWW	"Thallium" (Atomic Absorption, direct aspiration)
279.2	NPDES	N/A	1978	MCAWW	"Thallium" (Atomic Absorption, furnace technique)
282.1	NPDES	N/A	1978	MCAWW	"Tin" (Atomic Absorption, direct aspiration)
282.2	NPDES	N/A	1978	MCAWW	"Tin" (Atomic Absorption, furnace technique)
283.1	NPDES	N/A	1974	MCAWW	"Titanium" (Atomic Absorption, direct aspiration)
283.2	NPDES	N/A	1978	MCAWW	"Titanium" (Atomic Absorption, furnace technique)
286.1	NPDES	N/A	1974	MCAWW	"Vanadium" (Atomic Absorption, direct aspiration)
286.2	NPDES	N/A	1978	MCAWW	"Vanadium" (Atomic Absorption, furnace technique)
289.1	NPDES	N/A	1974	MCAWW	"Zinc" (Atomic Absorption, direct aspiration)
289.2	NPDES	N/A	1978	MCAWW	"Zinc" (Atomic Absorption, furnace technique)
300.0	NPDES	2.1	August 1993	EPA-600/R-93/100	"Determination of Inorganic Anions by Ion Chromatography"
305.1	NPDES	N/A	1974	MCAWW	"Acidity"
310.1	NPDES	N/A	1978	MCAWW	"Alkalinity" (Titrimetric, pH 4.5)
320.1	NPDES	N/A	1974	MCAWW	"Bromide" (Titrimetric)
325.1	NPDES	N/A	1971	MCAWW	"Chloride" (Colorimetric, Automated Ferricyanide AAI)
325.2	NPDES	N/A	1978	MCAWW	"Chloride" (Colorimetric, Automated Ferricyanide AAII)
325.3	NPDES	N/A	1982	MCAWW	"Chloride" (Titrimetric, Mercuric Nitrate)
330.1	NPDES	N/A	1978	MCAWW	"Chlorine, Total Residual" (Titrimetric, Amperometric)
330.3	NPDES	N/A	1978	MCAWW	"Chlorine, Total Residual" (Titrimetric, Iodometric)
335.1	NPDES	1.0	August 1993	EPA-600/R-93/100	"Determination of Total Cyanide by Semi-Automated Colorimetry"
335.2	NPDES	N/A	1980	MCAWW	"Cyanide, Total" (Titrimetric; Spectrophotometric)
335.3	NPDES	N/A	1978	MCAWW	"Cyanide, Total" (Colorimetric, Automated UV)
340.2	NPDES	N/A	1974	MCAWW	"Fluoride" (Potentiometric, Ion Selective Electrode)
345.1	NPDES	N/A	1974	MCAWW	"Iodide" (Titrimetric)
350.1	NPDES	2.0	August 1993	EPA-600/R-93/100	"Determination of Ammonia Nitrogen by Semi-Automated Colorimetry"

TABLE 8.2-1
Analytical Methods Routinely Performed by Quanterra®
(Continued)

Method Number	Approved by[1]	Version Number	Version Date[2]	Source/Document Number[3]	Method Title
413.1	NPDES	N/A	1978	MCAWW	"Oil and Grease, Total, Recoverable" (Gravimetric, Separatory Funnel Extraction)
413.2	NPDES	N/A	1978	MCAWW	"Oil and Grease, Total Recoverable" (Spectrophotometric, Infrared)
415.1	NPDES	N/A	1974	MCAWW	"Organic Carbon, Total" (Combustion or Oxidation)
418.1	NPDES	N/A	1978	MCAWW	"Petroleum Hydrocarbons, Total Recoverable" (Spectrophotometric, Infrared)
420.1	NPDES	N/A	1978	MCAWW	"Phenolics, Total Recoverable" (Spectrophotometric, Manual 4-AAP with Distillation)
420.2	NPDES	N/A	1974	MCAWW	"Phenolics, Total Recoverable (Colorimetric, Automated 4-AAP with Distillation)
425.1	NPDES	N/A	1971	MCAWW	"Methylene Blue Active Substances (MBAS)", (Colorimetric)
450.1	N/A	N/A	November 1980	EPA 600/4-81-056	"Total Organic Halide"
601	NPDES	N/A	October 8, 1991	40CFR Part 136 - Appendix A	"Purgeable Halocarbons"
602	NPDES	N/A	October 8, 1991	40CFR Part 136 - Appendix A	"Purgeable Aromatics"
603	NPDES	N/A	October 8, 1991	40CFR Part 136 - Appendix A	"Acrolein and Acrylonitrile"
608	NPDES	N/A	October 8, 1991	40CFR Part 136 - Appendix A	"Organochlorine Pesticides and PCBs"
610	NPDES	N/A	October 8, 1991	40CFR Part 136 - Appendix A	"Polynuclear Aromatic Hydrocarbons"
613	NPDES	N/A	October 8, 1991	40CFR Part 136 - Appendix A	"2,3,7,8-Tetrachlorodibenzo-p-Dioxin"
615	NPDES	N/A	October 8, 1991	40CFR Part 136 - Appendix A	"Chlorinated Herbicides"
624	NPDES	N/A	October 8, 1991	40CFR Part 136 - Appendix A	"Purgeables"
625	NPDES	N/A	October 8, 1991	40CFR Part 136 - Appendix A	"Base/Neutrals and Acids"
900.0	USEPA	N/A	August 1980	EPA/600/4-80-032	"Gross Alpha and Gross Beta Radioactivity in Drinking Water"
901.1	USEPA	N/A	August 1980	EPA/600/4-80-032	"Gamma Emitting Radionuclides in Drinking Water"
903.0	USEPA	N/A	August 1980	EPA/600/4-80-032	"Alpha-Emitting Radium Isotopes in Drinking Water"
903.1	USEPA	N/A	August 1980	EPA/600/4-80-032	"Radium in Drinking Water - Radium Emanation Technique"
904.0	USEPA	N/A	August 1980	EPA/600/4-80-032	"Radium-228 in Drinking Water"
905.0	USEPA	N/A	August 1980	EPA/600/4-80-032	"Radioactive Strontium in Drinking Water"
906.0	USEPA	N/A	August 1980	EPA/600/4-80-032	"Tritium in Drinking Water"
1010	RCRA	0	September 1986	SW-846	"Pensky-Martens Closed-Cup Method for Determining Ignitability"
1020A	RCRA	1	July 1992	SW-846	"Setaflash Closed-Cup Method for Determining Ignitability"
1311	RCRA	0	July 1992	SW-846	"Toxicity Characteristic Leaching Procedure"
1312	RCRA	0	September 1994	SW-846	"Synthetic Precipitation Leaching Procedure"

TABLE 8.2-1
Analytical Methods Routinely Performed by Quanterra®
(Continued)

Method Number	Approved by[1]	Version Number	Version Date[2]	Source/Document Number[3]	Method Title
4500-CN E	NPDES	N/A	1992	Standard Methods	"Cyanide, Colorimetric Method"
5030A	RCRA	1	July 1992	SW-846	"Purge-and-Trap"
5320B	APHA, AWWA, and WEF	N/A	1988	Standard Methods	"Dissolved Organic Halogen, Adsorption-Pyrolysis-Titrimetric Method"
6010A	RCRA	1	July 1992	SW-846	"Inductively Coupled Plasma-Atomic Emission Spectroscopy"
6020	RCRA	0	September 1994	SW-846	"Inductively Coupled Plasma"
7020	RCRA	0	September 1986	SW-846	"Aluminum (Atomic Absorption, Direct Aspiration)"
7040	RCRA	0	September 1986	SW-846	"Antimony (Atomic Absorption, Direct Aspiration)"
7041	RCRA	0	September 1986	SW-846	"Antimony (Atomic Absorption, Furnace Technique)"
7060A	RCRA	1	September 1994	SW-846	"Arsenic (Atomic Absorption, Furnace Technique)"
7061A	RCRA	1	July 1992	SW-846	"Arsenic (Atomic Absorption, Gaseous Hydride)"
7062	RCRA	1	September 1994	SW-846	"Antimony and Arsenic (Atomic Absorption, Borohydride Reduction)"
7080A	RCRA	1	September 1994	SW-846	"Barium (Atomic Absorption, Direct Aspiration)"
7090	RCRA	0	September 1986	SW-846	"Beryllium (Atomic Absorption, Direct Aspiration)"
7091	RCRA	0	September 1986	SW-846	"Beryllium (Atomic Absorption, Furnace Technique)"
7110	APHA, AWWA, and WEF	N/A	1991	Standard Methods	"Gross Alpha and Gross Beta Radioactivity (Total, Suspended, and Dissolved)"
7130	RCRA	0	September 1986	SW-846	"Cadmium (Atomic Absorption, Direct Aspiration)"
7131A	RCRA	1	September 1994	SW-846	"Cadmium (Atomic Absorption, Furnace Technique)"
7140	RCRA	0	September 1986	SW-846	"Calcium (Atomic Absorption, Direct Aspiration)"
7190	RCRA	0	September 1986	SW-846	"Chromium (Atomic Absorption, Direct Aspiration)"
7191	RCRA	0	September 1986	SW-846	"Chromium (Atomic Absorption, Furnace Technique)"
7195	RCRA	0	September 1986	SW-846	"Chromium, Hexavalent (Coprecipitation)"
7196A	RCRA	1	July 1992	SW-846	"Chromium, Hexavalent (Colorimetric)"
7197	RCRA	0	September 1986	SW-846	"Chromium, Hexavalent (Chelation/Extraction)"
7198	RCRA	0	September 1986	SW-846	"Chromium, Hexavalent (Differential Pulse Polarography)"
7200	RCRA	0	September 1986	SW-846	"Cobalt (Atomic Absorption, Direct Aspiration)"
7201	RCRA	0	September 1986	SW-846	"Cobalt (Atomic Absorption, Furnace Technique)"
7210	RCRA	0	September 1986	SW-846	"Copper (Atomic Absorption, Direct Aspiration)"
7211	RCRA	0	July 1992	SW-846	"Copper (Atomic Absorption, Furnace Technique)"

TABLE 8.2-1
Analytical Methods Routinely Performed by Quanterra®
(Continued)

Method Number	Approved by[1]	Version Number	Version Date[2]	Source/Document Number[3]	Method Title
7951	RCRA	0	July 1992	SW-846	"Zinc (Atomic Absorption, Furnace Technique)"
8010B	RCRA	2	September 1994	SW-846	"Halogenated Volatile Organics by Gas Chromatography"
8020A	RCRA	1	September 1994	SW-846	"Aromatic Volatile Organics by Gas Chromatography"
8021A	RCRA	1	September 1994	SW-846	"Halogenated Volatiles by Gas Chromatography Using Photoionization and Electrolytic Conductivity Detectors in Series: Capillary Column Technique"
8030A	RCRA	1	July 1992	SW-846	"Acrolein and Acrylonitrile by Gas Chromatography"
8080A	RCRA	1	September 1994	SW-846	"Organochlorine Pesticides and Polychlorinated Biphenyls by Gas Chromatography"
8100	RCRA	0	September 1986	SW-846	"Polynuclear Aromatic Hydrocarbons"
8140	RCRA	0	September 1986	SW-846	"Organophosphorus Pesticides"
8141A	RCRA	1	September 1994	SW-846	"Organophosphorus Compounds by Gas Chromatography: Capillary Column Technique"
8150B	RCRA	2	September 1994	SW-846	"Chlorinated Herbicides by Gas Chromatography"
8240B	RCRA	2	September 1994	SW-846	"Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)"
8260A	RCRA	1	September 1994	SW-846	"Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS): Capillary Column Technique"
8270B	RCRA	2	September 1994	SW-846	"Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS): Capillary Column Technique"
8280	RCRA	0	September 1986	SW-846	"The Analysis of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans"
8290	RCRA	0	September 1994	SW-846	"Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)"
8310	RCRA	0	September 1986	SW-846	"Polynuclear Aromatic Hydrocarbons"
8330	RCRA	0	September 1994	SW-846	"Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC)"
9010A	RCRA	1	July 1992	SW-846	"Total and Amenable Cyanide"
9012	RCRA	0	September 1986	SW-846	"Total and Amenable Cyanide (Colorimetric, Automated UV)"
9020B	RCRA	2	September 1994	SW-846	"Total Organic Halides (TOX)"
9030A	RCRA	1	July 1992	SW-846	"Acid-Soluble and Acid-Insoluble Sulfides"

TABLE 8.2-1
Analytical Methods Routinely Performed by Quanterra®
(Continued)

[2] For the NPDES methods, the date listed is the date the method was issued if no revisions were made. If a technical or editorial revision was made, the latest of those dates is listed here.

[3] The following table provides full source references:

Source	Source Reference
40CFR Part 136 - Appendix A	40CFR Part 136 - "Guidelines Establishing Test Procedures for the Analysis of Pollutants , Appendix A: "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater", Code of Federal Regulations, Revised July 1, 1995.
ASTM	1993 Annual Book of ASTM Standards, Section 11, Water and Environmental Technology, Volume 11.02, Water (II).
EPA-600/4-84-041	"Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air", Document No.: EPA-600/4-84-041, Environmental Monitoring System Laboratory, Office of Research and Development, United States Environmental Protection Agency, Research Triangle Park, North Carolina 27711, April 1984.
EPA-821-B-94-004b	Proposed Method 1664: "N-Hexane Extractable Material (HEM) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM) by Extraction and Gravimetry (Oil and Grease Total Petroleum Hydrocarbons)", Document No.: EPA-821-B-94-004b, Office of Water, Engineering and Analysis Division, Washington, D.C., 20460, April 1995. (This method has not been promulgated by the EPA).
EPA/600/4-80-032	"Prescribed Procedures for Measurement of Radioactivity in Drinking Water", Document No.: EPA/600/4-80-032, EMSL, Cincinnati, OH 45268, August 1980.
EPA/600/R-93/100	"Methods for the Determination of Inorganic Substances in Environmental Samples", Document Number EPA/600/R-93/100. Office of Research and Development, Washington, D.C. 20460, August 1993.
EPA/600/R-94/111	"Methods for the Determination of Metals in Environmental Samples", Supplement I, EMSL-CI, May 1994.
MCAWW	Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Revised March 1983, United States Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 45268.
Standard Methods	Standard Methods for the Examination of Water and Wastewater, 18th Edition, 1992. Prepared and published jointly by: APHA, AWWA, and WEF.
SW-846	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, (SW-846), Third Edition, September 1986. Contains Final Update I (July 1992), Final Update IIA (August 1993), Final Update II (September 1994), and Final Update IIB (January 1995). United States Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC 20460.
USEPA CLP (DFLM01.1)	United States Environmental Protection Agency, Statement of Work for Analysis of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans (PCDF).
USEPA CLP (ILM01.8)	United States Environmental Protection Agency, Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration, Document Number OLM01.0 (including revisions OLM01.1 (December 1990), OLM01.2 (January 1991), OLM01.3 (February 1991), OLM01.4 (March 1991), OLM01.5 (April 1991), OLM01.6 (June 1991), OLM01.7 (July 1991), and OLM01.8 (August 1991).
USEPA CLP (ILM03.0)	United States Environmental Protection Agency, Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration, Document Number ILM03.0.
USEPA CLP (OLM03.0)	United States Environmental Protection Agency, Statement of Work for Organics Analysis, Document Number OLM03.0.

[4] This is an SW-846 Proposed Update III method and has not been promulgated. Proposed Update III was released for public comment January 1995.

TABLE 8.4-2
Laboratory Quality Control Samples

Type	Frequency	Applicability		Accuracy and Precision Application	Introduced By
		Inorganic/ Radiochemical	Organic		
Analytical Spike	As specified in methods, or as needed	Yes	No	Accuracy	Analyst/ Prep
Duplicate	1 out of 20 or at least 1/month/run	Yes	Yes	Precision	Analyst/ Prep
Instrument Blank	As specified methods, or as needed	Yes	Yes	Accuracy	Analyst
Interference Check Sample	As specified in methods	Yes	No	Accuracy	Analyst
Internal Standard	Each sample and standard	Yes	Yes	Both	Analyst/ Prep
Laboratory Control Sample	1 per each group of samples processed up to 20 samples.	Yes	Yes	Accuracy	Analyst/ Prep
Matrix Spike	1 per each group of samples processed up to 20 samples.	Yes	Yes	Accuracy	Analyst/ Prep
Matrix Spike Duplicate	1 per each group of samples processed up to 20 samples.	Yes	Yes	Both	Analyst/ Prep
Method Blank	1 per each group of samples processed up to 20 samples.	Yes	Yes	Accuracy	Analyst/ Prep
Surrogate	All standards, method blanks, LCS, and samples.	No	Yes Method Dependent	Accuracy	Analyst/ Prep
Yield Monitor	Operation-specific	Yes	No	Accuracy	Prep

TABLE 8.4-4
Matrix Specific Quality Control Samples

Quality Control Sample	Purpose
Duplicate Samples	Estimates the ability of the laboratory to obtain precise measurements on a sample. This measure is dependent on the homogeneity of the sample being duplicated. Solid samples often portray poor sample homogeneity and therefore often have poor duplication with regards to the sample result.
Matrix Spike Sample	Estimates the ability of the laboratory to obtain accurate measurements on a sample. The measure is dependent on the bias a sample matrix may cause regarding a given analyte.
Matrix Spike Duplicate Sample	In addition to verifying the accuracy of the matrix spike sample, the matrix spike duplicate can be used with the matrix spike sample as a measure of precision by calculating the relative percent difference (RPD).

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Alkalinity	Method Blank	310.1 2320B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	Not Applicable
	Laboratory Control Sample	310.1 2320B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	Not Applicable
	Matrix Spike	310.1 2320B	Not Applicable	—	Not Applicable
	Matrix Spike Duplicate	310.1 2320B	Not Applicable	—	Not Applicable
	Duplicate	310.1 2320B	Frequency: 1 per batch of 10 samples Criteria 310.1: ≤ 20 % RPD[3] Criteria 2320B: ≤ 25 % RPD[3] Corrective Action: Flag data outside of limit.	—	Not Applicable

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Ammonia (TKN)	Method Blank	351.2 351.3	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	Not Applicable
	Laboratory Control Sample	351.2 351.3	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	Not Applicable
	Matrix Spike	351.2 351.3	Frequency: 1 per 10 samples, minimum of one per batch of samples processed Criteria: Must be within laboratory control limits Corrective Action: Flag data outside of limit	—	Not Applicable
	Matrix Spike Duplicate	351.2 351.3	Not Applicable	—	Not Applicable
	Duplicate	351.2 351.3	Not Applicable	—	Not Applicable

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Bromide	Method Blank	300.0[6] 320.1 D1246	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9056	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	300.0[6] 320.1 D1246	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within control limits, rerun all associated samples	9056	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within control limits, rerun all associated samples
	Matrix Spike	300.0[6] 320.1 D1246	Frequency: 1 per 10 samples, minimum of one per batch of samples processed Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	9056	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data associated with MS outside of limit
	Matrix Spike Duplicate	300.0[6] 320.1 D1246	Not Applicable	9056	Not Applicable
	Duplicate	300.0[6] 320.1 D1246	Methods 300.0, 320.1: Not Applicable Frequency: Method D1246: 1 with each batch of samples processed not to exceed 20 samples	9056	Frequency: 1 with each batch of samples processed Criteria: RPD[3] must be within laboratory control limits Corrective Action: Flag data associated with duplicates outside of laboratory RPD[3] limits

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Chloride	Method Blank	300.0[6] 325.1 325.2 325.3 4500-Cl E	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9056 9251 9252A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	300.0[6] 325.1 325.2 325.3 4500-Cl E	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within control limits, rerun all associated samples	9056 9251 9252A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples
	Matrix Spike	300.0[6] 325.1 325.2 325.3 4500-Cl E	Frequency: 1 per 10 samples, minimum of one per batch of samples processed Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	9056 9251 9252A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Methods 9251/9252 Corrective Action: If not within laboratory control limits, rerun all associated samples Method 9056 Corrective Action: Flag data associated with MS outside of limits

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Chlorine, Residual (continued)	Laboratory Control Sample	330.3	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	Not Applicable
	Matrix Spike	330.1 330.3	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Must be within laboratory control limits Corrective Action: Flag data outside of limit	—	Not Applicable
	Matrix Spike Duplicate	330.1 330.3	Not Applicable	—	Not Applicable
	Duplicate	330.1 330.3	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: ≤ 20 % RPD[3] Corrective Action: Flag data outside of limit.	—	Water

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Chromium (Cr^{+6}) (continued)	Duplicate	218.4 3500 Cr-D	Not Applicable	3060A[5] 7196A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: ≤ 20 % RPD[3] limit Corrective Action: Flag data outside of limit.
Color	Method Blank	110.2	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	Not Applicable
	Laboratory Control Sample	110.2	Not Applicable	—	Not Applicable
	Matrix Spike	110.2	Not Applicable	—	Not Applicable
	Matrix Spike Duplicate	110.2	Not Applicable	—	Not Applicable
	Duplicate	110.2	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: ≤ 20 % RPD[3] Corrective Action: Flag data outside of limit.	—	Not Applicable
Conductivity	Method Blank	120.1	Not Applicable	9050	Not Applicable

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Cyanide (Amenable) (continued)	Laboratory Control Sample	335.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	9010A 9012	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Rerun all samples associated with unacceptable LCS
	Matrix Spike	335.1	Frequency: 1 per 10 samples, minimum of one per batch of samples processed Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	9010A 9012	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Advisory limits are 75% - 125% recovery Corrective Action: Flag data associated with unacceptable Matrix Spike
	Matrix Spike Duplicate	335.1	Not Applicable	9010A 9012	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Advisory limits are 75% - 125% recovery Corrective Action: Flag data associated with unacceptable Matrix Spike
	Duplicate	335.1	Not Applicable	9010A 9012	Not Applicable

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Cyanide (Total) (continued)	Matrix Spike Duplicate	335.2 335.3 4500-CN E	Not Applicable	9010A 9012	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Limit is 75% - 125% recovery Corrective Action: Flag data associated with unacceptable Matrix Spike
	Duplicate	335.2 335.3	Methods 335.2, 335.3: Not Applicable Method 4500-CN E: Frequecny: 1 with each batch of samples processed not to exceed 20 samples Criteria: ≤ 20 % RPD[3] Corrective Action: Flag data outside of limit.	9010A 9012	Not Applicable
Flashpoint	Method Blank	—	Not Applicable	1010 1020A	Not Applicable
	Laboratory Control Sample	—	Not Applicable	1010 1020A	Not Applicable
	Matrix Spike	—	Not Applicable	1010 1020A	Not Applicable
	Matrix Spike Duplicate	—	Not Applicable	1010 1020A	Not Applicable

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Fluoride (continued)	Matrix Spike	300.0[6] 340.2	Frequency: 1 per 10 samples by IC Criteria: Must be within laboratory QC limits Corrective Action: Flag data outside of limit	9056	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data associated with outside of limit
	Matrix Spike Duplicate	300.0[6] 340.2	Not Applicable	9056	Not Applicable
	Duplicate	300.0[6] 340.2	Not Applicable	9056	Frequency: 1 with each batch of samples processed Criteria: RPD[3] must be within laboratory control limits Corrective Action: Flag data associated with duplicates outside of laboratory RPD[3] limits
Hardness	Method Blank	130.2 2340B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	Not Applicable

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Iodide	Method Blank	345.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	Not Applicable
	Laboratory Control Sample	345.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	Not Applicable
	Matrix Spike	345.1	Frequency: 1 per batch of 20 samples Criteria: Must be within laboratory QC limits Corrective Action: Flag associated data outside of limit	—	Not Applicable
	Matrix Spike Duplicate	345.1	Not Applicable	—	Not Applicable
	Duplicate	345.1	Not Applicable	—	Not Applicable

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Iron (continued)	Duplicate	3500-Fe D	Frequency: 1 per batch of 20 samples Criteria: Must be within laboratory QC limits Corrective Action: Flag associated data outside of limit	—	Not Applicable
Methylene Blue Active Substances (MBAS)	Method Blank	425.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	Not Applicable
	Laboratory Control Sample	425.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	Not Applicable

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Nitrate (continued)	Matrix Spike	300.0[6] 352.1	Frequency: 1 per 10 samples, minimum of one per batch of samples processed Criteria: Must be within laboratory control limits Corrective Action: Flag data outside of limit	9056 9200	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, flag all associated samples
	Matrix Spike Duplicate	300.0[6] 352.1	Not Applicable	9056 9200	Method 9056: Not applicable Method 9200: Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery and RPD[3] must be within laboratory control limits Corrective Action: If not within laboratory control limits, flag all associated samples
	Duplicate	300.0[6] 352.1	Not Applicable	9056 9200	Method 9056: Frequency: 1 per 10 samples Criteria: RPD[3] must be within laboratory control limits Corrective Action: If not within laboratory control limits, flag all associated samples Method 9200: Not applicable

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Nitrite (continued)	Duplicate	300.0[6] 354.1	Not Applicable	9056	Frequency: 1 per 10 samples Criteria: RPD[3] must be within laboratory control limits Corrective Action: If not within laboratory control limits, flag all associated samples
Nitrate-Nitrite	Method Blank	353.1 353.2 353.3	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	Not Applicable
	Laboratory Control Sample	353.1 353.2 353.3	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	Not Applicable

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Odor (continued)	Duplicate	140.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: ≤ 20 % RPD[3] Corrective Action: Flag data outside of limit.	—	Not Applicable
pH	Method Blank	150.1 4500-H^+ B	Not Applicable	9040B 9045C	Not Applicable
	Laboratory Control Sample	150.1 4500-H^+ B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Sample provided by external source, must be within ± 0.05 pH units Corrective Action: If not within laboratory control limits, rerun all associated samples	9040B 9045C	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Sample provided by external source, must be within ± 0.05 pH units Corrective Action: If not within laboratory control limits, rerun all associated samples
	Matrix Spike	150.1 4500-H^+ B	Not Applicable	9040B 9045C	Not Applicable
	Matrix Spike Duplicate	150.1 4500-H^+ B	Not Applicable	9040B 9045C	Not Applicable

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Phenolics (continued)	Matrix Spike	420.1 420.2	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data associated with unacceptable Matrix Spike	9065 9066	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag associated data
	Matrix Spike Duplicate	420.1 420.2	Not Applicable	9065 9066	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag associated data
	Duplicate	420.1 420.2	Not Applicable	9065 9066	Not Applicable
Phosphate	Method Blank	---	Not Applicable	9056	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	---	Not Applicable	9056	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Phosphorus (Total and Ortho-phosphate) (continued)	Laboratory Control Sample	300.0[4,6] 365.1 365.2 365.3	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	Not Applicable
	Matrix Spike	300.0[4,6] 365.1 365.2 365.3	Frequency: 1 per 10 samples Criteria: Must be within laboratory QC limits Corrective Action: Flag data outside of limit	—	Not Applicable
	Matrix Spike Duplicate	300.0[4,6] 365.1 365.2 365.3	Not Applicable	—	Not Applicable
	Duplicate	300.0[4,6] 365.1 365.2 365.3	Not Applicable	—	Not Applicable
Reactivity (Cyanide and Sulfide)	Method Blank	—	Not Applicable	Chapter 7 Sections 7.3.3 and 7.3.4	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Silica, Dissolved (continued)	Laboratory Control Sample	370.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	Not Applicable
	Matrix Spike	370.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	—	Not Applicable
	Matrix Spike Duplicate	370.1	Not Applicable	—	Not Applicable
	Duplicate	370.1	Not Applicable	—	Not Applicable
Solids	Method Blank	160.1 160.2 160.3 160.4	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	Not Applicable

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Specific Conductance (continued)	Laboratory Control Sample	120.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	9050	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples
	Matrix Spike	120.1	Not Applicable	9050	Not Applicable
	Matrix Spike Duplicate	120.1	Not Applicable	9050	Not Applicable
	Duplicate	120.1	Frequency: 1 with each batch of 20 samples processed Criteria: RPD[3] must be within laboratory QC limits Corrective Action: Flag associated data if outside of limits	9038 9050	Frequency: 1 with each batch of 20 samples processed Criteria: RPD[3] must be within laboratory QC limits Corrective Action: Flag associated data if outside of limits
Sulfate	Method Blank	300.0[6] 375.1 375.4	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9038 9056	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Sulfate (continued)	Duplicate	300.0[6] 375.1 375.4	Not Applicable	9038 9056	Frequency: 1 with each batch of samples processed Criteria: RPD[3] must be within laboratory control limits Corrective Action: Flag data associated with duplicates outside of laboratory RPD[3] limits
Sulfide	Method Blank	376.1 376.2	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9030A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	376.1 376.2	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	9030A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag associated data

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Sulfite (continued)	Laboratory Control Sample	377.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	Not Applicable
	Matrix Spike	377.1	Frequency: 1 per 20 samples, minimum of one per batch of samples processed Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag data outside of limit	—	Not Applicable
	Matrix Spike Duplicate	377.1	Not Applicable	—	Not Applicable
	Duplicate	377.1	Not Applicable	—	Not Applicable
Temperature	Method Blank	170.1	Not Applicable	—	Not Applicable
	Laboratory Control Sample	170.1	Not Applicable	—	Not Applicable
	Matrix Spike	170.1	Not Applicable	—	Not Applicable
	Matrix Spike Duplicate	170.1	Not Applicable	—	Not Applicable
	Duplicate	170.1	Not Applicable	—	Not Applicable

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Total Organic Carbon (TOC) (continued)	Matrix Spike Duplicate	415.1	Not Applicable	9060	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Reanalyze if sample remaining. If not, flag data associated with unacceptable Matrix Spike Duplicate
	Duplicate	415.1	Not Applicable	9060	Not Applicable
Total Organic Halides (TOX)	Method Blank	SM 5320B [6] 450.1 [6]	Frequency: 1 with each set of 8 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	9020B	Frequency: Run in duplicate between each group of 8 analytical determinations Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	SM 5320B [6] 450.1 [6]	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery of analyte must be within laboratory control limits Corrective Action: Rerun all samples associated with unacceptable LCS (ICV)	9020B	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery of analyte must be within laboratory control limits Corrective Action: Rerun all samples associated with unacceptable LCS (ICV)

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Turbidity (continued)	Laboratory Control Sample	180.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: If not within laboratory control limits, rerun all associated samples	—	Not Applicable
	Matrix Spike	180.1	Not applicable	—	Not Applicable
	Matrix Spike Duplicate	180.1	Not Applicable	—	Not Applicable
	Duplicate	180.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Must be within laboratory QC limits Corrective Action: Flag data outside of limit Not Applicable.	—	Not Applicable
Water Content	Method Blank	—	Not Applicable	—	Not Applicable
	Laboratory Control Sample	—	Not Applicable	—	Not Applicable
	Matrix Spike	—	Not Applicable	—	Not Applicable

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
GFAA and Flame AA Metals, Mercury by CVAA (continued)	Matrix Spike	200 series	Frequency: with each batch of samples processed not to exceed 20 samples Criteria: Recovery must be within 80-120 % Corrective Action: Flag data associated with unacceptable MS. (See SOP for detailed corrective action procedure and for other QC procedures.)	7000 series	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Recovery must be within 80-120 % Corrective Action: Flag data associated with unacceptable MS. (See SOP for detailed corrective action procedure and for other QC procedures.)
	Matrix Spike Duplicate	200 series	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Recovery must be within 80-120 %, RPD[3] must be within 20 % Corrective Action: Flag data associated with unacceptable MSD	7000 series	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Recovery must be within 80-120 %, RPD[3] must be within 20 % Corrective Action: Flag data associated with unacceptable MSD
	Duplicate	200 series	Not Applicable	7000 series	Not Applicable
	Post Digestion Spikes	200 series	Post Digestion Spike is conducted on all samples	7000 series	Post Digestion Spike is conducted on all samples
ICP Metals	Method Blank	200.7	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	6010A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank

TABLE 8.4-5
Inorganic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
ICP Metals (continued)	Duplicate	200.7	Not Applicable	6010A	Not Applicable
	Serial Dilutions	200.7	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: 10 % Difference Corrective Action: Flag data associated with unacceptable Serial Dilution	6010A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: 10 % Difference Corrective Action: Flag data associated with unacceptable Serial Dilution
ICP/MS Metals	Method Blank	200.8	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	6020	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	200.8	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Recovery within laboratory control limits Corrective Action: Rerun all samples associated with unacceptable LCS	6020	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Recovery within laboratory control limits Corrective Action: Rerun all samples associated with unacceptable blank
	Matrix Spike	200.8	Frequency: 1 per 10 samples, minimum of one per batch of samples processed Criteria: Recovery within laboratory control limits Corrective Action: Qualify data "suspect/matrix"	6020	Not Applicable

TABLE 8.4-6
Organic Laboratory Quality Control Samples

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Aromatic Volatiles by GC	Method Blank	602	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	8020A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	602	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery must be within acceptance limits given in method for each analyte Corrective Action: Rerun all samples associated with unacceptable LCS	8020A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte must be within historical acceptance limits Corrective Action: Rerun all samples associated with unacceptable LCS
	Matrix Spike	602	Frequency: 1 per 10 samples from each site or 1 per month, whichever is more frequent Criteria: percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable Matrix Spike	8020A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte should be within acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike

TABLE 8.4-6
Organic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Acrolein & Acrylonitrile by GC	Method Blank	603	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	8030A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	603	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery must be within acceptance limits given in method for each analyte Corrective Action: Rerun all samples associated with unacceptable LCS	8030A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte must be within historical acceptance limits Corrective Action: Rerun all samples associated with unacceptable LCS
	Matrix Spike	603	Frequency: 1 per 10 samples from each site or 1 per month, whichever is more frequent Criteria: percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable Matrix Spike	8030A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte should be within acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike

TABLE 8.4-6
Organic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Dioxins/ Dibenzo-furans	Method Blank	613	Frequency: 1 per batch of ≤ 20 samples extracted Criteria: Concentration less than reporting limit Corrective Action: Rerun all positive samples associated with unacceptable blank	8280 8290	Frequency: 1 per batch of ≤ 20 samples extracted Criteria: Concentration less than reporting limit Corrective Action: Rerun all positive samples associated with unacceptable blank
	Laboratory Control Sample	613	Frequency: 1 per batch of ≤ 20 samples extracted Criteria: percent recovery must be within acceptance limits given in method for each analyte Corrective Action: Rerun all samples associated with unacceptable LCS	8280 8290	Frequency: 1 per batch of ≤ 20 samples extracted Criteria: percent recovery for each analyte must be within historical acceptance limits Corrective Action: Rerun all samples associated with unacceptable LCS
	Matrix Spike	613	Frequency: 1 per analytical batch of ≤ 20 samples Criteria: percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable Matrix Spike	8280 8290	Frequency: 1 per analytical batch of ≤ 20 samples Criteria: percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable Matrix Spike
	Matrix Spike Duplicate	613	Frequency: 1 per analytical batch of ≤ 20 samples Criteria: percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable matrix spike Duplicate	8280 8290	Frequency: 1 per analytical batch of ≤ 20 samples Criteria: percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable matrix spike duplicate

TABLE 8.4-6
Organic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Halogenated Volatiles by GC (continued)	Matrix Spike	–	Not Applicable	8021A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte should be within acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike
	Matrix Spike Duplicate	–	Not Applicable	8021A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte should be within acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike
	Duplicate	–	Not Applicable	8021A	Not Applicable
	Surrogates	–	Not Applicable	8021A	Surrogates spiked into method blank and all samples (QC included) Method Blank Criteria and LCS: All surrogates must be within laboratory established control limits before sample analysis may proceed. Sample Criteria: Re-extract samples or flag sample data not meeting surrogate criteria.

TABLE 8.4-6
Organic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Herbicides (continued)	Matrix Spike Duplicate	615 [3]	Not Applicable	8150B	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte should be within control limits Corrective Action: Flag data associated with unacceptable matrix spike sample
	Duplicate	615 [3]	Not Applicable	8150B	Not Applicable
	Surrogates	615 [3]	Not Applicable	8150B	Surrogates spiked into method blank and all samples (QC included) Method Blank Criteria and LCS: All surrogates must fall within laboratory established control limits before sample analysis may proceed. Sample Criteria: Re-extract samples or flag sample data not meeting surrogate criteria
	Internal Standards	615 [3]	Not Applicable	8150B	Optional
Nitro-aromatics by HPLC	Method Blank	--	Not Applicable	8330	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank

TABLE 8.4-6
Organic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Organo-phosphorus Pesticides	Method Blank	--	Not Applicable	8140 8141A	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	--	Not Applicable	8140 8141A	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Percent recovery for each analyte should be within acceptance limits Corrective Action: Rerun all samples associated with unacceptable LCS
	Matrix Spike	--	Not Applicable	8140 8141A	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Percent recovery for each analyte should be within acceptance limits Corrective Action: Flag data associated with unacceptable MS
	Matrix Spike Duplicate	--	Not Applicable	8140 8141A	Not Applicable
	Duplicate	--	Not Applicable	8140 8141A	Not Applicable

TABLE 8.4-6
Organic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
PAHs by GC and HPLC (continued)	Matrix Spike	610	Frequency: 1 per 10 samples from each site or 1 per month, whichever is more frequent Criteria: percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable Matrix Spike	8100 8310	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte should be within acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike
	Matrix Spike Duplicate	610	Not Applicable	8100 8310	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte should be within acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike
	Duplicate	610	Not Applicable	8100 8310	Not Applicable
	Surrogates	610	Not specified in method	8100 8310	Surrogates spiked into method blank and all samples (QC included) Method Blank Criteria and LCS: Results must fall within laboratory established control limits Sample Criteria: Re-extract samples or flag sample data not meeting surrogate criteria
	Internal Standards	610	Optional	8100 8310	Optional

TABLE 8.4-6
Organic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Pesticides/ PCBs (continued)	Matrix Spike Duplicate	608	Not Applicable	8080A	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte should be within acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike
	Duplicate	608	Not Applicable	8080A	Not Applicable
	Surrogates	608	Not specified in method	8080A	Surrogates spiked into method blank and all samples (QC included) Method Blank Criteria and LCS: Results must fall within laboratory established control limits Sample Criteria: Re-extract samples or flag sample data not meeting surrogate criteria
	Internal Standards	608	Optional	8080A	Optional
Petroleum Hydro-carbons/Oil and Grease	Method Blank	413.1 413.2 418.1	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank Method 413.1: Not Applicable	9070 9071A	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank Method 413.1: Not Applicable

TABLE 8.4-6
Organic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Petroleum Hydro-carbons/Oil and Grease (continued)	Duplicate	413.1 413.2 418.1	Not Applicable	9070 9071A	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Percent recovery must be within laboratory control limits Corrective Action: Flag associated Method 9070: Not Applicable
	Surrogates	413.1 413.2 418.1	Not Applicable	9070 9071A	Not Applicable
	Internal Standards	413.1 413.2 418.1	Not Applicable	9070 9071A	Not Applicable
Petroleum Hydro-carbons	Method Blank	1664[4]	Frequency: 1 with each preparation batch Criteria: Concentration must be less than the reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	—	—

TABLE 8.4-6
Organic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Purgeable Halocarbons by GC	Method Blank	601	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	8010B	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	601	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery must be within acceptance limits given in method for each analyte Corrective Action: Rerun all samples associated with unacceptable LCS	8010B	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte must be within historical acceptance limits Corrective Action: Rerun all samples associated with unacceptable LCS
	Matrix Spike	601	Frequency: 1 per 10 samples from each site or 1 per month, whichever is more frequent Criteria: percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable Matrix Spike	8010B	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte should be within acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike

TABLE 8.4-6
Organic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Semivolatiles	Method Blank	625	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	8270B	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	625	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery must be within acceptance limits given in method for each analyte Corrective Action: Rerun all samples associated with unacceptable LCS	8270B	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte must be within historical acceptance limits Corrective Action: Rerun all samples associated with unacceptable LCS
	Matrix Spike	625	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable Matrix Spike	8270B	Frequency: 1 with each extraction batch of samples not to exceed 20 samples Criteria: percent recovery for each analyte should be within acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike

TABLE 8.4-6
Organic Laboratory Quality Control Samples
(Continued)

Analysis	QC Sample	Method	NPDES[1]	Method	RCRA (SW846)[2]
Volatiles by GC/MS	Method Blank	624	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank	8240B 8260A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than reporting limit Corrective Action: Rerun all samples associated with unacceptable blank
	Laboratory Control Sample	624	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable Matrix Spike	8240B 8260A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte must be within historical acceptance limits Corrective Action: Rerun all samples associated with unacceptable LCS
	Matrix Spike	624	Frequency: 1 per ≤ 20 samples from each site or 1 per month, whichever is more frequent Criteria: percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with unacceptable Matrix Spike	8240B 8260A	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: percent recovery for each analyte should be within acceptance limits Corrective Action: Flag data associated with unacceptable Matrix Spike

TABLE 8.4-6
Organic Laboratory Quality Control Samples
(Continued)

Footnotes

(1) National Pollutant Discharge Elimination System

(2) Resource Conservation and Recovery Act, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, (SW-846), Third Edition, September 1986. Contains Final Update I (July 1992), Final Update IIA (August 1993), Final Update II (September 1994), and Final Update IIB (January 1995).

(3) Method not listed in 40 CFR Part 136.

(4) Method 1664 is a proposed method only, and has not been promulgated by the EPA. These requirements are from Quanterra® SOP Number CORP-WC-0003, "HEM/SGT-HEM by Method 1664".

TABLE 8.4-7
USEPA Contract Laboratory Program Statement of Work Quality Control Samples (Continued)

Analysis	QC Sample	Method	Requirement
ICAP (excludes mercury)	Method Blank	ILM03.0	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than CRDL or less than 10x sample concentration Corrective Action: Reprep all samples associated with unacceptable blank
	Laboratory Control Sample	ILM03.0	Frequency: 1 with each batch of samples processed or for each SDG, whichever is more frequent Criteria: Water - 80-120% except silver and antimony Solid - Meet control limits established for solid reference material Corrective Action: Reprep all samples associated with unacceptable LCS
	Matrix Spike	ILM03.0	Frequency: 1 with each group of samples of a similar matrix type and concentration or for each SDG whichever is more frequent Criteria: 75-125% unless sample result > 4x spike amount Corrective Action: Flag data associated with unacceptable Matrix perform post digestion spike at 2xCRDL or 2x sample concentration whichever is greater
	Matrix Spike Duplicate	ILM03.0	Not Applicable
	Duplicate	ILM03.0	Frequency: 1 with each group of samples of a similar matrix type and concentration or for each SDG whichever is more frequent Criteria: RPD ≤ 20% or ± CRDL if sample or duplicate value < 5x CRDL Corrective Action: Flag all data associated with duplicate results outside control limits

TABLE 8.4-7
USEPA Contract Laboratory Program Statement of Work Quality Control Samples (Continued)

Analysis	QC Sample	Method	Requirement
GFAA (excludes mercury) (continued)	Duplicate	ILM03.0	Frequency: 1 with each group of samples of a similar matrix type and concentration or for each SDG whichever is more frequent Criteria: RPD ≤ 20% or ± CRDL if sample or duplicate value < 5x CRDL Corrective Action: Flag all associated data associated if duplicate results outside control limits
	Analytical Spike	ILM03.0	Frequency: 1 with each sample except matrix spike Criteria: Evaluate per method requirements Corrective action: Perform per method requirements
	Surrogates	ILM03.0	Not Applicable
	Internal Standards	ILM03.0	Not Applicable.
Mercury (CVAA)	Method Blank	ILM03.0	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than CRDL Corrective Action: Reprep all samples associated with unacceptable blank
	Laboratory Control Sample	ILM03.0	Frequency: 1 with each batch of samples processed or for each SDG, whichever is more frequent Criteria: Water - 80-120% Solid - Meet control limits established for solid reference material Corrective Action: Reprep all samples associated with unacceptable LCS
	Matrix Spike	ILM03.0	Frequency: 1 with each group of samples of a similar matrix type and concentration or for each SDG Criteria: 75-125% unless sample result > 4x spike amount Corrective Action: Flag data associated with unacceptable Matrix Spike

TABLE 8.4-7
USEPA Contract Laboratory Program Statement of Work Quality Control Samples (Continued)

Analysis	QC Sample	Method	Requirement
PCDD, PCDF (continued)	Duplicate	DFLM01.1	Frequency: 1 for each matrix analyzed for each SDG Criteria: RPD ≤ 50% Corrective Action: Verify all calculations and spiking; no further action required
	Surrogates	DFLM01.1	Not Applicable
	Internal Standards	DFLM01.1	Frequency: Internal standards are spiked into all samples and QC samples Criteria: 25 - 150% Corrective Action: Re-extract and reanalyze all samples with unacceptable surrogate recoveries
Pesticides/PCBs	Method Blank	OLM03.1	Frequency: 1 with each case of samples received (up to 20 samples), for each extraction procedure within each SDG, whichever is most frequent or whenever samples are extracted Criteria: Concentration < CRQL Corrective Action: Re-extract and reanalyze all samples associated with unacceptable blank
	Laboratory Control Sample	OLM03.1	Not Applicable.
	Matrix Spike	OLM03.1	Frequency: 1 with each case of samples received (up to 20 samples), for each extraction procedure or for each SDG, whichever is most frequent Criteria: Percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with Matrix Spike recoveries outside of advisory limits

TABLE 8.4-7
USEPA Contract Laboratory Program Statement of Work Quality Control Samples (Continued)

Analysis	QC Sample	Method	Requirement
Pesticides/PCBs (continued)	Laboratory Control Sample	OLM01.8	Not Applicable
	Matrix Spike	OLM01.8	Frequency: 1 with every 20 samples of each matrix Criteria: Percent recovery should be within advisory limits given in method Corrective Action: Flag data associated with matrix spike recoveries outside of advisory limits
	Matrix Spike Duplicate	OLM01.8	Frequency: 1 with every 20 samples of each matrix Criteria: Percent recovery and RPD should be within advisory limits given in method Corrective Action: Flag data associated with percent recovery or RPD outside of advisory limits
	Duplicate	OLM01.8	Not Applicable
	Surrogates	OLM01.8	Frequency: Spiked onto all samples and QC samples Criteria: Advisory limits are 60% - 150% Corrective Action: Flag surrogate recoveries outside of advisory limits
	Internal Standards	OLM01.8	Not Applicable
Semivolatiles by GC/MS	Method Blank	OLM03.1	Frequency: 1 with each batch of samples processed not to exceed 20 samples Criteria: Concentration less than CRQL except phthalates which must be ≤ 5x CRQL Corrective Action: Re-extract and re-analyze all samples associated with unacceptable blank
	Laboratory Control Sample	OLM03.1	Not Applicable.

TABLE 8.4-7
USEPA Contract Laboratory Program Statement of Work Quality Control Samples (Continued)

Analysis	QC Sample	Method	Requirement
Semivolatiles by GC/MS (continued)	Method Blank	OLM01.8	Frequency: 1 with each case of samples received (up to 20 samples) and including matrix spikes and reanalyses) that are of similar matrix (water or soil) or similar concentration (soil), or 1 with each 14 calendar day period (7 calendar day for 14-day data turnaround contracts) during which samples in a case are received, or 1 whenever samples are extracted by the same procedure (continuous liquid-liquid extraction or sonication) Criteria: Concentration ≤ CRQL except phthalates which must be < 5 x CRQL Corrective Action: Re-extract and re-analyze all samples associated with unacceptable blank
	Laboratory Control Sample	OLM01.8	Not Applicable
	Matrix Spike	OLM01.8	Frequency: 1 with each case of samples received (up to 20 samples), for each concentration level (soils) or for each 14 day calendar period (7 calendar day period for 14 day data turnaround contracts) during which field samples in a case were received, whichever is most frequent Criteria: Percent recovery for each analyte should be within advisory limits given in method Corrective Action: Flag data associated with Matrix Spike recoveries outside of advisory limits
	Matrix Spike Duplicate	OLM01.8	Frequency: 1 with each case of samples received (up to 20 samples), for each concentration level (soils) or for each 14 day calendar period (7 calendar day period for 14 day data turnaround contracts) during which field samples in a case were received, whichever is most frequent Criteria: Percent recovery for each analyte should be within advisory limits given in method. RPD between MS/MSD should be within advisory limits given in method. Corrective Action: Flag data associated with Matrix Spike recoveries or RPD outside of advisory limits

TABLE 8.4-7
USEPA Contract Laboratory Program Statement of Work Quality Control Samples (Continued)

Analysis	QC Sample	Method	Requirement
Volatiles by GC/MS (continued)	Matrix Spike Duplicate	OLM03.1	Frequency: 1 with each case of samples received (up to 20 samples), for each concentration level (soils) or for each SDG, whichever is most frequent Criteria: Percent recovery for each analyte should be within advisory limits given in method RPD between MS/MSD should be within advisory limits given in method Corrective Action: Flag data associated with Matrix Spike recoveries or RPD outside of advisory limits
	Duplicate	OLM03.1	Not Applicable
	Surrogates	OLM03.1	Frequency: Surrogates spiked onto all samples and QC samples Criteria: Percent recovery for each surrogate must be within limits given in method Corrective Action: Reanalyze all samples with unacceptable surrogate recoveries
	Internal Standards	OLM03.1	Frequency: Internal Standards are spiked onto all samples and QC samples Criteria: Internal Standard areas must be within -50% to + 100% from the last daily calibration check standard Corrective Action: Reanalyze all samples with unacceptable Internal Standard areas
	Storage Blank	OLM03.1	Frequency: 1 per SDG Criteria: Concentration less than CRQL except methylene chloride, acetone, 2-butanone must be ≤ 5x CRQL Corrective Action: Narrate with corrective action plan

TABLE 8.4-7
USEPA Contract Laboratory Program Statement of Work Quality Control Samples (Continued)

Analysis	QC Sample	Method	Requirement
Volatiles by GC/MS (continued)	Internal Standards	OLM01.8	Frequency: Internal Standards are spiked onto all samples and QC samples Criteria: Internal Standard areas must be within -50% to + 100% from the last daily calibration check standard Corrective Action: Re-analyze all samples with unacceptable Internal Standard areas
	Storage Blank	OLM01.8	Not Applicable

Notes:

SDG = Sample Delivery Group

TABLE 8.5-1
Inorganic Sample Containers, Preservatives, and Holding Times (Continued)

Analytical Parameters	Matrix	Minimum Sample Size[1]	NPDES[2], [3], [7]		RCRA (SW846)[3], [4]	
			Method	Requirements	Method	Requirements
Chloride	Water	50 mL	300.0[7] 325.1 325.2 325.3 4500 Cl E	250 mL plastic or glass, No preservative required, 28 days	9056 9251 9252A	Method 9056: Cool, 4°C, analyze ASAP after collection. Method 9251/9252A: 250ml plastic or glass, no preservative required, 28 days
	Solid	Not Applicable	—	Not Applicable	—	Not Applicable
	Waste	Not Applicable	—	Not Applicable	—	Not Applicable
Chlorine, Residual	Water	100 mL	330.1 330.3	250 mL glass or plastic, Cool, 4°C, analyze immediately	—	Not Applicable
	Solid	Not Applicable	—	Not Applicable	—	Not Applicable
	Waste	Not Applicable	—	Not Applicable	—	Not Applicable
Chromium (Cr^{+6})	Water	100 mL	218.4 3500 Cr-D	Method 218.4: 200 mL plastic or glass, Cool, 4°C, 24 hours Method 3500 Cr-D: 200 mL quartz, TFE, or polypropylene HNO_3 to pH <2 Cool, 4°C Analyze ASAP after collection	7196A	200 mL plastic or glass, Cool, 4°C, 24 hours
	Solid	Not Applicable	—	Not Applicable	3060A/ 7196A	30 days to digestion, 96 hours after digestion
	Waste	Not Applicable	—	Not Applicable	—	Not Applicable

TABLE 8.5-1
Inorganic Sample Containers, Preservatives, and Holding Times (Continued)

Analytical Parameters	Matrix	Minimum Sample Size[1]	NPDES[2], [3], [7]		RCRA (SW846)[3], [4]	
			Method	Requirements	Method	Requirements
Cyanide (Total) (continued)	Waste	50g	--	Not Applicable	9010A, 9012	8 or 16 oz glass Teflon-lined lids, Cool, 4°C
Flashpoint (Ignitability)	Liquid	Not Applicable	---	Not Applicable	1010	No requirements, 250 mL amber glass, Cool, 4°C is recommended
	Solid	Not Applicable	--	Not Applicable	---	Not Applicable
	Waste	Not Applicable	--	Not Applicable	---	Not Applicable
Fluoride	Water	300 mL	300.0[7] 340.2	500 mL plastic, No preservation required, 28 days	9056	Cool, 4°C, analyze ASAP after collection
	Solid	Not Applicable	---	Not Applicable	---	Not Applicable
	Waste	Not Applicable	---	Not Applicable	---	Not Applicable
Hardness (Total)	Water	50 mL	130.2 2340B	250 mL glass or plastic, Cool, 4°C, HNO_3 to pH < 2, 6 months	---	Not Applicable
	Solid	Not Applicable	---	Not Applicable	---	Not Applicable
	Waste	Not Applicable	---	Not Applicable	---	Not Applicable
Iodide	Water	100 mL	345.1 Dionex	100 mL plastic or glass, Cool, 4°C, 24 hours		Not Applicable
	Solid	Not Applicable	---	Not Applicable	---	Not Applicable
	Waste	Not Applicable	---	Not Applicable	---	Not Applicable
Iron (Ferrous)	Water	100 mL	3500-Fe D	1 liter glass or polyethylene container, 6 months **This test should be performed in the field.**	-	Not Applicable
	Solid	Not Applicable	-	Not Applicable	-	Not Applicable
	Waste	Not Applicable	-	Not Applicable	-	Not Applicable

TABLE 8.5-1
Inorganic Sample Containers, Preservatives, and Holding Times
(Continued)

Analytical Parameters	Matrix	Minimum Sample Size[1]	NPDES[2], [3], [7]		RCRA (SW846)[3], [4]	
			Method	Requirements	Method	Requirements
Ortho-phosphate	Water	50 mL	300.0[7] 365.1 365.2 365.3 365.4	100 mL plastic or glass, Filter on site Cool, 4°C, 48 hours	—	Not Applicable
	Solid	Not Applicable	—	Not Applicable	—	Not Applicable
	Waste	Not Applicable	—	Not Applicable	—	Not Applicable
pH	Water	50 mL	150.1 4500-H^+ B	100 mL plastic or glass. Analyze immediately. This test should be performed in the field.	9040B	100 mL plastic or glass. Analyze immediately. This test should be performed in the field.
	Solid	Not Applicable	—	Not Applicable	9045C	4 oz glass or plastic, Cool, 4°C, Analyze as soon as possible.
	Waste	Not Applicable	—	Not Applicable	9045C	4 oz glass or plastic, Cool, 4°C, Analyze as soon as possible.
Phenolics	Water	100 mL	420.1 420.2	500 mL glass, Cool, 4°C, H_2SO_4 to pH < 2, 28 days	9065 9066	1 liter glass recommended, Cool, 4°C, H_2SO_4 to pH < 2, 28 days
	Solid	Not Applicable	—	Not Applicable	—	Not Applicable
	Waste	Not Applicable	—	Not Applicable	9065	Not Specified
Phosphate	Water	50 mL	—	Not Applicable	9056	Cool, 4°C, analyze ASAP collection
	Solid	Not Applicable	—	Not Applicable	9056	Not Applicable
	Waste	Not Applicable	—	Not Applicable	9056	Not Applicable
Phosphorus (Total)	Water	50 mL	365.1 365.2 365.3 365.4	100 mL plastic or glass, H_2SO_4 to pH < 2, 28 days	—	Not Applicable
	Solid	Not Applicable	—	Not Applicable	—	Not Applicable
	Waste	Not Applicable	—	Not Applicable	—	Not Applicable

TABLE 8.5-1
Inorganic Sample Containers, Preservatives, and Holding Times (Continued)

Analytical Parameters	Matrix	Minimum Sample Size[1]	NPDES[2], [3], [7]		RCRA (SW846)[3], [4]	
			Method	Requirements	Method	Requirements
Specific Conductance	Water	50 mL	120.1	250 mL plastic or glass, Cool, 4°C, 28 days	9050	250 mL plastic or glass, Cool, 4°C, 24 hours
	Solid	Not Applicable	—	Not Applicable	—	Not Applicable
	Waste	Not Applicable	—	Not Applicable	—	Not Applicable
Sulfate (SO_4)	Water	100 mL	300.0[7] 375.1 375.4	100 mL plastic or glass, Cool, 4°C, 28 days	9056 9038	Method 9056: Cool, 4°C, analyze ASAP collection Method 9038: 200 mL plastic or glass, Cool, 4°C, 28 days
	Solid	Not Applicable	—	Not Applicable	—	Not Applicable
	Waste	100 mL	—	Not Applicable	9038	200 mL plastic or glass, Cool, 4°C, 28 days
Sulfide	Water	100 mL	376.1 376.2	500 mL plastic or glass, Cool, 4°C, Add 2 mL zinc acetate plus NaOH to pH > 9, 7 days	9030A	500 mL plastic, no headspace, Cool, 4°C, Add 2 mL zinc acetate plus NaOH to pH > 9, 7 days
	Solid	50 g	—	Not Applicable	9030A	Cool, 4°C, store headspace-free
	Waste	50 g	—	Not Applicable	9030A	Cool, 4°C, store headspace-free

TABLE 8.5-1
Inorganic Sample Containers, Preservatives, and Holding Times (Continued)

Analytical Parameters	Matrix	Minimum Sample Size[1]	NPDES[2], [3], [7]		RCRA (SW846)[3], [4]	
			Method	Requirements	Method	Requirements
Total Organic Halides (TOX)	Water	100 mL	5320B [7] 450.1 [7]	Method 5320B: 500 mL amber glass, Teflon®-lined lid, Cool, 4°C, HNO_3 to pH <2, no headspace, 14 days Method 450.1: 500 mL amber glass, Teflon®-lined lid, Cool, 4°C, HNO_3 to pH <2, no headspace, 28 days	9020B	500 mL amber glass, Teflon®-lined lid, Cool, 4°C, H_2SO_4 to pH < 2, no headspace, 28 days
	Solid	Not Applicable	—	Not Applicable	—	Not Applicable
	Waste	Not Applicable	—	Not Applicable	—	Not Applicable
Total Solids	Water	100 mL	160.3	250 mL plastic or glass, Cool, 4°C, 7 days	—	Not Applicable
	Solid	Not Applicable	—	Not Applicable	—	Not Applicable
	Waste	Not Applicable	—	Not Applicable	—	Not Applicable
Total Suspended Solids (Nonfilterable)	Water	100 mL	160.2	250 mL plastic or glass, Cool, 4°C, 7 days	—	Not Applicable
	Solid	Not Applicable	—	Not Applicable	—	Not Applicable
	Waste	Not Applicable	—	Not Applicable	—	Not Applicable
Turbidity	Water	50 mL	180.1	250 mL plastic or glass, Cool, 4°C, 48 hours	—	Not Applicable
	Solid	Not Applicable	—	Not Applicable	—	Not Applicable
	Waste	Not Applicable	—	Not Applicable	—	Not Applicable
Volatile Solids	Water	100 mL	160.4	250 mL plastic or glass, Cool, 4°C, 7 days	—	Not Applicable
	Solid	Not Applicable	—	Not Applicable	—	Not Applicable
	Waste	Not Applicable	—	Not Applicable	—	Not Applicable

TABLE 8.5-1
Inorganic Sample Containers, Preservatives, and Holding Times (Continued)

Footnotes

(1) Minimum sample size indicates sample amount needed for a single analysis. Matrix spikes or duplicates will require an additional sample amount of at least this amount for each additional QC sample aliquot required.
(2) National Pollutant Discharge Elimination System - MCAWW, March 1983.
(3) Holding times are calculated from date of collection.
(4) Resource Conservation and Recovery Act, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, (SW-846), Third Edition, September 1986. Contains Final Update I (July 1992), Final Update IIA, (August 1993), Final Update II (September 1994), and Final Update IIB (January 1995)
(5) Solid matrix type includes soil, sediment, sludge and other solid materials not classified as waste.
(6) Samples to be analyzed for cyanide should be field-tested for residual chlorine. If residual chlorine is detected, ascorbic acid should be added.
(7) Method not listed in 40 CFR Part 136.

TABLE 8.5-2
Organic Sample Containers, Preservatives, and Holding Times (Continued)

Analytical Parameters	Matrix	Minimum Sample Size[1]	NPDES[2], [3]		RCRA (SW846)[3], [4]	
			Method	Requirements	Method[6]	Requirements
Dioxins/ Dibenzo-furans (continued)	Waste	10 g	--	Not Applicable	8280	8 or 16 oz glass amber wide mouth with Teflon®-lined lid, Cool, 4°C, Extraction, 30 days Analysis, 45 days from date of collection
	Water	1L	613	1 liter amber glass with Teflon®-lined lid, Cool, 4°C, Extraction, 7 days Analysis, 40 days	8290	1 liter glass amber with Teflon®-lined lid, Cool, 4°C, Extraction, 30 days Analysis, 45 days from date of extraction
	Solid	10 g	--	Not Applicable	8290	8 or 16 oz glass amber wide mouth with Teflon®-lined lid, Cool, 4°C, Extraction, 30 days Analysis, 45 days from date of extraction
	Waste	10 g	--	Not Applicable	8290	8 or 16 oz glass amber wide mouth with Teflon®-lined lid, Cool, 4°C, Extraction, 30 days Analysis, 45 days from date of extraction
Halogenated Volatiles	Water	40 mL	--	Not Applicable	8021A	40 mL glass, VOA vial (in triplicate) with Teflon®-lined septa without headspace, Cool, 4°C, Add sodium thiosulfate if residual chlorine, HCl or H_2SO_4 or solid $NaHSO_4$ to pH ≤ 2, 14 days with pH ≤ 2
	Solid[5]	10 g	--	Not Applicable	8021A	4 or 8 oz glass with Teflon®-lined lid, Cool, 4°C, 14 days

TABLE 8.5-2
Organic Sample Containers, Preservatives, and Holding Times
(Continued)

Analytical Parameters	Matrix	Minimum Sample Size[1]	NPDES[2], [3]		RCRA (SW846)[3], [4]	
			Method	Requirements	Method[6]	Requirements
Nitroaromatics (continued)	Waste	50 g	—	Not Applicable	8330	4 or 8 oz glass widemouth with Teflon®-lined lid no preservative required
Organo-phosphorus Pesticides	Water	1L	—	Not Applicable	8140 8141A	1 liter amber glass with Teflon®-lined lid. If residual chlorine present, add 3 mL sodium thiosulfate per gallon. Cool, 4°C. Extraction, 7 days Analysis, 40 days after extraction
	Solid	50 g	—	Not Applicable	8140 8141A	4 or 8 oz glass widemouth with Teflon®-lined lid Cool, 4°C
	Waste	50 g	—	Not Applicable	8140 8141A	4 or 8 oz glass widemouth with Teflon®-lined lid no preservative required
PAHs by GC and HPLC	Water	1L	610	1 liter amber glass with Teflon®-lined lid, Adjust pH to 5-9 if extraction not to be done within 72 hours of sampling. Add sodium thiosulfate if residual chlorine present. Cool, 4°C, Extraction, 7 days Analysis, 40 days after extraction	8100 8310	1 liter amber glass with Teflon®-lined lid, If residual chlorine present, add 3 mL sodium thiosulfate per gallon, Cool, 4°C, Extraction, 7 days Analysis, 40 days after extraction

TABLE 8.5-2
Organic Sample Containers, Preservatives, and Holding Times (Continued)

Analytical Parameters	Matrix	Minimum Sample Size[1]	NPDES[2], [3]		RCRA (SW846)[3], [4]	
			Method	Requirements	Method[6]	Requirements
Petroleum Hydrocarbons /Oil and Grease	Water	1L	413.1 413.2 418.1	1 liter glass, Cool, 4°C, HCl to pH <2, 28 days	9070	1 liter glass with Cool, 4°C, HCl to pH <2, 28 days
	Solid	—	—	Not Applicable	9071A	8 oz. glass with Teflon®-lined lid, Holding Time not specified
	Waste	—	—	Not Applicable	9071A	8 oz. glass with Teflon®-lined lid, Holding Time not specified
	Water	1 L	1664[7]	1 liter glass, Cool, 0-4°C HCl or H_2SO_4 to pH <2 28 days	—	—
	Solid	30 g	1664[7]	8 or 16 oz. wide mouth glass jar, Cool, 0-4°C, 28 days	—	—
	Waste	—	—	Not Applicable	—	—
Purgeable Halocarbons	Water	40 mL	601	40 mL glass VOA vial (in triplicate) with Teflon®-lined septa with no headspace, Cool, 4°C, Add sodium thiosulfate if residual chlorine present, 14 days	8010B	40 mL glass VOA vial (in triplicate) with Teflon®-lined septa with no headspace, Cool, 4°C, HCl or H_2SO_4 or solid $NaHSO_4$ to pH ≤ 2, sodium thiosulfate if residual chlorine present, 14 days
	Solid	10 g	—	Not Applicable	8010B	4 or 8 oz glass container with Teflon®-lined lid, Cool, 4°C, 14 days

TABLE 8.5-2
Organic Sample Containers, Preservatives, and Holding Times (Continued)

Analytical Parameters	Matrix	Minimum Sample Size[1]	NPDES[2], [3]		RCRA (SW846)[3], [4]	
			Method	Requirements	Method[6]	Requirements
Volatile Organics	Water	40 mL	624	40 mL glass, VOA vial (in triplicate) with Teflon®-lined septa without headspace, Cool, 4°C, Add sodium thiosulfate if residual chlorine, 7 days with pH > 2, 14 days with pH ≤ 2[8]	8240B, 8260A	40 mL glass, VOA vial (in triplicate) with Teflon®-lined septa without headspace, Cool, 4°C, Add sodium thiosulfate if residual chlorine, HCl or H_2SO_4 or solid $NaHSO_4$ to pH ≤ 2, 14 days with pH ≤ 2[9]
	Solid[5]	10 g	--	Not Applicable	8240B, 8260A	4 or 8 oz glass with Teflon®-lined lid, Cool, 4°C, 14 days
	Waste	10 g	--	Not Applicable	8240B, 8260A	4 or 8 oz glass with Teflon®-lined lid, Cool, 4°C, 14 days

TABLE 8.5-3
Radiological Sample Containers, Preservatives, and Holding Times

Analytical Parameters	Matrix	Recommended Containers[1]	Preservative	Maximum Holding Time	Minimum Volume Required for Analysis[2]
Gross Alpha/Beta	Water	P, G	Field acidified to pH < 2 with HNO_3	180 days after collection	500 mls
	Soil	P, G	None		50[4] gms
Americium-241	Water	P, G	Field acidified to pH < 2 with HNO_3	180 days after collection	1000[5] mls
	Soil	P, G	None		50[4] gms
Carbon-14	Water	P, G	Field adjusted to pH > 9 with NaOH[3]	180 days after collection	100 mls
	Soil	P, G	None		50[4] gms
Calcium-45	Water	P, G	Field acidified to pH < 2 with HNO_3	180 days after collection	100 mls
Curium-242	Water	P, G	Field acidified to pH < 2 with HNO_3	180 days after collection	1000[5] mls
	Soil	P, G	None		50[4] gms
Gamma Emitters Actinides, as applicable, Co-60, Cs-137, K-40, Mn-54, and other fission/activation products	Water	P, G	Field acidified to pH < 2 with HNO_3	180 days after collection	1000[5] mls
	Soil	P, G	None		650[7] gms
Iron-55	Water	P, G	Field acidified to pH < 2 with HNO_3	180 days after collection	50 mls
Lead-210	Water	P, G	Field acidified to pH < 2 with HNO_3	180 days after collection	500 mls
	Soil	P, G	None		50[4] gms
Neptunium-237	Water	P, G	Field acidified to pH < 2 with HNO_3	180 days after collection	1000[5] mls
	Soil	P, G	None		50[4] gms
Promethium-147	Water	P, G	Field acidified to pH < 2 with HNO_3	180 days after collection	250 mls

TABLE 8.5-3
Radiological Sample Containers, Preservatives, and Holding Times (Continued)

Footnotes

(1) Plastic (polyethylene), Glass
(2) Assumes that quality control samples have been assigned in the field. If duplicates, matrix spikes and/or matrix spike duplicates are to be assigned by the laboratory, additional multiple sample volumes are required. Volumes listed are for standard aliquot size. Detection limit requirements may necessitate larger volumes.
(3) Assumes that carbon is in the form of CO_3^{--}.
(4) May be aliquoted or sequentially determined from the same volume.
(5) May be aliquoted or sequentially determined from the same volume.
(6) Tritium is very volatile. Sample containers must be air tight to eliminate tritium loss.
(7) Dry weight.

TABLE 8.5-4
Sample Containers, Preservatives, and Holding Times for USEPA Contract Laboratory Program Statement of Work (Continued)

Analytical Parameters	Matrix	Minimum Sample Size	Requirements[1]
Semivolatiles	Water	1L	1 liter amber glass with Teflon®-lined lid, Cool, 4°C, Extraction within 5 days of sample receipt Analysis within 40 days after start of extraction
	Soil/Sediment	50 g	8 or 16 oz glass widemouth with Teflon®-lined lid, Cool, 4°C, Extraction within 10 days of sample receipt Analysis within 40 days after start of extraction
Volatiles	Water	40 mL	40 mL glass with Teflon®-lined lid, no entrapped air bubbles pH <2[3], Cool, 4°C, 10 days
	Soil/Sediment	25 g	4 or 8 oz glass with Teflon®-lined lids, Cool, 4°C, 10 days

Footnotes

(1) Holding times are calculated from verified time of sample receipt.

(2) PCDD: Polychlorinated Dibenzo-p-dioxins
PCDF: Polychlorinated Dibenzofurans

(3) The OLM03.0 requirement is to acidify the sample to pH<2. The OLM01.8 requirement is to determine and report the pH of the sample to check that the sample was acidified in the field.

TABLE 8.5-6
Periodic Equipment Calibrations

Type of Equipment	Calibration Requirements
Balances	• Must be serviced and calibrated annually by a manufacturer's representative • Calibration must be checked daily or before use by analyst with weight(s) classified as Class "S" (or Class "S" traceable) by NIST per operation-specific SOPs. Acceptance criteria vary according to weight used and accuracy of balance. Acceptance criteria must be documented in log. • All Class "S" weights must be certified by an outside agency every three years.
Thermometers	• Working glass thermometers must be calibrated against a certified NIST thermometer at least annually as described in operation-specific SOPs. • Working non-glass thermometers must be calibrated against a certified NIST thermometer quarterly as described in operation-specific SOPs. • The NIST thermometer must be recertified every three years.
Refrigerators/Freezers	• Thermometers must be immersed in a liquid such as mineral oil or glycol • Temperature of units used for sample or standard storage must be checked daily as described in operation-specific SOPs. Refrigerator acceptance limits: 4°C ± 2°C Freezer acceptance limits: < - 10°C
Ovens	• Temperature of units must be checked daily or before use. • Acceptance limits vary according to use as described in operation-specific SOPs and must be documented in the temperature log.
Micropipettors	• Calibrations are checked gravimetrically as required by the operation-specific SOP. • Must be calibrated at the frequency (normally quarterly) required by the manufacturer at a minimum.
Syringes, Volumetric Glassware and Graduated Glassware	• All syringes and volumetric glassware are purchased as Class A items. • Class A items are certified by the manufacturer to be within ± 1% of the measured volume, therefore, calibration of these items by Quanterra® laboratories is not required. • All analysts are trained in the proper use and maintenance of measuring devices to ensure the measurement of standards, reagents and sample volumes are within method tolerances.

TABLE 8.5-7
Summary of Inorganic Method Calibrations
(Continued)

Analysis	Calibration	NPDES[1]		RCRA (SW846)[2]	
		Method	Requirement	Method	Requirement
Bromide	Initial	300.0[4] 320.1 ASTM D1246-88	Method 300.0 & ASTM D1246-88: 5 levels plus a blank, "r"[3] ≥ 0.995 Method 320.1: Not Applicable	9056	Method 300.0: 5 levels plus a blank, "r"[3] ≥ 0.995
	Continuing	300.0[4] 320.1 ASTM D1246-88	Method 300.0 & ASTM D1246-88:1 level every 10 samples ± 10% of true value Method 320.1 Not Applicable	9056	Method 300.0: Not Applicable
	Ending	300.0[4] 320.1 ASTM D1246-88	Not Applicable	9056	Not Applicable
Chemical Oxygen Demand (COD)	Initial	410.4 410.1 410.2	Method 410.4: 5 levels plus a blank"r"[3] ≥ 0.995 Methods 410.1 & 410.2: Standardize titrant.	–	Not Applicable
	Continuing	410.4 410.1 410.2	Method 410.4: 1 level every 10 samples ± 10% of true value Methods 410.1 & 410.2: Not Applicable	–	Not Applicable
	Ending	410.4	Method 410.4: 1 level ± 10% of true value Methods 410.1 & 410.2: Not Applicable	–	Not Applicable

TABLE 8.5-7
Summary of Inorganic Method Calibrations
(Continued)

Analysis	Calibration	NPDES[1]		RCRA (SW846)[2]	
		Method	Requirement	Method	Requirement
Chlorine, Residual	Initial	330.1 330.3	Standardize titrant	--	Not Applicable
	Continuing	330.1 330.3	Not Applicable	--	Not Applicable
	Ending	330.1 330.3	Not Applicable	--	Not Applicable
Color	Initial	110.2	3 levels plus blank	--	Not Applicable
	Continuing	110.2	1 level every 10 samples	--	Not Applicable
	Ending	110.2	1 level	--	Not Applicable
Conductivity	Initial	120.1	Standard KCl solution	9050	1 level to determine cell constant
	Continuing	120.1	Not Applicable	9050	Not Applicable
	Ending	120.1	Not Applicable	9050	Not Applicable
Cyanide (Amenable)	Initial	335.1	7 levels plus blank "r"[3] ≥ 0.995	9010A 9012	7 levels plus blank "r"[3] ≥ 0.995
	Continuing	335.1	1 level every 10 samples ± 10% of true	9010A 9012	1 mid-level every 10 samples ± 15% of true value
	Ending	335.1	1 level ± 10 % of true value	9010A 9012	± 15% of true value
Cyanide (Total)	Initial	335.1 335.2 335.3 4500-CN E	7 levels plus blank "r"[3] ≥ 0.995	9010A 9012	7 levels plus blank "r"[3] ≥ 0.995
	Continuing	335.1 335.2 335.3 4500-CN E	1 mid-level every 10 samples ± 10 % of true value	9010A 9012	1 mid-level every 10 samples ± 15% of true value
	Ending	335.1 335.2 335.3 4500-CN E	1 mid-level ± 10 % of true value	9010A 9012	± 15% of true value

TABLE 8.5-7
Summary of Inorganic Method Calibrations
(Continued)

Analysis	Calibration	NPDES[1]		RCRA (SW846)[2]	
		Method	Requirement	Method	Requirement
Iodide (continued)	Continuing	345.1 Dionex[3]	Method 345.1: Not Applicable Dionex: 1 mid-level every 10 samples ± 10 % of true value	--	Not Applicable
	Ending	345.1 Dionex[3]	Method 345.1: Not Applicable Dionex: 1 mid-level ± 10% of true value	--	Not Applicable
Iron (Ferrous)	Initial	3500-Fe D	3 levels plus a blank, "r"[3] ≥ 0.995	-	Not Applicable
	Continuing	3500-Fe D	1 mid-level every 10 samples ± 10% of true value	-	Not Applicable
	Ending	3500-Fe D	1 mid-level ± 10% of true value	-	Not Applicable
Methylene Blue Active Substances (MBAS)	Initial	425.1	4 levels plus blank "r"[3] ≥ 0.995	--	Not Applicable
	Continuing	425.1	1 level every 10 samples ± 10 % of true value	--	Not Applicable
	Ending	425.1	1 level ± 10 % of true value	--	Not Applicable

TABLE 8.5-7
Summary of Inorganic Method Calibrations
(Continued)

Analysis	Calibration	NPDES[1]		RCRA (SW846)[2]	
		Method	Requirement	Method	Requirement
Odor	Initial	140.1	No calibration	–	Not Applicable
	Continuing	140.1	Not Applicable	–	Not Applicable
	Ending	140.1	Not Applicable	–	Not Applicable
Phosphorus (total and Ortho-phosphate)	Initial	300.0[4] 365.1 365.2 365.3 365.4	Method 300.0/365.3/365.4: 3 levels plus a blank Method 365.2: 8 levels plus a blank	–	Not Applicable
	Continuing	300.0[4] 365.1 365.2 365.3 365.4	Method 300.0/365.3/365.4: 1 level every 10 samples ± 10% of true value Method 365.2: Blank and 2 standards with each series of samples, ± 2% of true value or recalibrate	–	Not Applicable
	Ending	300.0[4] 365.1 365.2 365.3 365.4	Method 300.0/365.3/365.4: ± 10% of true value Method 365.2: Not Applicable	–	Not Applicable
pH	Initial	150.1 4500-H^+ B	2 level calibration that bracket the expected pH of the sample (± 0.05 pH units of true value)	9040B 9045C	2 point calibration (± 0.05 pH units of true value)
	Continuing	150.1 4500-H^+ B	1 buffer check every 10 samples ± 5% of true value	9040B 9045C	Not Applicable
	Other	150.1 4500-H^+ B	Third point check	9040B 9045C	Third point check

TABLE 8.5-7
Summary of Inorganic Method Calibrations
(Continued)

Analysis	Calibration	NPDES[1]		RCRA (SW846)[2]	
		Method	Requirement	Method	Requirement
Specific Conductance	Initial	120.1	Standardize meter with 0.01 M KCl	9050	Not Applicable
	Continuing	120.1	1 level every 10 samples ± 10% of true value	9050	Not Applicable
	Ending	120.1	1 level ± 10% of true value	9050	Not Applicable
Sulfate	Initial	300.0[4] 375.1 375.4	Method 300.0/375.1: 5 levels plus blank "r"[3] ≥ 0.995 Method 375.4: 3 levels plus blank "r"[3] ≥ 0.995	9038 9056	Method 9038: 3 levels plus a blank for every hour of continuous sample analysis. Method 9056: 3 levels plus a blank
	Continuing	300.0[4] 375.1 375.4	Method 300.0/375.1: 1 mid-level after every 10 samples ± 10% of true value Method 375.4: 1 level every 3 or 4 samples ± 10% of true value	9038 9056	Method 9038: Independent-prepared check standard every 15 samples Method 9056: 1 per batch of 20 samples, ± 10% of true value
	Ending	300.0[4] 375.1 375.4	± 10% of true value	9038 9056	Not Applicable
Sulfide	Initial	376.1 376.2	Method 376.1: This is a titration method. Therefore, calibrations are not applicable. Method 376.2: 5 levels plus a blank "r"[3] ≥ 0.995	9030A	This is a colorimetric titration. Therefore, calibrations are not applicable.

TABLE 8.5-7
Summary of Inorganic Method Calibrations
(Continued)

Analysis	Calibration	NPDES[1]		RCRA (SW846)[2]	
		Method	Requirement	Method	Requirement
Total Kjeldahl Nitrogen (TKN)	Initial	351.2 351.3	Method 351.2: 5 levels plus blank "r"[3] ≥ 0.995 Method 351.3: Titrimetric: Standardize titrant Colorimetric: 7 levels plus blank	--	Not Applicable
	Continuing	351.2 351.3	Method 351.2: 1 mid-level every 10 samples ± 10% of true value Method 351.3: Not Applicable	--	Not Applicable
	Ending	351.2 351.3	Method 351.2: ± 10% of true value Method 351.3: Not Applicable	--	Not Applicable
Total Organic Carbon (TOC)	Initial	415.1	3 levels plus blank	9060	3 levels plus blank "r"[3] ≥ 0.995
	Continuing	415.1	1 mid-level every 10 samples ± 15% of true value	9060	1 mid-level every 10 samples ± 15% of true value
	Ending	415.1	± 15% of true value	9060	± 15% of true value

TABLE 8.5-7
Summary of Inorganic Method Calibrations
(Continued)

Analysis	Calibration	NPDES[1]		RCRA (SW846)[2]	
		Method	Requirement	Method	Requirement
Turbidity	Initial	180.1	Minimum of 1 level in each instrument range Follow manufacturer's instructions	--	Not Applicable
	Continuing	180.1	Not Applicable	--	Not Applicable
	Ending	180.1	Not Applicable	--	Not Applicable
Volatile Solids	Initial	160.4	This is a gravimetric determination. Calibrate balance before use.	--	Not Applicable
	Continuing	160.4		--	Not Applicable
	Ending	160.4		--	Not Applicable
Water Content	Initial	--	Calibrate Balance	--	Calibrate Balance
	Continuing	--	Not Applicable	--	Not Applicable
	Ending	--	Not Applicable	--	Not Applicable
GFAA Metals (excludes Hg)	Initial	200 series	3 levels plus blank ICV ± 10% of true value "r"[3] ≥ 0.995	7000 series	3 levels plus blank ICV ± 10% of true value "r"[3] ≥ 0.995
	Continuing	200 series	Every 10 samples ± 10% of true value	7000 series	Every 10 samples ± 20% of true value
	Ending	200 series	± 10% of true value	7000 series	± 20% of true value
	Other	200 series	Annually - Instrument detection limits	7000	Annually - Instrument detection limits

TABLE 8.5-7
Summary of Inorganic Method Calibrations
(Continued)

Analysis	Calibration	NPDES[1]		RCRA (SW846)[2]	
		Method	Requirement	Method	Requirement
Mercury by CVAA	Initial	245.1 245.5	5 levels plus blank ICV ± 10% of true value "r"[3] ≥ 0.995	7470A 7471A	5 levels plus blank ICV ± 10% of true value "r"[3] ≥ 0.995
	Continuing	245.1 245.5	Daily or every 10 samples, whichever is more frequent ± 20% of true value	7470A 7471A	Every 10 samples ± 20% of true value
	Ending	245.1 245.5	± 20% of true value	7470A 7471A	± 20% of original prepared standard
	Other	245.1 245.5	Annually: - Instrument detection limits	7470A 7471A	Annually - Instrument detection limits

Footnotes

(1) National Pollutant Discharge Elimination System

(2) Resource Conservation and Recovery Act, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, (SW-846), Third Edition, September 1986. Contains Final Update I (July 1992), Final Update IIA (August 1993), Final Update II (September 1994), and Final Update IIB (January 1995).

(3) "r" = correlation coefficient

(4) Method not listed in 40 CFR Part 136.

TABLE 8.5-8
Summary of Organic Method Calibrations
(Continued)

Analytical Parameter	Calibration	NPDES[1]		RCRA (SW846)[2]	
		Method	Requirement	Method	Requirement
Dioxins/ Dibenzofurans by HRGC/LRMS (continued)	Continuing	613	1 level each working day. % D must be ≤ 15%.	8280	1 level every 12 hours after window performance mix Standard must have RFs with %D ≤ 30% from initial
	Ending	613	Not Applicable	8280	Window performance mix
	Other	613	Establish Single Ion Monitoring conditions described in method	8280	Window mix to set congener windows every 12 hours at beginning of sequence. Isotope ratios in standard must meet criteria in method. Valley between 2,3,7,8-TCDD[3] and 1,2,3,4-TCDD must be ≤ 25% of the 2,3,7,8-TCDD[3] peak height.
Dioxins/ Dibenzofurans by HRGC/HRMS	Initial	--	Not Applicable	8290	5 levels plus window defining solution. %RSD for natives ≤ 20% for RFs; %RSD for labeled compounds ≤ 30% for RFs.
	Continuing	--	Not Applicable	8290	1 level every 12 hours after window defining solution. RFs with %D ≤ 20% for natives; %D ≤ 30% for labeled compounds from initial
	Ending	--	Not Applicable	8290	1 level: RFs with %D ≤ 20% for natives; %D ≤ 30% for labeled compounds from initial

TABLE 8.5-8
Summary of Organic Method Calibrations
(Continued)

Analytical Parameter	Calibration	NPDES[1]		RCRA (SW846)[2]	
		Method	Requirement	Method	Requirement
Nitroaromatics by HPLC (continued)	Ending	--	Not Applicable	8330	Midpoint calibration standard. %D: ± 15% of predicted response for any analyte quantitated and reported, %D + 30 to - 15% for analytes not detected.
	Other	--	Not Applicable	8330	Not Applicable
Polyaromatic Hydrocarbons by GC or HPLC	Initial	610	Minimum of 3 levels If % RSD < 10%, use avg RF. Otherwise, calibration curve employed	8100 8310	Minimum of 5 levels If % RSD < 20%, use avg RF. Otherwise, calibration curve employed.
	Continuing	610	1 or more calibration standards analyzed daily % D ± 15% of predicted response	8100 8310	Mid-level calibration standard analyzed every 10 samples. % D ± 15% of predicted response for any analyte quantitated and reported, %D + 30 to - 15% for analytes not detected.
	Ending	610	Not Applicable	8100 8310	Mid-level calibration standard. % D ± 15% of predicted response for any analyte quantitated and reported, %D + 30 to - 15% for analytes not detected.
	Other	610	Not Applicable	8100 8310	Not Applicable
Pesticides/ PCBs by GC	Initial	608	Minimum of 3 levels If % RSD < 10%, use avg RF. Otherwise, calibration curve employed	8080A	Minimum of 5 levels. If % RSD < 20%, use avg RF. Otherwise, calibration curve employed.
	Continuing	608	1 or more calibration standards analyzed daily % D ± 15% of predicted response	8080A	Mid-level calibration standard analyzed every 10 samples. % D ± 15% of predicted response for any analyte quantitated and reported, %D + 30 to - 15% for analytes not detected.

TABLE 8.5-8
Summary of Organic Method Calibrations
(Continued)

Analytical Parameter	Calibration	NPDES[1]		RCRA (SW846)[2]	
		Method	Requirement	Method	Requirement
Organophos-phorous Pesticides by GC (continued)	Continuing	--	Not Applicable	8140 8141A	Mid-level calibration standard analyzed every 10 samples. % D ± 15% of predicted response for any analyte quantitated and reported, %D + 30 to -15% for analytes not detected.
	Ending	--	Not Applicable	8140 8141A	Mid-level calibration standard % D ± 15% of predicted response for any analyte quantitated and reported, %D + 30 to -15% for analytes not detected.
	Other	--	Not Applicable	8140 8141A	Not Applicable
Purgeable Halocarbons by GC	Initial	601	Minimum of 3 levels If % RSD < 10%, use avg RF. Otherwise, calibration curve employed	8010B	Minimum of 5 levels If % RSD < 20%, use avg RF. Otherwise, calibration curve employed.
	Continuing	601	Analyze QC check sample and evaluate per method requirements	8010B	Mid-level calibration standard analyzed every 10 samples. Evaluate per method requirements.
	Ending	601	Not Applicable	8010B	Mid-level calibration standard Evaluate per method requirements.
	Other	601	Not Applicable	8010B	Not Applicable

TABLE 8.5-8
Summary of Organic Method Calibrations
(Continued)

Analytical Parameter	Calibration	NPDES[1]		RCRA (SW846)[2]	
		Method	Requirement	Method	Requirement
Semivolatiles (continued)	Ending	625	Not Applicable	8270B	Not Applicable
	Other	625	DFTPP[7] tuning every 24 hours before standard or sample runs.	8270B	DFTPP[7] tuning at the beginning of every 12 hour shift.
Volatiles	Initial	624	Minimum of 3 levels, If % RSD ≤ 35%, can use mean RF Otherwise calibration curve employed	8240B	Minimum of 5 levels, % RSD for RF for CCCs[4] ≤ 30% SPCCs[5]: RF > 0.300 (0.10 for Bromoform)
	Continuing	624	1 level every 24 hours Aceeptance criteria are found in the metnod	8240B	Mid-level standard every 12 hours (after tuning) %D for CCCs[4] < 20 % between RF from standard and avg RF from initial SPCCs[5]: RF > 0.300 (0.10 for Bromoform
	Ending	624	Not Applicable	8240B	Not Applicable
	Other	624	BFB[6] tuning every 24 hours before standard or sample runs.	8240B	BFB[6] tuning at the beginning of every 12 hour shift.
	Initial	--	Not Applicable	8260A	Minimum of 5 levels, %RSD for RF for CCCs[4] < 30% SPCCs[5]: RF ≥ 0.30 for Chlorobenzene and 1,1,2,2-tetrachloroethane, RF ≥ 0.10 for Chloromethane and 1,1-dichloroethane, RF > 0.10 for Bromoform

TABLE 8.5-9
Summary of USEPA Contract Laboratory Program Statement of Work Method Calibrations

Analytical Parameter	Calibration	Method	Requirement
Cyanide, Total	Initial	ILM03.0	Minimum 5 levels plus blank "r" ≥ 0.995
	Continuing	ILM03.0	1 mid-level every 10 samples ± 15 % of true value
	Ending	ILM03.0	± 15 % of true value
	Other	ILM03.0	Not Applicable
ICAP (excludes mercury)	Initial	ILM03.0	1 level and blank ICV: ± 10% of true
	Continuing	ILM03.0	Mid-level calibration standard Every 10 samples ± 10% of true value
	Ending	ILM03.0	Mid-level calibration standard ± 10% of true value
	Other	ILM03.0	ICSA, ICSAB: Analyze at beginning and end or every 8 hours whichever is more frequent CRI: Beginning and end of each run, and every 8 hours for all analytes at 2x CRDL or 2x IDL whichever is greater, except for Al, Ba, Ca, Fe, Mg, Na, K Quarterly: Instrument detection limits Linear Range Verification Annually: ICP interelement correction factors

TABLE 8.5-9
Summary of USEPA Contract Laboratory Program Statement of Work
Method Calibrations
(Continued)

Analytical Parameter	Calibration	Method	Requirement
Pesticides/PCBs (continued)	Ending	OLM03.1	Instrument Blank and midpoint calibration or PEM
	Other	OLM03.1	Resolution Check Mixture ≥ 60% PEM: ≥ 90% DDT, Endrin breakdown must each be ≤ 20% (≤ 30% combined)
	Initial	OLM01.8	3 levels for single component analytes, 1 level for multicomponent analytes RSD must be ≤20% for each single component target compounds (up to two single components target compounds per column may be > 20.0% but those compounds must have an RSD ≤30.0%.
	Continuing	OLM01.8	Instrument Blank and mid-point calibration standard or PEM every 12 hours Must meet resolution, retention time window, and RPD requirements in method
	Ending	OLM01.8	Instrument Blank and mid-point calibration standard or PEM Must meet resolution retention time window, and RPD requirements in method
PCDD, PCDF	Initial	DFLM01.1	Minimum 5 levels Resolution: 13C12-2378-TCDD and 13C12-1234-TCDD < 25% 123478-HxCDD and 123678-HxCDD ≤ 50% %RSD unlabeled PCDDs/PCDFs and internal standards ≤ 15%
	Continuing	DFLM01.1	Analyze CC3 or CPS solution every 12 hours Must meet ion abundance, S/N, and %D criteria in method
	Ending	DFLM01.1	Analyze CC1 solution at end of 12 hour period Must meet ion abundance and S/N criteria in method
	Other	DFLM01.1	Window Defining Mix: verify switching times

TABLE 8.6-1
Precision and Accuracy Measurements

Measurement	Definition
Accuracy	The degree of agreement of a measurement with an accepted reference or true value. The only true or known values in the laboratory are spiked samples. Expressed as laboratory control sample (LCS) percent recovery (% R): $$LCS\ \%Recovery = \frac{X}{t} x\ 100$$ where: X = observed concentration t = concentration of spike added Expressed as matrix spike/matrix spike duplicate (MS/MSD) sample percent recovery (% R): $$MS/MSD\ \%Recovery = \frac{X_s - X}{t} x\ 100$$ where: X_s = observed concentration in spiked sample X = observed concentration in unspiked sample t = concentration of spike added
Precision	The measure of analytical reproducibility of two values. Expressed as the relative percent difference (RPD) of two values. $$RPD = \left[\frac{|X_1 - X_2|}{\left(\frac{X_1 + X_2}{2}\right)}\right] x\ 100$$ where: X_1 = first observed concentration X_2 = second observed concentration

TABLE 8.11-5
Instrument Maintenance Schedule
Flame Atomic Absorption Spectroscopy[1]

Daily	Monthly	As Needed
Verify proper safety precautions are working.	Clean all filters and fans.	Check drain receptacle.
Verify gas box operates properly and safely.	Change capillary tubing	Check background corrector for alignment.
Verify sensitivity using elements in UV/VIS spectrum.	Clean optical windows	Clean burner head.
		Clean nebulizer.
		Clean spray chamber.
		Check sample introduction O-rings.

TABLE 8.11-6
Instrument Maintenance Schedule
Inductively Coupled Argon Plasma/Mass Spectrometry (ICAP/MS)[1]

Daily	Weekly	Monthly	Quarterly	Annually	As Needed
Check sample waste container level.	Check peristaltic pump: proper roller pressure, sample introduction tubing, correct pump rotation, condition of drain tubing.	Clean all filters and fans.	Replace oil in roughing pumps.	Replace oil in turbo-molecular pump.	Check electronic settings for optimum sensitivity: resolution, mass calibration, ion optics, CEM, deflector voltage.
Check quartz torch condition.	Check condition of sampler and skimmer cones.	Check recirculator water level.			
Measure quartz torch for proper alignment.	Check and drain oil mist eliminator on roughing pumps.				
Clean spray chamber and nebulizer.					
Check oil level of roughing pumps.					

TABLE 8.11-8
Instrument Maintenance Schedule
Graphite Furnace Atomic Absorption[1]

Daily	Monthly	As Needed	Annually
Check gas lines and gas supply.	Check coolant level in cooling unit. Add coolant if error message appears.	Replace contact cylinder.	Notify manufacturer service engineer to clean optics.
Clean optical windows.		Adjust autosampler arm.	
Clean contact cylinders.			
Check tubes and platform; replace if corroded, faking, or if low absorbance results.			
PE4100ZL: clean fume extraction tip, replace fume extraction filter and H_2O trap.			
As needed, trim sampling capillary.			
Check drain lines and waste containers; empty as needed.			
Check acid rinse containers; fill as needed.			

TABLE 8.11-9
Instrument Maintenance Schedule
Cold Vapor Atomic Absorption (Leeman PS 200)[1]

Daily	As Needed	Annually
Change drying tube	Change pump tubing	Change Hg lamp.
Check pump tubing/drain tubing	Check/change Hg lamp	
Check gas pressure	Clean optical cell	
Check aperture reading	Lubricate pump	

TABLE 8.11-10
Instrument Maintenance Schedule
Cold Vapor Atomic Absorption (PE 5000)[1]

Daily	Monthly
Clean aspirator by flushing with DI water.	Clean cell in aqua regia.
Check tubing and replace if needed.	Clean aspirator in aqua regia.
Clean windows with methanol.	
Change silica gel in drying tube.	
Check argon gas supply.	
Adjust lamp.	

TABLE 8.11-11
Maintenance Schedule
Gas Chromatograph[1]
(Continued)

Daily	As Needed	Quarterly/Semi-annually/Annually
GC (continued)	HP 7673 Autosampler: replace syringe, fill wash bottle, dispose of waste bottle contents.	(continued)
	Purge & trap devices: periodic leak checks, replace/condition traps (when poor response or disappearance of reactive or poorly trapped compounds), clean sample lines, valves (if they become contaminated), clean glassware.	
	Purge & trap autosamplers: leak check system, clean sample lines, valves. PTA-30 autosampler also requires cleaning the syringes, frits, valves, and probe needles, adjustment of micro switches, replacement of Teflon® valve, and lubrication of components.	

TABLE 8.11-13
Instrument Maintenance Schedule
TRAACS 800 Auto Analyzer [1]

As Needed	Daily	Monthly	Semi-annually	Annually
Replaces air filter when progressive loss of air pressure is observed.	Check air pressure gauge (22 ± 2 psi)	Change all pump tubes (or after 200 hours of pumping time)	(or after 1000 hours of pumping time)	Lightly lubricate the Linear Sample Rails (use semi-fluid lubricant)
Replace air valve tubing when occlusion in tubing is observed	Use recommended washout procedure (at end of analysis operations)	Clean sample probe shaft	Replace pump platens	Replace colorimeter lamp (or after 2500 hours of use)

TABLE 8.11-14
Instrument Maintenance Schedule
Sonicator [1]

Daily	As Needed
Daily when used: Inspect probe tips for inconsistencies (etching/pitting).	Replace probe tip.
	Disassemble and clean sonicator probe tips.
	Tune sonicator assembly.

TABLE 8.11-15
Instrument Maintenance Schedule
Analytical/Top Loading Balances[1]

Daily	Annually
Daily when used: Calibrate with check weights.	Internal weight train serviced. Gears and electronics serviced.

TABLE 8.11-16
Instrument Maintenance Schedule
Refrigerators/Walk-in Coolers[1]

Daily	As Needed
Temperatures checked and logged.	Refrigerant system and electronics serviced.

TABLE 8.11-21
Instrument Maintenance Schedule
Conductance Meter[1]

Daily	As Needed
Daily when used: Calibrate with check standards.	Electronics serviced.

TABLE 8.11-22
Instrument Maintenance Schedule
Chemical Oxygen Demand (COD) Reactor

Daily	As Needed
Daily when used: Calibrate with check standards.	Electronics serviced.

TABLE 8.11-23
Instrument Maintenance Schedule
Spectrophotometer[1]

As Needed	Daily	Monthly	Annually
Dust the lamp and front of the front lens.	Check the zero %T adjustment.	Perform wavelength calibration at 530 nm.	Oil bearings.

TABLE 8.11-24
Instrument Maintenance Schedule
pH Meter[1]

As Needed	Daily
Clean electrode.	Verify electrodes are properly connected and filled.
Refill reference electrode.	Make sure electrode is stored in buffer.

TABLE 8.11-27
Instrument Maintenance Schedule
Total Organic Carbon Analyzer (OI 7000)

Daily	Weekly	Monthly	Semi-Annually
Check: Oxygen supply Persulfate supply Acid supply Carrier gas flow rate (~ 150 cc/min) IR millivolts for stability (after 30 min. warm-up)	Check liquid-flow-rate-pump-tubing conditions on autosampler Check injection port septum	Clean digestion vessel Clean condenser column Do the leak test	Change pump tubing

Footnotes to Preventive Maintenance Tables

(1) Refer to manufacturer's instructions for each instrument to perform maintenance operations.
(2) Also see Table 8.11-11 for applicable "As Needed" GC maintenance.

Glossary

Glossary (continued)

acceptance limits
Data quality limits specified for analytical method performance.

accuracy
Accuracy is the degree of agreement between a measurement and the true or expected value, or between the average of a number of measurements and the true or expected value. Systematic errors affect accuracy. For chemical properties, accuracy is expressed either as a percent recovery (R) or as a percent bias (R - 100).

aliquot, aliquant
A measured portion of a sample taken for analysis.

analytical spike
A sample created by spiking target analytes into a prepared portion of a sample just prior to analysis. (Also see matrix spike.)

anomaly
See nonconformance.

areas needing improvement
Represent isolated instances of noncompliance or issues that are judged to have a less immediate impact on data quality. Laboratory management must correct the situation or otherwise ensure that the condition does not recur. This term replaces the previous term used "Observations."

arithmetic mean
The arithmetic mean ($\bar{x}$) is the average of a set of values. It is equal to the sum of the observed values divided by the number of observations. Also called "average".

where: $\bar{x}$ = the mean
x_i = the i^{th} data value
n = number of data values

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

Glossary (continued)

which measure physical parameters such as mass, time, and temperature. This type of calibration is independent of use in specific analyses and projects.

calibration curve
The graphical relationship between the known values for a series of calibration standards and instrument responses.

calibration factor (CF)
The ratio of the instrument response of an analyte to the amount injected. CFs are used in external standard calibrations.

$$CF = \frac{Total\ Area\ of\ Peak}{Mass\ Injected}$$

calibration standard
A standard used to quantitate the relationship between the output of a sensor and a property to be measured. Calibration standards should be traceable to standard reference materials (provided by NIST, or other recognized standards agencies) or a primary standard.

Certificate of Analysis
The standard Quanterra® format for reporting analytical results.

certified reference material
A reference material accompanied by a certificate issued by an organization certifying the contents and concentration(s) of the material. (See also standard reference material.)

chain-of-custody (COC)
A system of documentation demonstrating the physical custody and traceability of samples.

Glossary (continued)

completeness
Completeness is a measure of the percentage of measurements that are judged to be valid measurements. At a minimum, the objective for completeness of data is 90% for each constituent analyzed. It is usually expressed as a percentage:

$$\%\ Completeness = \frac{V}{n} x\ 100$$

where: V = number of measurements judged valid
n = total number of measurements

composite
A sample composed of two or more increments.

control chart
A graphical representation of analytical accuracy. Displays the arithmetic mean of a data set, the upper and lower warning limits and the upper and lower control limits.

control table
A tabular presentation of test results with respect to time or sequence of measurement, together with limits within which the results are expected to lie when the analytical process is in a state of control.

controlled document
A document for which the distribution is known. Updates of the document are sent to the original recipients, unless the copy distributed is an uncontrolled copy.

corrective action
A measure taken to rectify conditions adverse to quality and, where necessary, to preclude their recurrence.

Glossary (continued)

data validation
See validation - data.

data verification
See verification - data.

deficiency
See nonconformance.

degrees of freedom
The number of independent deviations used in calculating an estimate of the standard deviation.

double blind performance evaluation sample
A sample that contains select parameters at defined levels. The levels are unknown to the laboratory. The laboratory is also unaware that the sample is a performance evaluation sample.

duplicate sample analyses
Different aliquots of the same sample are analyzed to evaluate the precision of an analysis.

error
The difference between an observed or measured value and its true value.

field blank
A blank that is prepared and handled in the field and analyzed in the same manner as its corresponding client samples.

field matrix spike
A sample created by spiking target analytes into a sample in the field at the point of sample acquisition.

Glossary (continued)

matrix
The component or substrate which contains the analyte(s) of interest. Examples of matrices are water, soil or sediment, and air. Matrix is not synonymous with phase (liquid or solid).

matrix effect
An interference in the measurement of analyte(s) in a sample that is caused by materials in the sample. Matrix effects may cause elevated reporting limits or may prevent the acquisition of acceptable results.

matrix spike (MS)
An aliquot of a matrix fortified (spiked) with known quantities of specific compounds and subjected to an entire analytical procedure in order to indicate the appropriateness of the method for a particular matrix. The percent recovery for the respective compound(s) is then calculated.

matrix spike duplicate (MSD)
A second aliquot of the same matrix as the matrix spike (above) that is spiked in order to determine the precision of the method.

may
Denotes permission but not a requirement.

mean
See arithmetic mean.

measurement
The process or operation of ascertaining the extent, degree, quantity, dimensions, or capability with respect to a standard.

median
The middle value of a set of data when the data set is ranked in increasing or decreasing order.

Glossary (continued)

notable practices

Laboratory practices that increase effectiveness and quality and represent improvements with respect to conventional laboratory operations.

nonconformance

An unplanned deviation from an established protocol or plan. The deviation may be the result of Quanterra's® actions, then termed a deficiency. If the deviation is the result of events beyond the control of Quanterra®, it is termed an anomaly.

operational calibration

Routinely performed as part of instrument usage, such as the development of a standard calibration curve. Operational calibration is generally performed for instrument systems.

outlier

A result excluded from the statistical calculations due to being deemed "suspicious" when applying the "Grubbs Test" (or equivalent).

parameter

A constant or coefficient that describes some characteristic of a population (e.g., standard deviation, mean, regression coefficients). Also, a chemical being measured, i.e., an analyte.

percent difference

When two independent measurements of the same characteristics are available, it is possible to use the percent difference instead of the coefficient of variation to measure precision.

$$\%D = \left| \frac{X_1 - X_2}{X_1} \right| x\ 100\%$$

where: $\%D$ = percent difference
X_1 = first value
X_2 = second value

Glossary (continued)

difference (RPD) for duplicate measurements. Table 8.6-1 illustrates the formulae used to calculate units of precision (i.e., RSD and RPD).

preventive maintenance
An organized program within Quanterra® laboratories of actions (such as equipment cleaning, lubricating, reconditioning, adjustment and/or testing) taken to maintain proper instrument and equipment performance and to prevent instruments and equipment from failing during use.

primary standard
A material having a known, stable property that can be accurately measured or derived from established physical or chemical constants. It is readily reproducible and can be accepted (within stated limits) and used to establish the same value of another substance or item.

procedure
Detailed instructions to permit replication of a method. (See standard operating procedure.)

proficiency testing
A series of planned tests which will determine the ability of field technicians or laboratory analysts to perform routine analyses. The results from this testing may be used for comparison against established criteria or for relative comparisons among the data from a group of technicians or analysts.

project-specific reporting limit (PSRL)
See reporting limit.

protocol
Methodology specified in regulatory, authoritative, or contractual situations.

QC batch
The QC batch consists of a set of up to 20 field samples that behave similarly (i.e., same matrix) and are processed using the same procedures, reagents, and standards within the same time period.

Glossary (continued)

quality control (QC)
The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that it meets the stated requirements established by the client or by Quanterra®.

quality improvement
The process of improving the quality of operations. This process encourages worker recommendations for improvement of work processes and requires timely management evaluation and feedback or implementation.

quality management
That aspect of the overall management system of the organization that determines and implements the quality policy. Quality management includes strategic planning, allocation of resources, and other systematic activities (e.g., planning, implementation, and assessment) pertaining to the quality management system.

quality management system (QMS)
A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, and implementation plan of an organization for ensuring quality in its work processes, products, and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC.

random error
Variations of repeated measurements that are random in nature and individually not predictable.

range
The difference between the largest and smallest numbers in a set of numbers.

Glossary (continued)

relative response factor (RRF)
A measure of the relative mass spectral response of a compound compared to its internal standard. RRFs are determined by analysis of standards and are used in the calculation of concentrations of analytes in samples. Because a RRF is the comparison of two responses, it is a unitless number. RRFs are determined by the following equation:

$$RRF = \frac{A_x}{A_{IS}} x \frac{C_{IS}}{C_x}$$

where: A = area of the characteristic ion measured
C = concentration
IS = internal standard
x = analyte of interest

relative standard deviation (RSD)
See coefficient of variation.

reporting limit (RL)
One of two types of reporting limit conventions within Quanterra®. The Reporting Limit (RL) is a uniform, Quanterra® -wide reporting limit based on an evaluation of the PQLs at Quanterra® laboratories and the expected method performance in routine water and soil matrices. Project Specific Reporting Limits (PSRLs) are reporting limits that are defined by project requirements.

representative sample
A sample taken to represent a lot or population as accurately and precisely as possible.

representativeness
Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, a variation in a physical or chemical property at a sampling point, or an environmental condition. Data representativeness is primarily a function of sampling strategy; therefore, the sampling scheme must be designed to maximize representativeness. Representativeness also relates to ensuring that, through sample homogeneity, the sample analysis result (concentration) is

Glossary (continued)

standard deviation
A measure of the dispersion about the mean of the elements in a population. The square root of the variance of a set of values:

$$s = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$

where: s = standard deviation
Σ = sum of
X = observed values
n = number of observations

standardization
The establishment of the value of a potential standard with respect to an established or known standard.

standard method
A method of known and demonstrated precision issued by an organization generally recognized as competent to do so.

standard operating procedure (SOP)
A written document that details an operation, analysis, or action, with prescribed techniques and steps, that is officially approved as the method for performing certain routine or repetitive tasks.

standard reference material (SRM)
A material produced in quantity, of which certain properties have been certified by the National Institute of Standards and Technology (NIST), formerly NBS, or other agencies to the extent possible to satisfy its intended use.

standard verification
Standard is checked by Quanterra® versus manufacturer specification. See Section 8.5.4.3.

Glossary (continued)

technique
Physical or chemical principle for characterizing materials of chemical systems.

traceability of data
The entire documented chain of acquired data from the original acquisition effort through to the final tabulation, synthesis, reduction, and storage activities. The documentation will allow complete reconstruction of the data.

traceability of samples
During all environmental monitoring field efforts, acquired samples will be assigned specific and unique identification numbers. These sample numbers shall be accompanied by documentation (chain-of-custody form) which clearly identifies all parameters associated with sample acquisition. All additional sample numbering systems applied to the sample must be clearly cross-referenced to the field sample number to provide for traceability of samples from acquisition to reporting of sample results.

traceability of standards
The ability of an analytical standard material used for calibration purposes to be traced to its source. The standards used by Quanterra® must be traceable via written documentation to sources which produce or sell verified or certified standards, i.e., National Institute for Standards and Technology, or vendors preparing standards from those sources which they have certified.

validation - computer software
The process of establishing documented evidence which provides a high degree of assurance that a specific process will consistently produce a product meeting predetermined specifications and quality attributes. This process demonstrates and documents that the software performs correctly and meets all specified requirements.

validation - data
The process of a second party performing a systematic review of the raw and final data produced by a laboratory using predetermined criteria to ascertain the validity of the data with respect to the criteria (e.g., HAZWRAP data validation).

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Appendix A

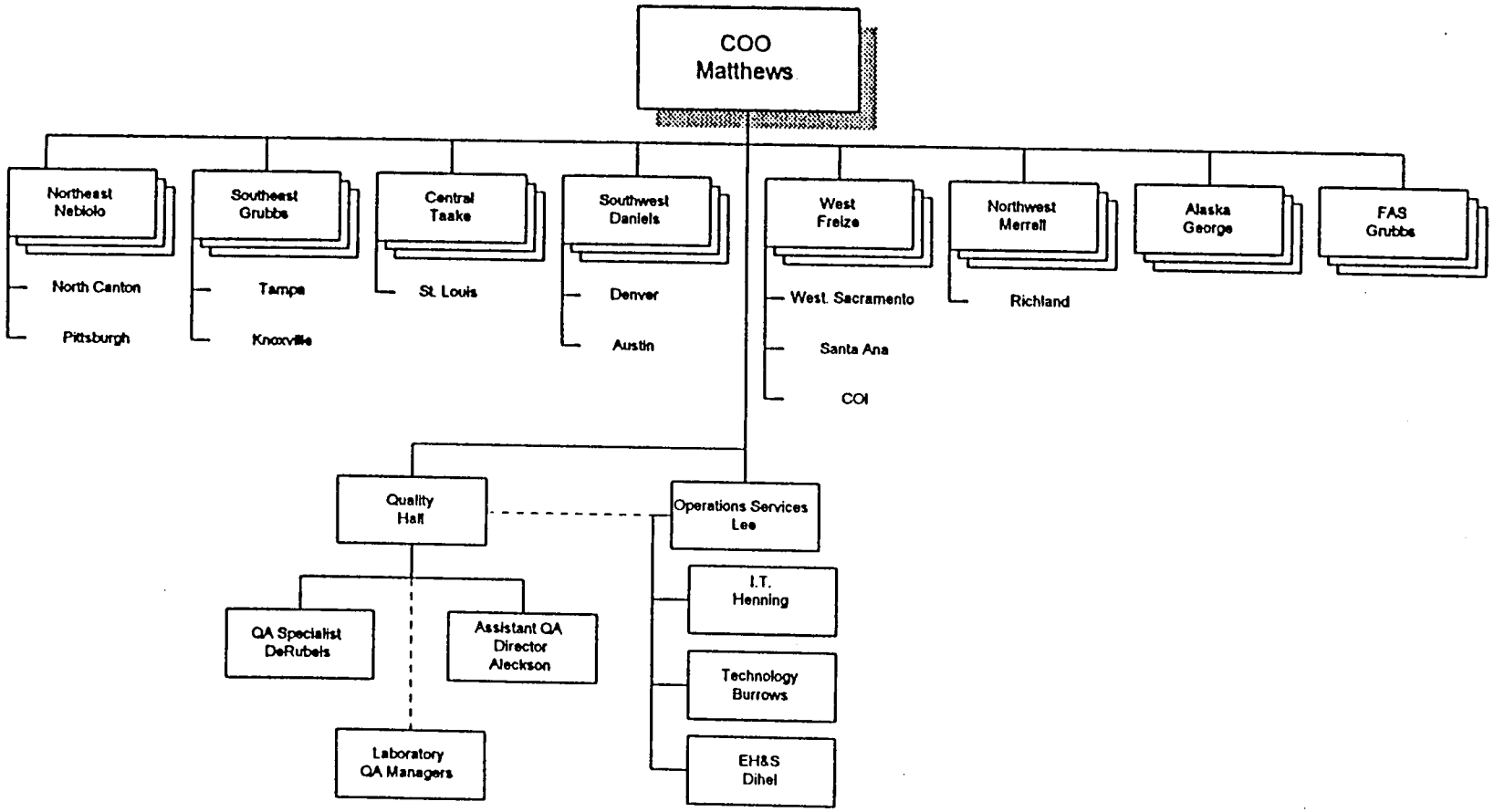
Quanterra®
Quality Assurance Management Plan

Corporate Key Personnel List and Quanterra® Operations Organizational Chart

Quanterra®
Corporate Key Personnel List

Associate Name	Title	Degree	Years of Experience
Gerhard F. König	President and CEO	MBA	32
Enos Tracey	Chief Financial Officer	BS, Accounting MBA, Accountancy	13
Elizabeth Chapman	Human Resources Manager	MS, Human Resources	8
Mark Matthews	Chief Operating Officer	BA, Accounting	18
Chris M. Lee	Vice President Operations Services	Business/Biology	13
Donnie Heinrich	Senior Vice President of Sales	BS, Chemistry	22
Brad S. Figley	Senior Vice President Legal and Strategy	JD in Law	16
Bill Henning	Director of Information Technology	BA, Sociology MBA, Quantitative Studies	14
Jack Hall	Corporate Director of Quality Assurance	BS, Chemistry	33
Don Dihel	Corporate Director of Environmental Health and Safety	BA, Chemistry	23
Richard Burrows	Technology/Principal Scientist	BS, Chemistry Ph.D., Analytical Chemistry	12

QUANTERRA OPERATIONS ORGANIZATIONAL CHART



as of 5/1/97

Appendix B

Quanterra®
Quality Assurance Management Plan

Addresses of Quanterra® Locations

APPENDIX B

ADDRESSES OF Quanterra® LOCATIONS

LABORATORIES

Alaska
Quanterra®
5761 Silverado Way
Suite N
Anchorage, Alaska 99518
Voice: (907) 563-4800
Fax: (907) 563-4815

California
Quanterra®
18501 East Gale Avenue
Suite 130
City of Industry, California 91748
Voice: (818) 965-1006
Fax: (818) 965-1003

Quanterra®
1721 South Grand Avenue
Santa Ana, California 92705
Voice: (714) 258-8610
Fax: (714) 258-0921

Quanterra®
880 Riverside Parkway
West Sacramento, California 95605
Voice: (916) 373-5600
Fax: (916) 372-1059

Colorado
Quanterra®
4955 Yarrow Street
Arvada, Colorado 80002
Voice: (303) 421-6611
Fax: (303) 431-7171

Florida
Quanterra®
5910 H Breckenridge Parkway
Tampa, Florida 33610
Voice: (813) 621-0784
Fax: (813) 623-6021

Missouri
Quanterra®
13715 Rider Trail North
Earth City, Missouri 63045
Voice: (314) 298-8566
Fax: (314) 298-8757

Ohio
Quanterra®
4101 Shuffel Drive, N.W.
North Canton, Ohio 44720
Voice: (216) 497-9396
Fax: (216) 497-0772

Pennsylvania
Quanterra®
450 William Pitt Way, Building 6
Pittsburgh, Pennsylvania 15238
Voice: (412) 826-5477
Fax: (412) 826-5571

Appendix C

Quanterra®
Quality Assurance Management Plan

Facility-Specific Appendix

List of Laboratory Locations

This appendix contains facility-specific, quality-related information and requirements for Quanterra® laboratories. These laboratories are located in the following cities:

- Anchorage, Alaska
- Austin, Texas
- City of Industry, California
- Denver, Colorado
- Knoxville, Tennessee
- North Canton, Ohio
- Pittsburgh, Pennsylvania
- Richland, Washington
- Sacramento, California
- Santa Ana, California
- St. Louis, Missouri
- Tampa, Florida

Each laboratory section in this appendix contains information specific to that laboratory only and contains the following basic outline:

Section	Contents
0	Table of Contents
1	Organizational Chart
2	Instrument List
3	Standard Operating Procedures List
4	Analytical Methods
5	MDLs, RLs, and CRDLs
6	Performance Evaluation Studies
7	Additional Operation-Specific Information

HEALTH AND SAFETY PLAN

DOVATRON INTERNATIONAL
ORDER ON CONSENT INDEX # B7-0516-97-05
SITE CODE #704024

Formerly Binghamton Plastics Site
498 Conklin Avenue
Binghamton, New York

Prepared by:

SHIELD ENVIRONMENTAL ASSOCIATES, INC.
Lexington, Kentucky
November 11, 1998

Job No. 396-0460

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1.0 INTRODUCTION

The health and safety of site workers and the general public is of primary concern during site operations where hazardous conditions may be present. Thus, a comprehensive, carefully managed, and thoroughly documented Health and Safety Plan (HASP) is crucial for successful project completion.

The following plan for the Dovatron International Site (formerly Binghamton Plastics) located in the City of Binghamton, Broome County, New York describes specific responsibilities, training requirements, protective equipment, and site operating procedures to be utilized and implemented in order to protect on-site personnel and the public, to the extent practicable, from the potential hazards associated with hazardous waste site activities. Additional site investigation activities may require a modified or amended plan. If conditions encountered in the field differ from those described within this HASP, work should be stopped immediately and the Health and Safety Officer notified. This HASP has been specifically written for additional sampling activities and on-site feasibility studies to be conducted as a part of the Remedial Investigation/Feasibility Study (RI/FS). Recommendations for protective equipment use and site operation procedures necessary during the RI/FS implementation will be based upon site monitoring data gathered during the remedial design activities.

The HASP has been developed based on the following:

- The Occupational Health and Safety Administration (OSHA) regulations in 29 CFR Parts 1910 and 1926, specifically Part 1910.120 (Hazardous Waste Operations and Emergency Response).

- The Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, NIOSH/OSHA/USCG/EPA, October 1985.

- The Standard Operating Safety Guides from the U.S. Environmental Protection Agency (USEPA), Office of Emergency and Remedial Response, June 1992.

The complete HASP will be distributed by the site contractor and discussed with all site personnel prior to commencing on-site activities. This is necessary so that personnel are sufficiently aware of the potential for hazardous conditions. In addition, the HASP gives field personnel advance preparation and knowledge of the coordinated procedures that should be followed if emergency conditions are encountered.

A copy of this HASP, as well as any health and safety plans utilized by contractors or subcontractors working at the Site, will be available during all on-site activities. All field personnel will have access to the HASP for the purpose of reviewing pertinent safety guidelines as they apply to all aspects of on-site operations. The HASP will be amended as required by field

conditions, and all appropriate personnel will be informed of amendments. Upon review of the HASP, on-site personnel will sign and date the Acknowledgment of Health and Safety Review form contained in Attachment 1.

1.1 Site Location

The Dovatron International (formerly Binghamton Plastics) Site is located in the City of Binghamton, Broome County, New York (Figure 1). The property measures approximately 4 acres and is located 700-800 feet south of the Susquehanna River at 498 Conklin Avenue.

1.2 Site History

The facility at the subject site was constructed in 1956 by Binghamton Plastics. Additions to the property were constructed in 1963, the late 1970s, and the early 1980s. Universal Instruments Corporation purchased the facility in the early 1980s and continued operations until Universal Instruments was taken over by Dover Electronics Corporation. In 1993, Dover Electronics was separated from Dover as a stand alone corporation named Dovatron, Inc. In 1996, Dovatron changed its name to the DII Group. The building has been occupied by McIntosh Laboratories since the late 1980s. The facility has been used as a circuit board assembly plant and is currently operated as an electronic repair facility.

The subject site consists of a large industrial building (44,800 square feet) with associated parking, landscape, and storage areas. A complete list of chemical substances used at the plant is not available; however, the use of TCE and 1,1,1-TCA has been substantiated.

In addition, a 1,000-gallon underground storage tank (UST) that was used to store hydraulic oil contaminated with 1,1,1-trichloroethane (1,1,1-TCA) and trichloroethene (TCE), was removed in 1986. Figure 2 shows the former location of the tank and significant site features.

Shield reviewed a June 1990 letter to Hagopian Engineering Associates from the Broome County Health Department (Hagopian 1990). This letter indicated that there were three contaminated sites within a 1/2-mile radius of Conklin Avenue. One of those sites was identified as Binghamton Plastics Dump, which was listed as being located at 498 Conklin Avenue. Reportedly, waste plastics and oils were thought to have been disposed of there. However, this information has not been substantiated.

Periodic groundwater monitoring and additional site investigations conducted by Shield have substantiated the presence of TCE, 1,1,1-TCA, and their degradation products in the soils and groundwater at the site. The contamination appears to be isolated to a perched water zoned on the west side of the building and may have infiltrated the utility conduits in Chambers Street.

2.0 ON-SITE ORGANIZATION AND PERSONNEL

2.1 Project Organization and Personnel Responsibilities

Shield's project team at the site will work under the direction of the Project Director and Project Manager. Project personnel responsibilities are listed below.

- Project Director: For this effort, Daniel V. Terrell, III, will serve as Project Director. Mr. Terrell will be responsible for assessing and monitoring overall project progress, approving project plans and reports, making conclusions/recommendations, and leading major briefings/meeting negotiations.

- Project Manager: Michael E. Morris, P.G., will serve as Project Manager. Mr. Morris' responsibilities will include project team management, being the focal point for day-to-day client interactions and conducting briefings and client regulatory meetings. Mr. Morris will also be responsible for project schedule, budget monitoring, technical task integration and communications and coordination of team leaders and field efforts. He will also monitor the project for adherence to the Quality Assurance Project Plan (QAPP).

- Quality Assurance Officer: Barbara H. Jones will serve as the Quality Assurance Officer. Ms. Jones has the primary responsibility for overseeing and implementing the quality assurance (QA) program. She reports directly to the Project Director. In her role as Quality Assurance Officer, Ms. Jones will provide independent oversight to make sure that overall QA procedures are in place for the project.

- Site Supervisor: Kreg Mills will be designated as Site Manager. Mr. Mills will be responsible for overseeing all on-site activities. He will also interact with other field personnel so that field efforts are successfully completed. The Site Manager will communicate regularly with the Project Manager concerning project status, additional material and/or labor needs, etc., and keep a daily summary of all on-site activities.

- Site Health and Safety Officer: The Health and Safety Officer is responsible for proper operation of all safety equipment, monitoring activities during site work, selecting the necessary level of personal protection, and enforcing the HASP. Sarah Donaldson will act as the Health and Safety Officer for this project. The Health and Safety Officer will have the authority to stop work if conditions exceed allowable limits. The Health and Safety Officer will assist other members of the field team as needed to maintain the safe operation of the field program.

Other Authorized Personnel

All field personnel are to comply with federal, state and local safety codes, ordinances, and regulations in order to maintain safe working conditions at the job site. All personnel will be responsible for reporting unsafe working conditions to the Health and Safety Officer, Site Supervisor, or Project Manager. Prompt reporting of unsafe conditions is critical to provide field personnel with proper information, first aid, or other medical treatment in a timely manner; therefore, all questions or inquiries must be addressed to one of these persons immediately.

The Project Manager, Site Supervisor, and Health and Safety Officer are responsible for enforcing health and safety requirements including the following:

- Team members have received the required health and safety training.
- Team members are familiar with the health and safety procedures outlined in this plan.
- Equipment used on-site is suitable and adequate.
- Standard operating procedures are followed.

The designated Health and Safety Officer has direct responsibility for administering and coordinating all site health and safety activities. The Site Supervisor and/or Health and Safety Officer will be in the field full-time while site activities are in progress. The Health and Safety Officer is responsible for responding to any unanticipated health and safety concerns encountered. Appropriate actions will be directed by the Health and Safety Officer to protect site workers.

3.0 HAZARD EVALUATION

There is the potential for site personnel to come in contact with physical, chemical and biological hazards at the site.

3.1 Chemical Hazards

Based upon available information, organic compounds (specifically, chlorinated organics) are present in soils and ground water at the site. A list of the suspected volatile chemical hazards and their permissible exposure limits (PELs) is contained in Table 1. The presence of these compounds and airborne concentrations can only be established once field operations have commenced.

The primary exposure for the chemicals of concern will be through physical contact with contaminated soils or water, or inhalation of dusts or vapors. The potential for exposure will be judged on a continuous basis as work progresses. The personal protective equipment (PPE) required will be adjusted based upon field conditions encountered. Ambient air monitoring and visual observations will be used as a basis for these adjustments. Table 2 provides a task-by-task risk assessment that defines equipment used, hazards, and protective measures taken to minimize hazard risks.

3.2 Physical Hazards

Heat Stress

Heat stress monitoring will commence whenever the temperature on-site exceeds 75°F and personnel are wearing chemical-resistant coveralls. Under such conditions, the work load will be adjusted, and additional work/rest periods will be initiated. Suggested heat stress monitoring procedures are contained in the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (NIOSH/OSHA/USCG/EPA).

A summary of heat stress monitoring procedures is as follows:

- Visual Observations. The Health and Safety Officer will monitor field personnel through visual observations of breathing rate and redness of skin. If the Health and Safety Officer suspects heat stress, further personnel monitoring will be initiated.

- Heart Rate. The radial pulse will be counted during a 30-second period as early as possible in the rest period. If the pulse rate exceeds 110 beats per minute, the next work cycle will be shortened by one-third and the rest period kept the same. The procedure will be repeated each rest period, shortening the work cycle as needed by one-third.

- Oral Temperature. A clinical thermometer (3 minutes under the tongue) or similar instrument will be used to measure the oral temperature at the end of the work period (before drinking). If the temperature exceeds 99.6°F, the next work cycle will be shortened by one-third without changing the rest period. This procedure will be repeated each rest period. A worker will not be permitted to wear a semipermeable or impermeable garment when his/her temperature exceeds 100.6°F.

Cold Exposure

Cold temperatures can produce impaired ability to work. Cold emergencies (e.g., frostbite and hypothermia) are the result of exposure to cold temperatures and can result when wind chill factors are low. When working under such conditions, workers should wear appropriate clothing and have shelter readily available. Work and rest periods should also be scheduled, and workers should be monitored for exposure.

3.3 Biological Hazards

Animal/Insect/Snake Bites

In case of animal or snake bites, American Red Cross First Aid will be administered and the victim will be transported to the hospital for observation by trained medical personnel if the skin has been broken. If the skin has not been broken, the victim will be observed by the Health and Safety Officer. In the case of insect bites or stings, a victim who demonstrates an allergic reaction will be transported to the hospital immediately. Personnel with a history of allergic reactions to bites and/or stings should identify themselves to the Health and Safety Officer.

4.0 EMPLOYEE TRAINING

The HASP will be distributed and explained in a meeting with all contractors, subcontractors and other on-site personnel before they enter the active work site. It is the responsibility of the Project Manager, the Site Supervisor, and the Health and Safety Officer to see that the HASP is distributed and a meeting is conducted.

All field workers must be familiar with the required safety equipment and monitoring schedules. No unauthorized personnel will be permitted in the active work zone during site activities.

4.1 Training Procedures

The first requirement of a complete HASP is a thorough understanding of the types of hazards most likely to be encountered at hazardous waste sites and the personal protection measures needed to protect project personnel and the general public. This knowledge can only be obtained through proper training. Each project team member will have participated in a comprehensive training course prior to working on-site. Additional briefings will be held, as necessary, by the Health and Safety Officer to explain and discuss site-specific health and safety matters.

Under current OSHA regulations set forth in 29 CFR Part 1910.120, all personnel engaged in site activities that may include exposure to hazardous wastes/substances must complete and be certified in 40 hours of Hazardous Materials/Health and Safety training. In addition, field personnel must complete a minimum of 24 hours of field experience prior to the commencement of on-site activities. All personnel are required to take an 8-hour refresher course each year, reemphasizing issues crucial to personal health and safety in a hazardous environment. Management and supervisory personnel are required to supplement the 40-hour training with an 8-hour training course emphasizing additional issues applicable to management.

4.2 Records

All site personnel, regardless of level or position, must present proof of appropriate training before being allowed on the job site unless authorized by the Health and Safety Officer. All contractor and subcontractor personnel who are assigned to the field program will also be required to provide documentation which certifies their training.

5.0 PERSONAL PROTECTIVE EQUIPMENT

5.1 Personal Protective Equipment Program

Based on previous site work and analytical data collected at the subject site, there is currently sufficient evidence of conditions in the area that would warrant precautions during on-site activities. Accordingly, Level D safety equipment will be used with provisions for Level B protection as dictated by ongoing surveillance with air monitoring equipment. Refer to Attachment 2 for further information on Levels B, C and D PPE.

It is well established that worker safety and efficiency decrease in direct proportion to the amount of protective gear required. Thus, it is desirable to use as little protective equipment as possible and still provide adequate protection.

Persons performing preliminary site activities will wear, at a minimum, the following Level D PPE:

- Work clothes
- Safety boots
- Chemical-resistant gloves (if necessary)
- Hard Hat

These requirements are subject to change at any time by the Health and Safety Officer based on contaminant monitoring, visual observations, or changes in work or site conditions.

The following PPE will also be available:

- Chemical-resistant safety boots or overboots
- Safety glasses or goggles
- Chemical-resistant (Tyvek®) coveralls
- Self-contained breathing apparatus (SCBA)

One or several of these pieces of equipment will be worn to supplement Level D protection if and when the Health and Safety Officer establishes that such a change is necessary. Level B PPE equipment will also be available for site activities requiring this level of protection (see Table 3).

PPE selection is based on USEPA Levels of Protection, as defined in *Standard Operating Safety Guides* (June 1992). Level D protection, with provisions to upgrade to Level B, was chosen for most of the site activities on this project.

6.0 MEDICAL SURVEILLANCE REQUIREMENTS

6.1 Medical Program

All site personnel are required to be in a medical monitoring program. All other outside contractors are also required to provide their on-site field personnel with a medical monitoring program.

The medical monitoring program required by 29 CFR Part 1910.120 begins with a "baseline" physical examination. This primary medical information must be established prior a person's working in a hazardous environment. Medical monitoring of field personnel must be performed on an annual basis; it must include, but not be limited to, a chest X-ray, a liver/kidney examination, and a complete health screen, which includes a blood chemistry profile and a pulmonary function test to establish if the worker may use a respirator. If on-site exposures are deemed significantly hazardous, exposed personnel should receive a follow-up medical examination when field activities at a particular site cease.

Medical monitoring records shall be kept by the individual's employer for safekeeping. A letter shall be on file with the employer stating that the individual has passed his/her medical monitoring exam and is fit to wear a respirator.

7.0 MONITORING PROCEDURES

Continuous visual monitoring of personnel and of the job site is required. Another major consideration at the Site is instrument monitoring of ambient air to minimize exposure levels of any chemical gases/vapors. In addition, monitoring personnel for possible temperature-related problems may be necessary. Under no circumstances shall personnel enter confined spaces or other areas where oxygen may be limited until a confined space permit is prepared and personnel are properly trained.

7.1 Air Monitoring (Work Zone)

Under 29 CFR 1910 and SARA Title III, Section 1206 E, monitoring of ambient air in the work area is required to prevent inhalation of toxic gases and/or vapors. During investigation and sampling in areas where volatile organic compounds are expected, air in the breathing zone and work areas will be monitored continuously with a photoionization detector (PID). Measurements will be recorded at specified intervals for future reference. The Health and Safety Officer may require more frequent measurements based on field conditions and previous readings. Sufficient equipment will be maintained on-site to immediately address increased contaminant levels and to upgrade personal protection. Applicable action levels in response to various exposure levels are summarized in Table 4.

The use and type of respirators are at the discretion of the Project Manager, Site Supervisor, and/or Health and Safety Officer. Respiratory protection will be chosen based upon monitored conditions, applicable regulations, and accepted practices.

In addition to monitoring for organic vapors, the air will be monitored for combustible gases and to verify that sufficient oxygen is available in work areas. Monitoring for oxygen and combustible gases will be performed with a portable, calibrated gas detector instrument (Table 4).

During site operations, airborne dust may be generated. Particulate monitoring will be performed using a real-time particulate monitor (MIE® PDM-3 Miniram) that detects particulate matter less than 10 microns (PM_{10}). Particulate levels will be monitored immediately downwind at the working site and integrated over a period not to exceed 15 minutes (NYSDEC, 1989). A reliable wind indicator will be installed at the site. Additionally, the Health and Safety Officer will visually monitor the active work zone for dust or other hazards. If conditions warrant, the excavation will be sprayed with water until dust concentrations reach acceptable levels. Additionally, the Health and Safety Officer may require all personnel in active work areas to wear particle masks, chemical-resistant gloves, safety goggles, and/or chemical-resistant coveralls, as applicable.

Field monitoring equipment will be calibrated and operated in accordance with the manufacturer's specifications. Documentation of instrument calibration must be kept on file. Prior to work on-

site, operators must be trained in the proper use of these field instruments.

7.2 Air Monitoring (Community)

A Community Air Monitoring Plan (CAMP) will be established for real-time monitoring of volatile compounds and particulates. If total organic vapor levels at the downwind perimeter of the work area exceed 5 ppm above background, activities will stop and air monitoring will continue under the Vapor Emission Response Plan (VERP).

Under the VERP, if organic vapor levels are greater than 5 ppm over background but less than 25 ppm over background, activities can resume provided the organic vapor level 200 feet downwind of the work area, or half the distance to the nearest residential or commercial structure, whichever is less, is below 5 ppm over background. If organic vapor levels exceed 25 ppm at the work zone perimeter, activities must shut down. When shut down occurs, air monitoring must be conducted in accordance with the Major Vapor Emission Plan (MVEP).

Under the MVEP, if organic vapors exceed 5 ppm over background 200 feet downwind of the work area, or half the distance to the nearest residential or commercial property from the work area, all work activities must stop. If organic levels persist over 5 ppm after the cessation of work, the air quality must be monitored within 20 feet of the perimeter of the nearest residential or commercial structure (20-foot zone). If levels remain above 5 ppm for more than 30 minutes in the 20-foot zone, the Major Vapor Emission Response Plan (MVERP) shall go into effect. The following activities will be undertaken under the MVERP:

- All emergency contacts listed in the HASP of the Work Plan will go into effect.
- Local police authorities will be contacted and advised of the situation.
- Frequent air monitoring will be conducted at 30-minute intervals within the 20-foot zone.

8.0 STANDARD OPERATING PROCEDURES

Activities to be conducted at the Site during the RI/FS include the following:

- Site reconnaissance
- Soil boring and monitoring well installation
- Soil, groundwater and surface water sampling, as appropriate
- Test pit excavation
- Pump Tests/Slug tests
- SVE Tests

8.1 Safe Work Practices

The following paragraphs describe site-specific standard operating procedures used to protect the health and safety of all field personnel:

- Visual contact must be maintained between workers in each active work zone.

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of contaminated material is prohibited within any active work zone.

- The consumption of alcoholic beverages or other intoxicating substances is prohibited during the work day.

- No excessive facial hair which interferes with the satisfactory fit of respiratory protection is allowed on personnel required to wear such equipment. Each staff member must pass a fit test for respirators.

- The number of personnel and amount of equipment in any active work zone should be minimized while allowing for effective site operations.

- Proper decontamination of machinery and sampling equipment will be conducted prior to leaving the site.

- Work areas and decontamination procedures will be established based on prevailing site conditions and are subject to change.

- Contact with contaminated or potentially contaminated surfaces should be avoided. Whenever possible, do not walk through puddles, mud or any discolored ground surface; do not kneel on the ground.

- No personnel will be admitted in the active work zone without proper safety equipment.
- Proper decontamination procedures must be followed before leaving active work zones.
- All personnel must comply with established safety procedures. No firearms may be brought on-site, and no horseplay is permitted. Any staff member who does not comply with the above safety policy, as established by the Health and Safety Officer and/or the Project Manager, will be immediately dismissed from the Site.
- Personnel shall not use equipment without proper training.
- Any medical emergency supersedes routine safety requirements.

Before entering the Site, the following procedures should be performed:

- Review site information (see Project Manager or Health and Safety Officer, if necessary):

  - Expected hazards
  - Special conditions
  - Sampling procedures
  - Location of decontamination areas and telephones
  - Emergency medical information
  - Level of personal protection required
  - Emergency escape routes, work areas, and route to hospital

- Check safety gear and equipment. The following equipment and supplies should be available:

  - PID/FID meters
  - Oxygen/LEL meter
  - Hard hats
  - Rubber safety boots
  - Tyvek® coveralls
  - Safety glasses or goggles
  - Gloves
  - Particle masks
  - Ziploc bags (quart and gallon size) and aluminum foil to keep spare equipment clean
  - Copy of Health and Safety Plan
  - Eye wash and hand wash station
  - SCBAs
  - First aid kit including snake bite kit, as appropriate
  - Fire extinguishers
  - Mobile phone

- Proper barricades and signs

- No eating/drinking/smoking will be allowed while in active work zone. Exception: Sports drinks or water. Before drinking, gloves should be cleaned.

- Check location of water supply and telephones

- As applicable, don safety gear (if required) in the following order:

  - Suit
  - Boots
  - Chemical-resistant gloves
  - Particle mask or respirator
  - Safety glasses or goggles

- Check gear for rips/tears/malfunctions

- Check wind direction

- Make preliminary site observation

- Establish/delineate the work zone using barricades, traffic cones, caution tape, etc. to keep unauthorized personnel and/or vehicles from entering the area.

- Use caution; go slowly

- If any problem with gear or equipment arises, exit by same route entered

- On return, check gear for damage

During sampling activities, the following procedures should be adhered to:

- No eating/drinking/smoking while sampling

- Use standard sampling techniques

- Use care in handling samples

- Wipe off spills, dirt, and residue immediately

- If any gear or equipment damage develops, immediately repair or replace

- If any physical discomfort, abnormalities, or light-headedness is experienced, stop work,

notify person you are working with, and go back to the support zone

8.2 Decontamination and Waste Handling Procedures

The decontamination of machinery and sampling equipment will occur on site as outlined in the QAPP. A decontamination pad will be constructed on site and all decontamination water will be contained in 55-gallon drums and staged at the site pending analysis and disposal. A pressure washer will be used to decontaminate augers and heavy equipment.

Drill cuttings and sediment that accumulates on the decontamination pad will be placed in 55-gallon drums and staged on site pending analysis and disposal. Impacted soils encountered in the test excavations will be staged on and covered with plastic pending analysis and disposal.

8.3 Confined Space Entry Procedures

A confined space is defined as a space that is large enough to enter, has limited entrances and exits, and is not designed for continuous occupancy. A confined space could contain a hazardous atmosphere such as oxygen less than 19.5 percent or volatile compounds above permissible exposure limits (PELs) or exceeding the lower explosive limit (LEL). Examples of confined spaces include vaults, tanks, excavations, silos, storage bins, pits, and trenches. Attachment 3 contains vessel and confined space entry procedures and a confined space entry permit.

State and federal laws specify that a permit is required prior to entering a confined space if it meets one or more of the following criteria:

- It contains or has a potential to contain a hazardous atmosphere
- It contains a material that has the potential for engulfing the worker in the confined space
- Its configuration is such that a worker could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward to a smaller cross section
- It contains any other recognized serious safety or health hazards

Confined space entry procedures include:

- Employee training - employees must be trained in proper confined space procedures and rescue procedures prior to performing work.
- Atmospheric testing - prior to entering a confined space, testing should be performed to evaluate the hazards of the space (if any) and to verify that acceptable entry conditions exist. Testing should first be performed for the presence of oxygen, then combustible or explosive gases, and last for organic vapors

- Authorized entry and attendant supervisor - one or more persons should be stationed outside the work area to monitor the safety of the worker in the confined space and respond as necessary to any emergencies.

8.3 Safety Meetings and Inspections

An initial safety meeting will be held with all field personnel prior to commencing site activities. This meeting will be conducted by the Health and Safety Officer and will address procedures to be followed during site activities. A question-and-answer session will be held at the end of the meeting to address questions by site personnel. Appropriate documentation and records will be made of this and all other health and safety meetings (see Attachment 4).

As appropriate, additional health and safety meetings will be held by the Health and Safety Officer. All new personnel will be briefed regarding health and safety procedures by the Health and Safety Officer prior to commencing work on the site. If necessary, health and safety drills and/or exercises will be undertaken by site personnel under the direction of the Health and Safety Officer.

Periodic safety inspections will be undertaken by the Health and Safety Officer and/or Project Manager. If inappropriate activities are taking place, they will be immediately rectified. A record shall be kept of all safety inspections and corrective actions (see Attachment 5).

8.4 Communication Procedures

A telephone will be maintained at the job site for routine as well as emergency communications. In the event of an emergency, the Project Manager or Site Supervisor will be notified as soon as possible. If site personnel are engaged in work in remote areas, portable phones will be used to maintain communications. A minimum of two persons will be required for work in remote areas.

9.0 SITE CONTINGENCY/EMERGENCY PLAN

The Site Contingency/Emergency Plan describes procedures to be followed in the event of a site emergency. A site emergency would include any of the following:

- Accident involving site personnel and/or equipment
- Release of a gas/vapor cloud from the work area
- Physical injury to site personnel

The above list is not intended to represent a comprehensive listing of all emergencies/accidents that could happen at the Site; it only provides examples of possible activities requiring contingency planning.

9.1 Emergency Procedures

The following are numbers which may be used in the event of a site emergency:

Emergency Services: 911

Hospital: Binghamton General Hospital; Binghamton, New York
(607) 762-2200

Travel Route to Hospital (map): see Figure 3

Ambulance: City of Binghamton Ambulance Service (607) 723-7475

Non-Emergency Fire or Hazardous Materials Incident:
City of Binghamton Fire Bureau (607) 723-7475

Police: City of Binghamton Police (607) 723-5321

Airport: Broome County Airport (607) 763-4471

National or Regional Sources of Assistance

NYSDEC (Mr. James A. Moras, P.E.)	(518) 457-0315
NYSDOH (Mr. Gary Robinson)	(315) 426-7627
Broome County Health Dept. (Mr. Robert Denz)	(607) 778-2887

EPA (Emergency Response - New York)	(212) 637-4390
Chemtrec (24 hours)	(800) 424-9300
Center for Disease Control (Biological Agents)	(404) 633-5313
National Response Center, NRC (Oil/Hazardous Substances)	(800) 424-8802
DOT, Office of Hazardous Materials Safety	(202) 366-0656
DOT (Hazardous Materials Standards)	(202) 366-4488

The hospital closest to the Site is Binghamton General Hospital located approximately 4.8 miles from the subject site at 10-42 Mitchell Avenue in Binghamton, NY (see Figure 3). The hospital can be reached from the site by taking Conklin Avenue west approximately 3.7 miles to Tremont Avenue. Turn left onto Tremont Ave. and travel south approximately 0.3 miles to Vestal Ave. Turn right onto Vestal Ave. and travel 0.5 miles west to Mitchell Ave. Turn left onto Mitchell Ave. and travel approximately 0.3 miles to Binghamton General Hospital.

9.2 Emergency Procedures and Emergency Medical Care

In the event of a site emergency, the Health and Safety Officer, Site Supervisor, or Project Manager must be notified as soon as practicable. They will assess the situation and indicate the appropriate actions to be taken. In the event of an accident and depending on the severity of the injury, treatment may either be given at the Site by trained personnel (additional assistance from emergency medical technicians may be required) or the victim may have to be transported to a hospital.

Heat-related illnesses can occur at any time when protective clothing is worn. Heat stroke requires prompt treatment to prevent irreversible damage or death. Unless the victim is obviously contaminated, decontamination should be minimized and treatment begun immediately. Attachment 6 contains a summary of symptoms and first aid for heat stress.

9.3 Nonemergency Medical Care

If an accident occurs which does not require emergency care, the Health and Safety Officer, Site Supervisor or Project Manager will be notified as soon as possible. The accident victim will undergo decontamination procedures as appropriate, and first aid will be administered by qualified personnel (on-site or off-site).

9.4 Records and Reporting Procedures

An accident/injury form will be completed by the Health and Safety Officer or the senior person in attendance at the time of the accident. A copy of the form will be retained at the site, and one copy will be sent to the main office of the selected contractor. See Attachment 7 for an example of a Report of Accident form.

At the time of the incident, an oral report will be given to the Health and Safety Officer. It will contain the following information:

- Name, location, and title of the person(s) reporting
- Location of accident/incident
- Casualties (fatalities, disabling injuries)
- Suspected/known chemical substances involved, if any
- Details of any existing chemical hazard or contamination
- Summary of accident/incident, giving pertinent details, including type of operation at time of accident, time of accident, etc.
- Suspected/known cause of accident/incident

It will be the responsibility of the Project Manager or Health and Safety Officer to investigate thoroughly the details of any accident or injury. Based upon the findings, this person should recommend any corrective action relative to field procedures to prevent recurrence of the incident.

10.0 REFERENCES

American National Red Cross. 1993. *Standard First Aid Manual.*

Martin, William F., John M. Lippitt, and Timothy G. Prothero. 1987. *Hazardous Waste Handbook for Health and Safety.* Butterworth Publishers, Stoneham, Massachusetts.

National Records and Archives Administration. Revised July 1992. *Code of Federal Regulations 29 Parts 1910 and 1926.*

NIOSH. June 1990. *Pocket Guide to Chemical Hazards.* DHHS (NIOSH) Publication No. 90-117.

NIOSH/OSHA/USCG/EPA. October 1985. *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities.* DHHS (NIOSH) Publication No. 85-115.

New York State Department of Environmental Conservation. October 1989. *Division Technical and Administrative Guidance Memorandum--Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites.* HWR-89-4031

U.S. Environmental Protection Agency. June 1992. *Standard Operating Safety Guides.*

Figures

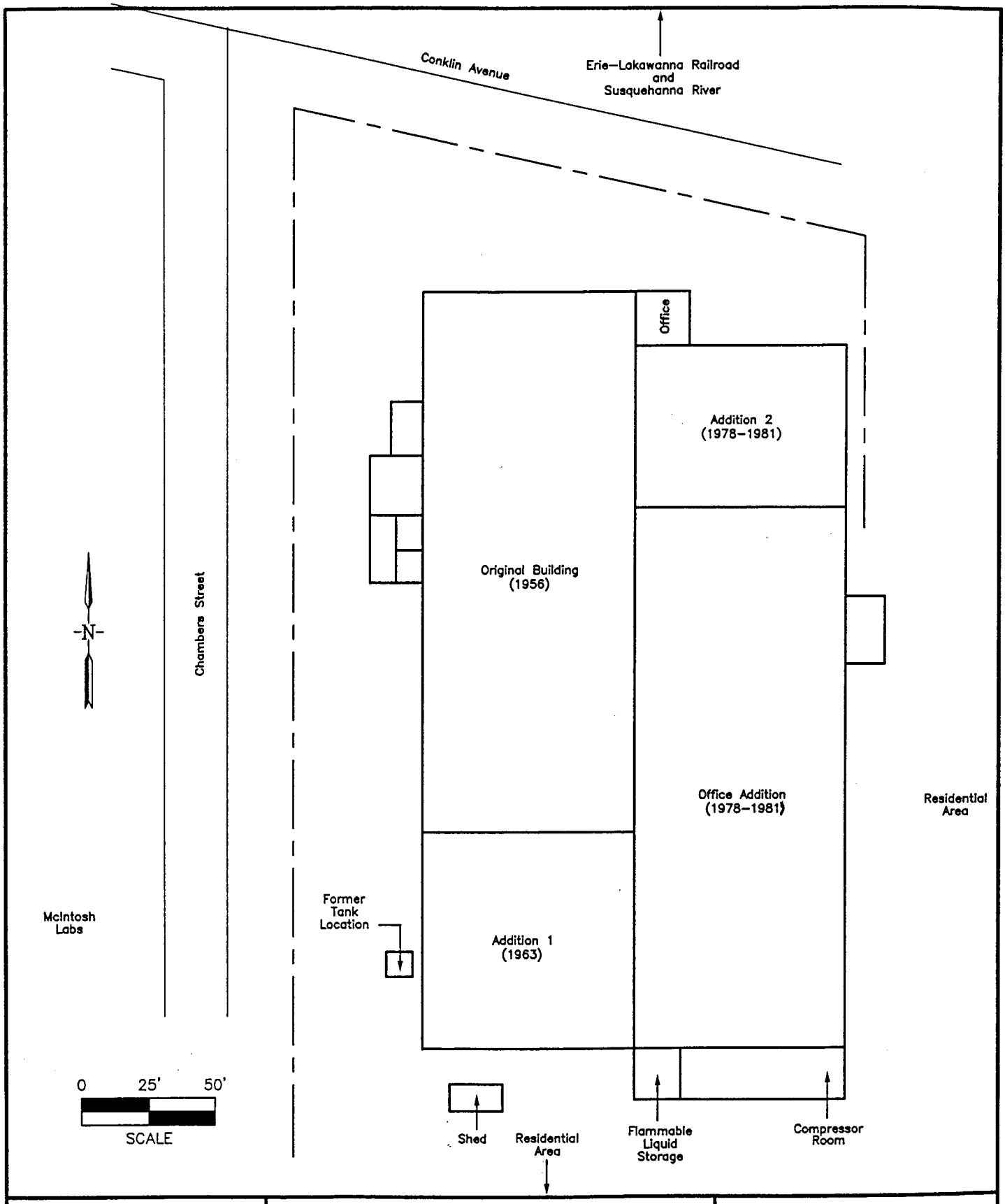
SOURCE: USGS Topographic Quadrangle Maps
Binghamton East, New York
1968 – Photoinspected 1976
Binghamton West, New York
1968 – Photoinspected 1976

N

0 1,000' 2,000'
SCALE

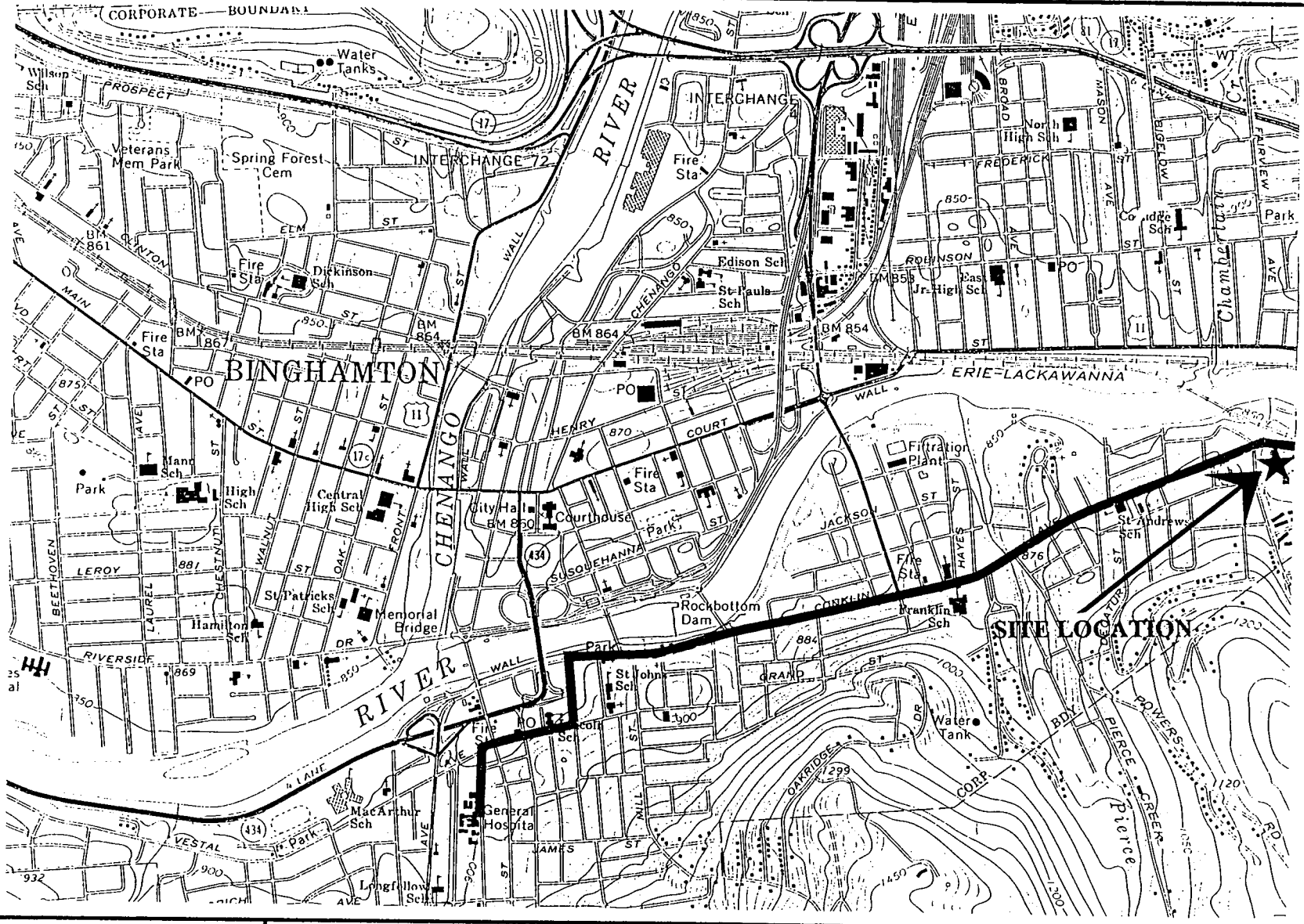
DATE: 12/2/97	FIGURE 1	**SHIELD**
DRAWN BY: P.D.H.	SITE LOCATION MAP DII – BINGHAMTON PLASTICS CONKLIN AVENUE BINGHAMTON, NEW YORK	ENVIRONMENTAL ASSOCIATES, INC.
APPROVED BY: M.M.		LEXINGTON, KENTUCKY
CLIENT NO.: 396-0460		

60-



DATE: 1/23/98	FIGURE 2	**SHIELD**
DRAWN BY: P.D.H.	MAP SHOWING HISTORICAL SITE FEATURES AND SURROUNDING PROPERTIES	ENVIRONMENTAL ASSOCIATES, INC.
APPROVED BY: M.M.	DII – BINGHAMTON PLASTICS	
CLIENT NO.: 396–0460	CONKLIN AVENUE, BINGHAMTON, NEW YORK	LEXINGTON, KENTUCKY

60460–2



DATE: 6/19/98	FIGURE 3 ROUTE TO HOSPITAL DII – BINGHAMTON PLASTICS CONKLIN AVENUE BINGHAMTON, NEW YORK	**SHIELD** ENVIRONMENTAL ASSOCIATES, INC. LEXINGTON, KENTUCKY
DRAWN BY: P.D.H.		
APPROVED BY: M.M.		
CLIENT NO.: 396–0460		

60460–

TABLE 1
LISTED POTENTIAL VOLATILE CHEMICAL HAZARDS

Chemical Name	PEL (ppm)	Ceiling (ppm)	IDLH (ppm)
Chloroethane	1000	---	---
1,1-Dichloroethane	100	---	4000
1,1-Dichloroethene	---	---	---
1,2-Dichloroethene	200	---	4000
Ethylbenzene	100	---	2000
Tetrachloroethene	100	---	500
1,1,1-Trichloroethane	350	---	1000
Trichloroethene	100	200	1000
Vinyl Chloride	1	5	---

PEL = Permissible exposure limits
IDLH = Immediately dangerous to life or health
--- = No data available
Source: NIOSH Pocket Guide to Chemical Hazards, June 1997.

TABLE 2
TASK-BY-TASK RISK ASSESSMENT

Background Review: ☐ Complete ☐ Partial If partial, why?

Activities Covered Under This Plan: Remedial Investigation/Feasibility Study

No.	Task/Subtask	Description
1.	Mobilization	Mobilize personnel, equipment, materials
2.	Remedial Investigation	Drilling and trenching activities
3.	Feasibility Studies	Pump tests/slug tests/SVE tests
4.	Demobilization	Remove personnel and equipment

Types of Hazards:

☐ Numbers refer to one of the following hazard evaluation forms. Complete hazard evaluation forms for each appropriate hazard class.

Physiochemical 1

☐ Flammable

☐ Explosive

☐ Corrosive

☐ Reactive

☐ O_2 Rich

☐ O_2 Deficient

Chemically Toxic 1

☐ Inhalation ☐ Carcinogen

☐ Ingestion ☐ Mutagen

☐ Contact ☐ Teratogen

☐ Absorption

☐ OSHA 1910.1000 Substance (Air Contaminants)

☐ OSHA Specific Hazard Substance Standard
(Refer to HASP Form 04HASP.894 for listing.)

Biological 2

☐ Etiological Agent

☐ Other (plant, insect, animal)

☐ Physical Hazards 4

☐ Construction Activities

Source/Location of Contaminants and Hazardous Substances

Directly Related to Tasks

☐ Air

☐ Other surface

☐ Groundwater

☐ Soil

☐ Surface water

☐ Sanitary wastewater

☐ Process wastewater

☐ Other

Indirectly Related to Tasks - Nearby Process(es) That Could Affect Team Members:

☐ Client Facility

☐ Nearby nonclient facility

Describe:

☐ Client briefing arranged

TABLE 2
TASK-BY-TASK RISK ASSESSMENT

TASK DESCRIPTION

Mobilization/Demobilization

EQUIPMENT REQUIRED/USED
(be specific, e.g., hand tools, heavy equipment, instruments, PPE)

Level D PPE
Heavy equipment (Drill Rigs/Excavators)

POTENTIAL HAZARDS/RISKS

CHEMICAL

☐ **Hazard Present** **Risk Level:** ☐ **H** ☐ **M** ☐ **L**

What justifies risk level? None.

PHYSICAL

☒ **Hazard Present** **Risk Level:** ☐ **H** ☐ **M** ☒ **L**

What justifies risk level? Hazards associated with heavy lifting. Slips, trips, falls. Manual lifting. Field operating procedures will be followed to minimize risk.

BIOLOGICAL

☐ **Hazard Present** **Risk Level:** ☐ **H** ☐ **M** ☐ **L**

What justifies risk level? None.

LEVELS OF PROTECTION/JUSTIFICATION

Level D PPE

TABLE 2
TASK-BY-TASK RISK ASSESSMENT

TASK DESCRIPTION

Remedial Investigation

EQUIPMENT REQUIRED/USED
(be specific, e.g., hand tools, heavy equipment, instruments, PPE)

Heavy equipment (drill rigs,excavators)
Level B,C, D PPE
FID or PID
CGI/O_2 Meter

POTENTIAL HAZARDS/RISKS

CHEMICAL

☐ **Hazard Present** **Risk Level:** ☐ **H** ☐ **M** ☐ **L**

What justifies risk level? Exposure to chlorinated organic compounds is possible during test pit excavations and monitoring well drilling.

PHYSICAL

☐ **Hazard Present** **Risk Level:** ☐ **H** ☐ **M** ☐ **L**

What justifies risk level? The risks for physical hazards such as working with heavy equipment and other construction activities will be minimized through the implementation of this Health & Safety/Contingency Plan and the field operating procedures.

BIOLOGICAL

☐ **Hazard Present** **Risk Level:** ☐ **H** ☐ **M** ☐ **L**

What justifies risk level? There is a low level risk of contact with poisonous animals and insects.

LEVELS OF PROTECTION/JUSTIFICATION

Level D PPE will be used as worker protection with Levels B and C available for use if conditions warrant.

TABLE 2
TASK-BY-TASK RISK ASSESSMENT

TASK DESCRIPTION

Feasibility Studies
- Pump Tests
- Slug Tests
- SVE Tests

EQUIPMENT REQUIRED/USED
(be specific, e.g., hand tools, heavy equipment, instruments, PPE)

Heavy equipment
FID or PID
CGI/O_2 of explosive atmosphere
Level D PPE
Level B and Level C PPE

POTENTIAL HAZARDS/RISKS

CHEMICAL

☐ **Hazard Present** **Risk Level:** ☐ **H** ☐ **M** ☐ **L**

What justifies risk level? Chlorinated organics have been detected at high levels in the groundwater at the site.

PHYSICAL

☐ **Hazard Present** **Risk Level:** ☐ **H** ☐ **M** ☐ **L**

What justifies risk level? The risks for physical hazards such as working with heavy equipment will be minimized through the implementation of field operating procedures.

BIOLOGICAL

☐ **Hazard Present** **Risk Level:** ☐ **H** ☐ **M** ☐ **L**

What justifies risk level? There is a low level risk of contact with poisonous animals and insects.

LEVELS OF PROTECTION/JUSTIFICATION

Level D with Levels B and C available if conditions warrant.

TABLE 2
TASK-BY-TASK RISK ASSESSMENT

TASK DESCRIPTION

Subsurface sampling of waste material and underlying native soils

EQUIPMENT REQUIRED/USED
(be specific, e.g., hand tools, heavy equipment, instruments, PPE)

Heavy equipment
FID or PID
CGI/O122
of explosive atmosphere
Level D and modified Level D PPE
Level B and Level C PPE
Detection tubes for benzene
Summa® canisters
Weather station

POTENTIAL HAZARDS/RISKS

CHEMICAL

☐ **Hazard Present** **Risk Level: ☐ H ☐ M ☐ L**

What justifies risk level? The risk of encountering benzene during this task is expected to be high. However, the monitoring will be used to establish if the concentration will pose a significant hazard to the worker. If the concentrations exceed action levels, contingency measures described in Table 3 of this plan will be implemented.

BIOLOGICAL

☐ **Hazard Present** **Risk Level: ☐ H ☐ M ☐ L**

What justifies risk level? The risks for physical hazards such as working with heavy equipment will be minimized through the implementation of field operating procedures.

BIOLOGICAL

☐ Hazard Present *Risk Level: ☐ H ☐ M ☐ L*

What justifies risk level? There is a low level risk of contact with poisonous animals and insects.

LEVELS OF PROTECTION/JUSTIFICATION

Level D and Modified Level D

TABLE 2
TASK-BY-TASK RISK ASSESSMENT

TASK DESCRIPTION

Site Restoration and Demobilization

EQUIPMENT REQUIRED/USED
(be specific, e.g., hand tools, heavy equipment, instruments, PPE)

Level D PPE
Heavy Equipment

POTENTIAL HAZARDS/RISKS

CHEMICAL

☐ **Hazard Present** **Risk Level:** ☐ **H** ☐ **M** ☐ **L**

What justifies risk level? None.

PHYSICAL

☐ **Hazard Present** **Risk Level:** ☐ **H** ☐ **M** ☐ **L**

What justifies risk level? Hazards will be minimized through the implemenation of field operating procedures and through hazard communications.

BIOLOGICAL

☐ **Hazard Present** **Risk Level:** ☐ **H** ☐ **M** ☐ **L**

What justifies risk level? None.

LEVELS OF PROTECTION/JUSTIFICATION

Level D PPE

TABLE 3
SUMMARY OF SITE ACTIVITIES AND PPE LEVELS

Site Activity	PPE Level*
Baseline air quality survey	D
Surface water and sediment sampling	D
Monitoring well/piezometer installation	D
Groundwater and potable water supply sampling	D
Dye trace study/pump test/slug test	D
Soil sampling (subsurface)	D
Test pit excavation	B/D
Waste characterization sampling	B/D
Air quality sampling	D
Air monitoring/sampling during excavation	B/D

* The PPE level designated may be upgraded depending upon site conditions

TABLE 4

SUMMARY OF SITE MONITORING ACTIVITIES AND PPE LEVELS

Instrument/Contaminant/ Exposure Limit	Instrument Response/ Action Limits	Action
PID (organic vapors/PEL)/TLV or NIOSH REL.	>1 ppm above background in breathing zone for 10 consecutive minutes.	Upgrade to Level B PPE.
MIE® PDM-3 Miniram/particulates/ug/m^3	> 100 ug/m^3 above background	Implement dust suppression techniques and modify PPE to include dust masks.
CGI (outdoor)/combustible gases or vapors % of LEL.	Direct-reading instrument:	
FID will supplement CGI	<10%	Continue operations.
	>10% to <20%	Extreme caution, establish source.
	>20%	Stop work until % LEL <10.
O_2 meter/oxygen level %	<19.5% O_2	Upgrade to Level B.
	19.5 to 25% O_2	Continue work in Level B.
	>25% O_2	Initiate ventilation procedures to reduce O_2 to less than 25%.

NIOSH National Institute for Occupational Safety and Health
PID Photoionization detector
TLV Threshold limit values
REL Recommended exposure limits
PPE Personal protective equipment
CGI Combustible gas indicator
LEL Lower explosive equipment
FID Flame ionization detector
ppm Parts Per Million

ATTACHMENT 1

Acknowledgement of Health and Safety Review

ACKNOWLEDGEMENT OF HEALTH AND SAFETY REVIEW

Prior to conducting any field work at this site, all personnel must review this site-specific Health and Safety Plan and sign this section. If any information presented is unclear, the Project Manager or Health and Safety Officer should be contacted for clarification. A copy of this Health and Safety Plan must be kept on-site for the duration of field activities.

I have reviewed the attached Health and Safety Plan for the Dovatron International site. I have discussed any questions regarding this plan with the Project Manager or Health and Safety Officer, and I understand all of the requirements. I have also discussed any pertinent health problems or allergic reactions with the Project Manager or Health and Safety Officer.

Signature: _____ Date: _____

Signature: _____ Date: _____

Signature: _____ Date: _____

Signature: _____ Date: _____

Signature: _____ Date: _____

Signature: _____ Date: _____

Signature: _____ Date: _____

Signature: _____ Date: _____

Signature: _____ Date: _____

ATTACHMENT 2

Levels B, C, and D Personal Protective Equipment

LEVEL B PERSONAL PROTECTIVE EQUIPMENT

EQUIPMENT	PROTECTION PROVIDED	USE CRITERIA[a]	LIMITING CRITERIA[b]
Required: Pressure-demand SCBA Chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; hooded one- or two-piece chemical splash suit; disposable chemical-resistant coveralls). Inner and outer chemical-resistant gloves Chemical-resistant boots with steel toe and shank Hard hat Optional: Coveralls Disposable outer boots Face shield	The same level of respiratory protection but less skin protection than Level A It is the minimum level recommended for initial site entries until the hazards have been further identified	Oxygen-deficient, nauseating, or irritating atmosphere where the exact type of chemical present is unknown Concentrations of unidentified gases or vapors exceed 5 ppm (but are less than 500 ppm), as measured by some type of total organic vapor analyzer	Total atmospheric concentration of unidentified gases or vapors does not exceed 500 ppm Gases and vapors are not suspected of containing high levels of chemicals that can injure or be absorbed through the skin

Martin et. al., 1987, Hazardous Waste Handbook for Health and Safety

[a] USE CRITERIA are those conditions that a particular level of protection is effective against.

[b] LIMITING CRITERIA are those conditions that must be present if a particular level of protection can be used.

LEVEL C PERSONAL PROTECTIVE EQUIPMENT

EQUIPMENT	PROTECTION PROVIDED	USE CRITERIA[a]	LIMITING CRITERIA[b]
Full-face, air-purifying, canister-equipped respirator The same protective clothing as Level B Chemical-resistant clothing Chemical-resistant gloves Chemical-resistant boots with steel toe and shank Hard hat	The same level of skin protection as Level B, but a lower level of respiratory protection	There is danger of splashing	Atmosphere contains at least 19.5% oxygen The types of air contaminants have been identified, concentrations measured, and canister is available that can remove the contaminant Airborne contaminants possess properties that warn of exposure

Martin et. al., 1987, Hazardous Waste Handbook for Health and Safety

[a] USE CRITERIA are those conditions that a particular level of protection is effective against.
[b] LIMITING CRITERIA are those conditions that must be present if a particular level of protection can be used.

LEVEL D PERSONAL PROTECTIVE EQUIPMENT

EQUIPMENT	PROTECTION PROVIDED	USE CRITERIA[a]	LIMITING CRITERIA[b]
Required: Coveralls Chemical-resistant boots with steel toe and shank Safety glasses or chemical-splash goggles Optional: Gloves Outer chemical-resistant disposable boots (required if leather boots are worn) Hard hat Face shield	No respiratory protection* Minimal skin protection *(Except for emergency escape)	This level of protection should not be worn in the excavation zone	Atmosphere contains at least 19.5% oxygen Atmosphere contains no known hazard Work functions preclude splashes, immersion, or the potential for unexpected inhalation of any chemicals Only boots may be contaminated

Martin et. al., 1987, Hazardous Waste Handbook for Health and Safety

[a] USE CRITERIA are those conditions that a particular level of protection is effective against.
[b] LIMITING CRITERIA are those conditions that must be present if a particular level of protection can be used.

ATTACHMENT 3

Vessel and Confined Space Entry
and
Confined Space Entry Permit

ATTACHMENT 4

Documentation of Health and Safety Meetings

TAILGATE SAFETY MEETING

Date: _____ Time: _____
Client: _____ Job No.: _____
Site Location: _____
Type of Work: _____

SAFETY TOPICS PRESENTED

Chemical Hazards: _____
_____
_____

Physical Hazards: _____
_____
_____

Protective Clothing: _____
_____
_____

Equipment Safety Procedures: _____
_____
_____

Emergency Procedures: _____
_____
_____

Other: _____
_____
_____

ATTENDEES

Name (Printed) Social Security No. Signature

_____
_____
_____
_____
_____
_____
_____
_____
_____

Meeting conducted by: _____

ATTACHMENT 5

Safety Inspection Forms

SITE SAFETY INSPECTION

Date: _____ Client: _____

Time: _____ Job No.: _____

Site Location: _____

Type of Work: _____

Inspection: Initial: _____ Follow-up: _____ Last Date: _____

WALKOVER (This section documents the Site Health & Safety Officer's routine checks of daily operations).

Personal Protective Equipment: _____
_____

Site Control/Work Zones: _____
_____

Decontamination: _____
_____

Air Monitoring: _____
_____

Equipment Operations: _____
_____

Sample Handling: _____
_____

Emergency Preparedness: _____
_____

Other: _____
_____

INSPECTION CHECKLIST: Findings itemized as unacceptable are detailed in the REMEDIES Section. (A, Acceptable; U, Unacceptable; NA, Not Applicable)

Recordkeeping

Training Certifications ___
Fit Test Records ___
Orientation Form ___
Physician's Opinions ___
Approved HASP ___
Safety Meeting Form ___

Emergency Preparedness

Site Communications ___
Certified First Aid/CPR ___
Designate On-site Evacuation Routes ___
Emergency Showers ___
First Aid Kits: ___
- stocked ___
- accessible ___
Site Organization ___
Emer. Phone Nos. Posted ___
15-min Eye Wash ___
Fire Extinguishers ___

Site Operations

Work Zones ___
Decontamination Access Marked: ___
- for personnel ___
- for equipment ___
- waters contained ___
- waters maintained ___
Safe Work Practices ___
Safe Conditions ___
Utility Clearances ___
Excavation/Trenching: ___
- sloped/shored ___
- fenced ___
- stockpiles secured ___

Sampling/Monitoring

Equipment Maintained ___
Logbook Maintained ___
Operated per HASP ___
Samples Handled Properly ___

Site Conditions

Access Control ___
Site Security ___
Traffic Control ___

Construction and Drilling Equipment

Backup Alarms ___
Safe Fuel Handling and Storage ___
Oil/Hydraulic Leaks ___
Operating Procedures ___

Health and Safety

Personal Protective Equipment: ___
- proper levels observed ___
- PPE support ___

General Health and Safety

Observation of Work Zone ___
Personal Hygiene (eating, drinking, smoking) ___
Hard Hats Worn ___

REMEDIES: The inspector shall explain all unacceptable conditions noted at the time of inspection to the Project Manager or designee. This discussion will include scheduled dates/times for remedies as noted below:

ITEM	EXPLANATION	REMEDY	DUE DATE

SIGNATURES

Inspector _____ Date _____

Project Manager _____ Date _____

Health and Safety Officer _____ Date _____

ATTACHMENT 6

Symptoms and First Aid for Heat-Related Injury

HEAT-RELATED INJURY

Heat Cramps

Heat cramps are painful muscle spasms that usually occur in the legs and abdomen. They can be a warning signal of a possible heat-related emergency.

Treatment for Heat Cramps:

- Have individual rest in a cool place
- Give cool water or commercial sports drink
- Lightly stretch the muscle and gently massage the area
- When cramps stop, individual can usually start activity again if there are no other signals of illness; he/she should continue to drink plenty of fluids
- Watch person for further signals of heat-related illness

Heat Exhaustion

Heat exhaustion is a more severe condition than heat cramps and often affects workers who wear heavy clothing in a hot, humid environment.

Symptoms:

- Cool, moist, pale or flushed skin
- Headache, nausea, dizziness, weakness, and exhaustion

Heat Stroke

Heat stroke is the least common but most severe heat emergency (often occurs when people ignore the signals of heat exhaustion). It develops when the body systems are overwhelmed by heat and begin to stop functioning.

Symptoms include:

- Red, hot, dry skin
- Changes in consciousness
- Rapid, weak pulse
- Rapid, shallow breathing

Treatment for Heat Exhaustion and Heat Stroke:

- Remove individual from heat and have him/her rest
- Loosen any tight clothing and apply cool, wet cloths
- If individual is conscious, give cool water to drink (about 4 ounces every 15 minutes)
- Watch carefully for changes in his/her condition
- Individual should not resume normal activities the same day

Source: American National Red Cross. 1993. Standard First Aid Manual

ATTACHMENT 7

Accident Report Form

SUPERVISOR'S REPORT OF ACCIDENT

Name of Injured _____

Company _____

Address _____ Phone _____

Occupation _____ How Long Employed _____

Address of Accident _____

Date of Accident _____ Time _____
Place of Accident _____

Name of Attending Physician _____

What was employee doing when injured? _____
_____
_____

How did accident occur? _____
_____
_____

Describe injury and body part or parts affected: _____
_____
_____

Object which injured employee: _____
_____
_____

Other comments: _____
_____
_____
_____

Signature _____ Date _____