

164658
**Engineering Evaluation/Cost Analysis
(EE/CA) Work Plan**

Soil Study Plan
Hydrogeological Study Plan
Field Sampling Plan
Quality Assurance Project Plan
Health and Safety Plan
Disposal Plan

Olin Area
Hanlin-Allied-Olin Site
Moundsville, West Virginia



CORPORATION

MAY, 1996

RUST

Rust Environment & Infrastructure

AR300060



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May 30, 1996

Mr. Eugene P. Wingert
Remedial Project Manager
U.S. Environmental Protection Agency (3HW41)
841 Chestnut Building
Philadelphia, PA 19107-4431

RE: Final EE/CA Work Plan
Olin Area, Hanlin-Allied-Olin Site, Moundsville, WV
EPA Docket No. III-94-29-DC

VIA: FedEx

Dear Mr. Wingert:

Enclosed are ten (10) copies of the final EE/CA Work Plan for the Olin Area of the Hanlin-Allied-Olin Site in Moundsville, WV. This version incorporates agreed to changes made between the EPA and Olin, including those in your May 1, 1996 approval letter.

Please note, Olin's preferred analytical laboratory has recently changed their name from Pace Incorporated to Katahdin Analytical Services, Incorporated. This was simply a name change and the EE/CA was revised accordingly.

As you are aware, Olin hired DynCorp (Alexandria, Virginia) to coordinate the methods study for the chemicals listed in the Work Plan Table 6-9. The first task of this methods study, identification of laboratories capable of conducting the methods study, was completed on April 17, 1996. DynCorp identified 63 laboratories capable of conducting the methods study, of which five (5) were selected for task 2. Olin is proceeding with task 2: Develop Method Validation Study and Identify (a single) Laboratory. We anticipate that the methods study will be complete in November, 1996.

We look forward to moving ahead on the Moundsville project. If you have any questions, please call me at (423) 336-4576.

Sincerely,
OLIN CORPORATION

A handwritten signature in black ink, appearing to read "Richard W. McClure", written over a horizontal line.

Richard W. McClure, P.G., R.E.M.
Senior Project Coordinator

Mr. Eugene P. Wingert
May 30, 1996
Page 2

cc: Ken Ellison, West Virginia DEP
Tom O'Brien, Olin
Ray Horn, Olin
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- H Air Monitoring Requirements
- I August 4, 1995 Letter to EPA Outlining Use of Phosgene at Olin Area
- J Personal Protective Equipment

AR300069

1.0 INTRODUCTION

This document is the Engineering Evaluation/Cost Analysis (EE/CA) Work Plan for the Olin Area of the Hanlin-Allied-Olin Site (Site) in Moundsville, West Virginia. Included within this Work Plan are the soil study, hydrogeological study, field sampling, quality assurance, health and safety, and disposal plans.

This EE/CA Work Plan is based on the Administrative Order by Consent (EPA Docket No. III-94-29-DC) and on the pre-scoping meeting held with EPA on October 18, 1994. Following is a description of the Site, the objectives of this Work Plan, and a summary of the organization of this Work Plan. A summary of the history of the Hanlin-Allied-Olin Site is presented in Section 2 of this EE/CA Work Plan.

1.1 SITE LOCATION AND DESCRIPTION

The Hanlin-Allied-Olin Site is located approximately three miles south of Moundsville, West Virginia and is between the Ohio River, WV Route 2 and the Moundsville Golf Course (Figure 1-1). The Site is in the mid-northern portion of Round Bottom, a sickle-shaped bottom land alluvial deposit along the inside of a sharp meander in the Ohio River. Round Bottom encompasses an area approximately four miles in length and a width of one-half mile at it widest point.

The approximately 420-acre Hanlin-Allied-Olin Site consists of the South Plant (Allied) and the North Plant (Allied Park [Allied] and the Olin Area; Figure 1-2). The Olin Area consists of approximately 146 acres and is situated on the northeast portion of the Hanlin-Allied-Olin Site.

The Olin Area (site) slopes gently downwards from WV Route 2 towards the Ohio River and consists primarily of fields with some woods, gravel/asphalt roads, a parking lot, and some flat and level foundations of former process buildings (Figure 1-3 shows an aerial photograph taken in August 1994). There are no buildings or containers in the area. An active railroad crosses the property and there is an active natural gas relay station on the western side (Columbia Natural Gas Transmission, Inc.). The entrance road to the site is blocked by a locked, heavy chain placed between two steel posts and by a locked gate within a chain link fence.

1.2 OBJECTIVES

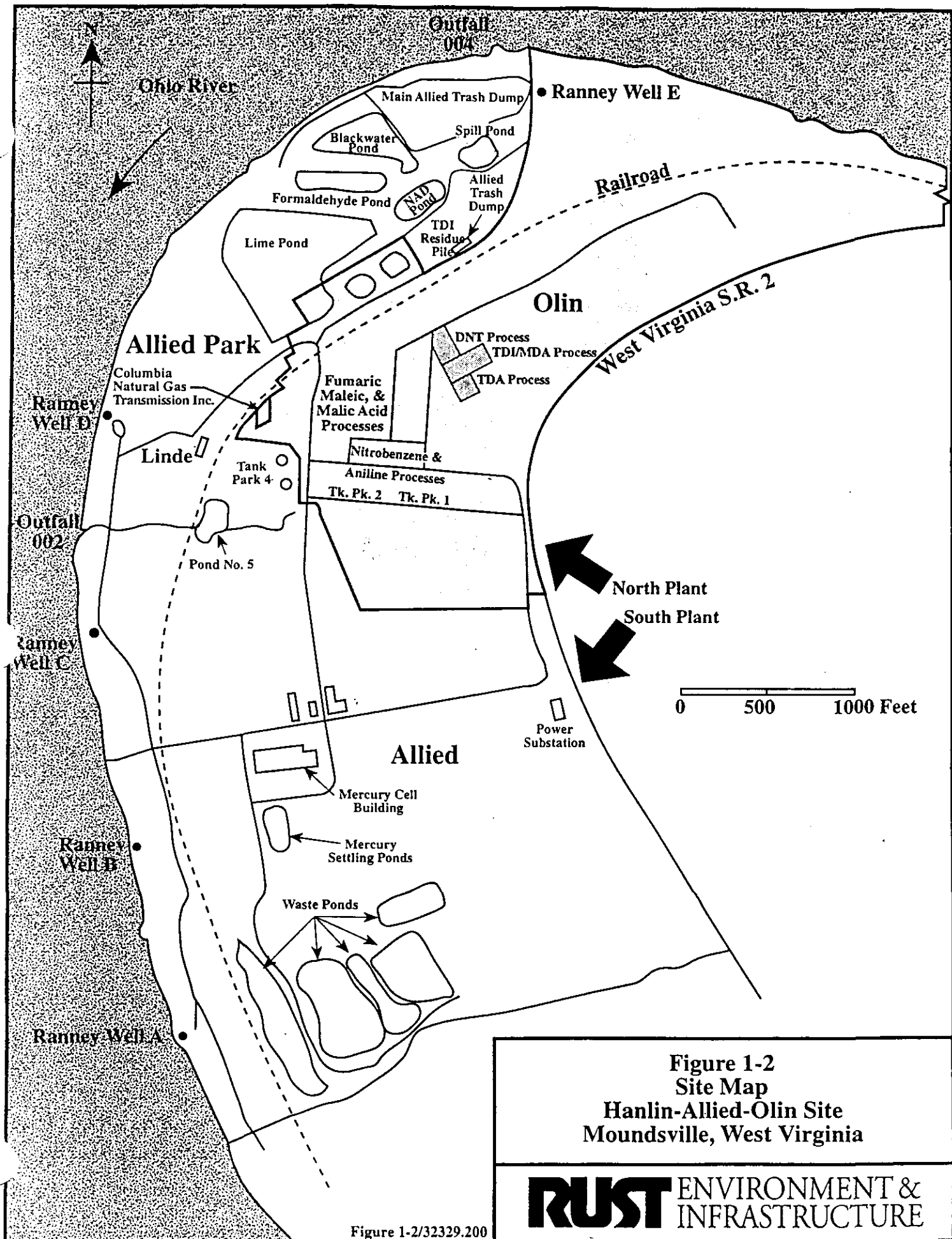
The mutual objectives of EPA and Olin are to perform an EE/CA to characterize the nature and extent of chemical presence in the Olin Area. That information will subsequently be used to identify source areas and to prepare an EE/CA Report.

1.3 EE/CA WORK PLAN

This EE/CA Work Plan includes the following sections:

- Soil Study Plan (Section 3.0)
- Hydrogeological Study Plan (Section 4.0)
- Field Sampling Plan (FSP; Section 5.0)
- Quality Assurance Project Plan (QAPjP; Section 6.0)
- Health and Safety Plan (HASP; Section 7.0)
- Disposal Plan (Section 8.0)
- EE/CA Schedule (Section 9.0).

This Work Plan is based on the Administrative Order by Consent and on the October 18, 1994 scoping meeting with EPA. It also follows the guidance document "Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA," (EPA/540-R-93-057, August 1993).



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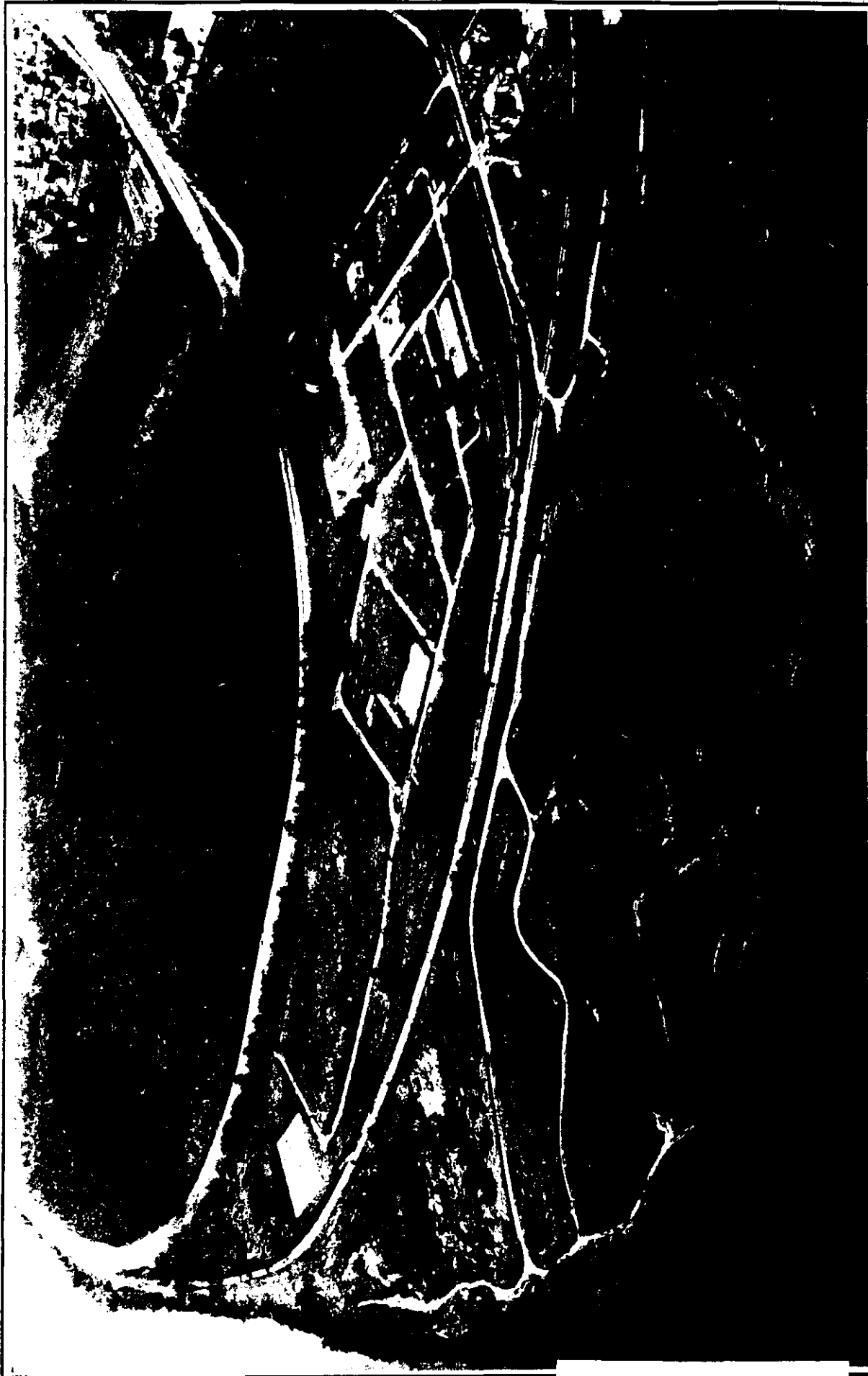


Photo taken from about 2500 feet altitude looking towards the north. Ohio River flows from left to right. Area in center foreground is Allied Park.

RUST ENVIRONMENT &
INFRASTRUCTURE

Fig. 1-2500-000-000

Figure 1-3
August 1994 Aerial Photograph
Olin Area
Hanlin - Allied - Olin Site
Moundsville, West Virginia

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2.0 SUMMARY OF HANLIN-ALLIED-OLIN SITE HISTORY

Following is a summary of the Hanlin-Allied-Olin Site History.

2.1 ALLIED CHEMICAL CORPORATION (1953-1981)

Construction of most of the processes at the Hanlin-Allied-Olin Site were completed in 1953-1956 by Allied Chemical Corporation (Allied). The facility was essentially divided by Allied into the North and South Plants (Figure 1-2) and operated by Allied Chemical Corporation.

Allied's primary activity at the South Plant was production of chloromethanes, chlorine, sodium hydroxide, and hydrogen from brine using the mercury cell process. In 1980, after 27 years of operation, Allied sold the South Plant to the company which became Hanlin. Hanlin filed Chapter 11 bankruptcy in 1991. In connection with the Hanlin bankruptcy proceedings, Allied has agreed to assume the environmental liabilities of Hanlin at the Moundsville facility.

At the North Plant, Allied's primary activities were production of aniline (Allied's National Aniline Division or NAD) and nitrobenzene, and starting in 1956, methylene dianiline (MDA), dinitrotoluene (DNT), toluenediamine (TDA), and toluene diisocyanate (TDI). Other processes included fumaric acid from 1954 to 1973 (Building 42), phosgene from 1956 to 1984 (hydrogen-carbon monoxide or HYCO process, Buildings 65, 66, 67, and 68), maleic acid from 1954 to 1973 (Building 41), and malic acid (pomalus) from 1965 to 1979.

Following are the primary raw materials used in these processes:

Dinitrotoluene (DNT) Process

Toluene
Nitric Acid
Sulfuric Acid
Soda Ash

Toluene Diamine (TDA) Process

DNT
Hydrogen Gas
Palladium Catalyst

HYCO/Phosgene Process

Natural Gas
Chlorine (liquid)
Carbon Monoxide

Monoethanolamine
Sodium Hydroxide
Catalyst (chromium, iron oxide, nickel, zinc oxide, activated alumina)

Toluene Diisocyanate (TDI) Process

TDA
Phosgene
Dichlorobenzene
Benzoyl Chloride
Sodium Hydroxide
Catalyst (activated alumina)

Methylene Dianiline (MDA) Process

Formaldehyde
Aniline
Hydrochloric Acid
Sodium Hydroxide.

In addition to the production processes discussed above, an area of the North Plant was used by Allied for waste storage, treatment, and disposal. This area, now called Allied Park and still owned by Allied, is adjacent to the Ohio River (Figures 1-2 and 1-3). Allied Park included the unlined National Aniline Division (NAD) Pond (Pond No. 1), Formaldehyde Pond (Pond No. 2), Black Water Pond (Pond No. 3), Emergency Spill Pond (Pond No. 6), at least two trash dumps, aniline/nitrobenzene burning trenches adjacent to the Ohio River, and a TDI residue pile. The waste ponds and dumps have been filled and graded. Allied Park is not directly subject to this EE/CA.

From approximately 1956 to 1967, Union Carbide (Linde Plant) produced acetylene in an area southwest of Allied Park. Waste from this process, primarily calcium oxide, was placed in the Lime Pond. The eastern portion of the Lime Pond was used by Allied in 1977 to build the Settling and Equalization Ponds.

Production of aniline at Building 31 was halted in 1972. In addition, aniline was reportedly no longer stored at Tank Park No. 1 south and across the road from Building 31 (Figure 3-1). Benzene nitration (production of nitrobenzene) in Building 35, distillation of nitrobenzene between Buildings 35 and 31, and storage of nitrobenzene in Tank Park Nos. 1 and 2 reportedly ceased in 1972. However, use of the sulfuric acid concentrator (SAC unit) on the north end of Building 35 continued through the remainder of Allied's ownership and during the three years of Olin production.

In addition to these process waste treatment and disposal areas, there were a number of support processes. These included storage of gasoline and diesel fuel in underground storage tanks (near Buildings 1, 2, and 3), electrical transformers with polychlorinated biphenyl (PCB) oils, equipment

storage yards, a variety of tank parks, and underground sewers. These areas are shown on Figure 3-1 and will be further discussed in Section 3.0 of this Work Plan.

2.2 OLIN YEARS (1981-PRESENT)

Olin Corporation purchased a portion of the North Plant Site in October 1981, which is now the Olin Area of the Hanlin-Allied-Olin Site. Use of this area was characterized by three periods: production, decommissioning, and current use. These are further described below.

2.2.1 Production (1981-1984)

Olin purchased this area from Allied in October 1981 and operated facilities for three years from October 26, 1981 to December 31, 1984. Terms and conditions of the purchase were specified in the Purchase and Sale Agreement.

The very comprehensive Purchase and Sale Agreement included specific provisions relating to environmental conditions and remediation, and Allied Park. These are summarized below.

The following Purchase and Sale Agreement provisions relate to environmental conditions and remediation:

- Allied will indemnify Olin for claims relating to Allied's operations, the migration of contaminated groundwater outside the boundaries of Allied Park, aniline present at the facility as a result of Allied's operations, and chemicals not used or emitted by Olin's operations.
- Olin will indemnify Allied for claims relating solely to the movement, position, or physical condition of equipment and other physical assets at the plant or transportation facilities after October 26, 1981.
- Allied is solely responsible (through 2001) for the cost of installation and operation of any new groundwater pump and treat systems.
- Olin is responsible (through 2001) for the cost of pumping Ranney Well E up to 1800 gallons per minute (gpm); Allied is responsible for the cost above 1800 gpm.
- Allied is responsible (through 2001) for capital expenditures for a system for treatment of water from Ranney Well E up to 825 gpm, and for capital expenditures for treatment over 1800 gpm. Allied and Olin will share operating costs for treatment up to 1800 gpm; Allied will bear all operating costs above 1800 gpm.

The following Purchase and Sale Agreement provisions relate to Allied Park:

- Formaldehyde Pond (Pond No. 2), Black Water Pond (Pond No. 3), and Spill Pond (Pond No. 6) - By agreement, Allied took title to all sludge in the pond, and Olin retained title to the

supernatant. Allied agreed to indemnify Olin against groundwater contamination resulting from use of the ponds, unless resulting from Olin's negligence.

- TDI Residue Pile - Allied agreed to indemnify Olin from liability resulting from Olin's residue placed on the pile, unless the liability is "solely attributable" to Olin's residue.

Olin's plant shutdown was a staggered event with various production processes ceasing at different times, with December 31, 1984 an approximation of the actual closure date. Olin continued certain operations, including DNT, TDA, TDI, and MDA, conducted by Allied during its 27 year tenure in this area of the Site. Aniline and nitrobenzene production had been terminated prior to Olin's purchase. Furthermore, Olin did not operate the food acid processes (fumaric, maleic, and malic acids).

A comprehensive description of by-products and wastes produced, as well as waste disposal, was provided in the CERCLA Section 104(e) response (Questions 5 through 10) submitted to EPA on June 24, 1994 (Mr. David L. Cummings, Olin to Ms. Joan Armstrong, EPA).

As part of Olin's waste management process, there were five RCRA units (Figure 3-1). The RCRA units consisted of the permitted TDI residue waste storage pile (west of Tank Park No. 3) and the following four interim status units: container storage (north of Building 42), tank storage (Tank Park No. 8), drum storage (east of Building 64), and the Equalization Pond (a.k.a., Pond No. 7 and Equalization Basin). Closure of these units is described below under the decommissioning discussion.

2.2.2 Decommissioning (1985-1989)

Decommissioning of the Olin plant began in 1985 using a work plan prepared by BCM and conducted by OHM. Process chemicals were sold to other companies or shipped to other Olin facilities for use in production. Olin removed wastes and byproducts, including those previously generated by Allied. In many cases, substantial portions of the wastes or by-products were generated by Allied prior to Olin's purchase of the Olin Area but had not been used or disposed by Allied.

Asbestos containing materials (ACM) were removed from buildings prior to demolition work. Pipes and sewers were flushed, sewers plugged with concrete, and the liquids treated on-site or sent off-site for proper disposal. Other potentially contaminated media such as soil, building materials, rubble, glassware, spent catalysts, and protective equipment (gloves, booties, coveralls) were properly disposed off-site. Scrap steel and other construction materials were decontaminated and then recycled to the extent possible. Some clean concrete building rubble was used as fill material to contour the site.

After the buildings were demolished, most of the former process building foundations were covered with clean, local, clayey soil, regraded, and allowed to revegetate. However, most of the roadways were left intact. Decommissioning is summarized in the document "Project Engineering Summary of the Moundsville Project, Olin Chemical, Moundsville, West Virginia Facility" (BCM Engineers, Inc., Pittsburgh, Pennsylvania, February 1991).

The five RCRA units discussed in Section 2.2.1 were also closed during decommissioning. Closure certifications were received by the West Virginia Department of Natural Resources (WVDNR) on October 22, 1986 for the four interim status RCRA units (except the permitted TDI residue waste pile discussed below). In accordance with Section 13 of the West Virginia Hazardous Waste Management Regulations and Section 40 CFR 265.143(h), Olin was notified by the WVDNR on December 19, 1986 that financial assurance for closure no longer needed to be maintained (letter from Mr. Ronald Potesta, WVDNR, to Mr. Verrill Norwood, Jr., Olin).

Closure certification was received by the WVDNR on December 17, 1986 for the permitted TDI residue waste pile. In accordance with the West Virginia Hazardous Waste Management Regulations and Section 40 CFR 264.143(i), Olin was notified by the WVDNR in January 1987 that financial assurance for closure no longer needed to be maintained (letter from Mr. Ronald Potesta, WVDNR, to Mr. Verrill Norwood, Jr., Olin).

Olin sold a parcel of land containing three 500,000 gallon above ground tanks in the western portion of the Olin Area to Hanlin on October 10, 1987. At that time, all three tanks were intact after having been cleaned and decontaminated by Olin. The parcel is not subject to this EE/CA.

2.2.3 Current Use (1990-Present)

The Olin Area is vacant and is managed as a closed industrial facility. Access via WV Route 2 is controlled by a locked, heavy chain placed between two steel posts and by locked gates in a chain link fence. The Olin Area is checked daily by Olin or other security persons by agreement with Olin.

The Olin Area consists primarily of open, grassy fields with some woods, gravel/asphalt roads, a parking lot, and some flat and level foundations of former process buildings (Figure 3-1). There are no buildings or containers in the Olin Area. An active railroad crosses the Olin Area (Figure 3-1) and there is a natural gas relay facility on the western side of the Olin Area (Columbia Natural Gas Transmission, Inc.). In addition, there is three-phase electrical service to the pump for Ranney Well E (Figure 1-2).

The only ongoing activity at the Olin Area is the pumping and analysis of water from Ranney Well E. As required by a WVDNR Consent Decree (October 22, 1981, Civil Action No. 81-C-554N between the State of West Virginia and Allied Corporation), Ranney Well E water is to be continuously pumped to prevent direct off-site migration of groundwater from the Allied Park area. As part of the Purchase and Sale Agreement between Olin and Allied (summarized in Section 2.2.1), Olin is presently responsible for pumping Ranney Well E.

Currently, Ranney Well E is pumped at approximately 450 to 475 gallons per minute (gpm). Extracted water is pumped approximately 600 feet to the south to a small, man-made sump. The water then flows by gravity to the Ohio River for approximately 700 feet through an open ditch (equipped with a flume for flow measurement) for discharge at Outfall 004 (Figure 3-1). Outfall 004 is permitted under the National Pollutant Discharge Elimination System (NPDES). In 1991, Olin

submitted an NPDES permit renewal application for Outfall 004, including sampling data on discharge water.

Section 3.0

AR300081

3.0 SOIL STUDY PLAN

This section presents the soil sampling objectives and strategy, methodology to identify sensitive environments and ecosystems, and methodology to determine soil cleanup levels.

3.1 SOIL SAMPLING OBJECTIVES AND STRATEGY

Following is a discussion of soil sampling objectives, strategy, procedures, analyses, locations, and depths.

3.1.1 Sampling Objectives

The soil sampling objectives are to determine the surface and subsurface soil chemistry and then use these results to prepare the EE/CA Report. A phased approach will be used for both the soil study and for the groundwater study (Section 4.0). This will allow more accurate delineation of soil and groundwater chemistry than just a single phased approach to investigation. Details of the Phase 1 study are provided below.

3.1.2 Sampling Strategy, Procedures, and Analyses

Following is a discussion of sampling strategy, procedures, and analyses.

3.1.2.1 Sampling Strategy

The sampling strategy is based primarily on a knowledge of past practices during the Allied and Olin occupation (discussed in Section 2.0), the sampling objectives, and on professional judgment. Three primary strategies were considered for selection of soil sample locations at the Olin Area: (1) random, (2) uniform grid (e.g., at 500 foot centers), and (3) biased towards the locations of previous industrial operations. The first two strategies would be more appropriate for a site where there was little historical documentation of past activities while the third sampling strategy applies to facilities where current (or past) operational histories are documented.

Over the 35 year operation history of the North Plant (of which the Olin Area is a portion), its operations, raw materials, finished products, and waste streams were very well documented. This documentation includes: internal memos, official correspondence, bill of lading records, inventory records, engineering plans, facility and process maps, aerial photographs, and much more. In addition, Olin has interviewed former Allied and current Olin employees to learn more about potential sources of contamination at the Olin Area.

Sampling strategy also follows the EPA guidance for conducting EE/CA programs (EPA, August 1993), including the section "Source, Nature, and Extent of Contamination". For instance, on page 27, the guidance states "Existing information may be useful in determining the location(s) of contamination at a particular site." This section continues describing various information used to determine sample locations. On page 28 of the EE/CA guidance, it indicates "Contaminant sources and locations can often be determined by: Using nonanalytical methods...aerial photographs...and reviewing past operations and information...including past or current employees..." For these reasons, this sampling strategy will determine "hot spots" during the Phase I and will delineate the extent of any contamination.

Proposed sampling locations (Figure 3-1) are divided into locations that are:

- (1) Non-process related areas,
- (2) Former organic production process areas (e.g., DNT, TDA, TDI, MDA) including tank parks, and
- (3) Former process support activities, including:
 - (a) Transformers at electrical substations
 - (b) Hydrogen gas bags/filters
 - (c) Cooling towers
 - (d) General maintenance
 - (e) Waste water treatment (Equalization and Settling Ponds)
 - (f) Underground fuel storage tanks
 - (g) Underground sewers.

As discussed previously, a phased approach will be used for the soil study. In Phase 1, samples will be collected at select locations (discussed in detail below) from the surface soil (0 to 1 foot depth) and at the 6 to 8 foot depth (a depth interval that is at or below former sewers). Based on these results, additional sample locations and depths will be proposed (as an amendment to this Work Plan) to the EPA as the Phase 2 portion of the soil study. Specific analytes being sampled at each Phase I location are explained in detail in Section 3.1.3.

3.1.2.2 Sampling Procedures

Subsurface soil boreholes will be advanced using a hollow-stem auger drill rig. Surface soil samples (land surface to one foot depth below land surface) and subsurface samples will be collected using a three-inch inside diameter, five foot long, split barrel sampler (or equivalent) that is pushed into the soil ahead of the auger borehole. Soil borings will be geologically logged as specified in the Field Sampling Plan or FSP (Section 5.0).

If large pieces of concrete fill are encountered in the 0 to 1 foot depth interval such that an adequate soil sample can not be collected for laboratory, analysis, then the boring location will be moved a reasonable distance such that soil is encountered at the 0 to 1 foot depth interval.

Soil samples would then be collected at the new location and the new location marked on Figure 5.2.

Specific sampling procedures, including equipment decontamination, sample handling, and plugging the boreholes, are discussed in the FSP (Section 5.0). Health and safety issues related to sampling and other field activities are discussed in the Health and Safety Plan or HASP (Section 7.0). Disposal of drill cuttings not submitted for analysis are discussed in the Disposal Plan (Section 8.0).

3.1.2.3 Sample Analyses

Proposed analyses for Phase 1 of the soil study are based on the historical uses by Allied at locations within the site. The analyses will include volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), chromium, mercury, pH, and total organic carbon (the last two parameters may be used for vadose zone modeling). However, some samples will also have a full target analyte/target compound list (TAL/TCL) analysis performed, as discussed at the October 18, 1994 EPA meeting and in the following sections. A summary of boring locations and associated analyses is presented in Table 5-1.

Specific analytical methods and their associated analytes are discussed in detail in the FSP (Sections 5.0) and QAPJP (Section 6.0). In addition, field screening for VOCs will be conducted on the soil collected from borings using a flame ionization detector (FID) (e.g., OVA), or equivalent. Field screening for PCBs in samples from former transformer areas will also be conducted. Phase 2 analyses will depend on the results of the Phase 1 soil study.

3.1.3 Sampling Locations

As discussed above, sampling locations for Phase 1 were selected based on a knowledge of past processes and activities during Allied and Olin occupation, upon a consideration of the sampling objectives and EPA guidance, and on professional judgment.

Because of the relatively large size of the site and general lack of visible landmarks, boring locations shown on Figure 3-1 will be located by surveyors so that the locations are correctly positioned relative to the non-process, former process, or former process support locations (also see Figure 5-2 for current site conditions). Sampling locations will be marked in the field with high, durable poles (at least 5 feet of stickup, steel conduit pipes or equivalent) such that they are clearly visible. Prior to advancing any borings, both a utilities representative and an Olin representative will approve all boring locations. In addition, locations will be marked at the completion and abandonment of a borehole.

Labeling nomenclature for soil borings will be alphanumeric using the letter B to indicate a boring (e.g., B1). This alphanumeric nomenclature is further discussed in the FSP (Section 5.0).

Phase 2 locations will depend on Phase 1 results. For example, Phase 2 locations may be deeper samples from previous Phase 1 locations (to better define vertical residual extent) or may be at different locations adjacent to Phase 1 locations (to better define areal extent of residuals).

3.1.3.1 Non-Process Related Areas

Of the Olin Area (146 acres), approximately 40 acres were relatively undeveloped by either Allied or Olin and were not used for production or process support by either Allied or Olin. The primary non-process areas are the fields on the east and west sides of Building 100 and adjacent to WV Route 2 and the woods south of the aniline/nitrobenzene area (Buildings 31 and 35 on Figure 3-1; to be called the South Woods in this Work Plan). The five acres around Building 100 and the former Fire Pond (Pond No. 4; lined with EPDM rubber liner) were used to store food-grade acids (e.g., fumaric, malic) and water, respectively.

In addition, the soil in the approximately 20 acres in and around the Grove's Pile (soil and rock from the widening of WV Route 2) was most likely not impacted by production processes and was reportedly used to place non-contaminated debris, primarily rock and soil from the widening of WV Route 2. The asphalted, employee parking lot and the area between the parking lot and WV Route 2 (approximately 5 acres) is not expected to be impacted.

Consequently, approximately 70 acres is not expected to have been impacted by former production processes. However, select soil borings will be conducted in these areas to confirm this contention.

3.1.3.1.1 Fields Adjacent to Building 100

Two soil borings will be advanced: B1 will be approximately 800 feet to the east and B2 will be 600 feet southwest of Building 100. At each of these sampling locations, one sample will be collected at 0 to 1 foot depth and one at the 6 to 8 foot depth. Each sample will be analyzed for TAL/TCL constituents, pH, and TOC. Analytical data from these two borings (B1 and B2), along with boring B7 (discussed below), will be considered to be background soil data.

3.1.3.1.2 Building 100 and Firewater Pond

Soil boring B3 will be advanced in the center of the closed Firewater Pond (Figure 3-1). One sample will be collected at the 0 to 1 foot depth interval (surface soil), one at the 6 to 8 foot depth interval, and one at the 14 to 16 foot depth interval. Each of these samples will be analyzed for TAL/TCL constituents, pH, and TOC.

3.1.3.1.3 Grove's Pile/Ranney Well E

As stated previously, the Grove's Pile is rock and soil placed at the Olin Area during the widening of West Virginia Route 2. S. J. Grove was the D.O.T. contractor and the pile is clean material (e.g., rock, soil) primarily cut from the hillside. Soil boring B4 will be advanced at the toe of the Grove's Pile (Figure 3-1). One sample will be collected at the 0 to 1 foot depth interval (surface soil) and one at the 6 to 8 foot depth interval. Each of these samples will be analyzed for TAL/TCL constituents and pH.

Soil boring B5 will be advanced approximately 400 feet south of Ranney Well E (Figure 3-1). One sample will be collected at the 0 to 1 foot depth interval (surface soil) and one at the 6 to 8 foot depth interval. Each of these samples will be analyzed for TAL/TCL constituents and pH.

Soil boring B6 will be collected from the ditch that drains pumped Ranney Well E water to Outfall 004 (Figure 3-1). One sample will be collected at the 0 to 1 foot depth interval (surface soil/sediment) and one at the 6 to 8 foot depth interval. Each of these samples will be analyzed for temperature, E_H , pH, conductivity, color (Munsell), TOC, grain size, moisture and solids, TAL/TCL constituents and pH.

3.1.3.1.4 Employee Parking Lot

Soil boring B7 will be advanced between the parking lot and WV Route 2 (Figure 3-1). One sample will be collected at the 0 to 1 foot depth interval (surface soil) and one at the 6 to 8 foot depth interval. Each of these samples will be analyzed for TAL/TCL constituents, pH, and TOC.

3.1.3.1.5 South Woods

The South Woods (due south of the Gas Company Easement Road on Figure 3-1) is a non-process area. Drainage, primarily from Allied's aniline/nitrobenzene process (Building 31 and 35), may have impacted this area, as well as other buildings and processes in this vicinity. The ditch draining this area went to Pond No. 5 (Allied) and then to the Ohio River via Outfall 002. Consequently, soil boring B8 will be in the ditch at the Olin Area property line and soil boring B9 will be to the east and upgradient of B8. At sampling locations B8 and B9, one sample will be collected at 0 to 1 foot depth and one at the 6 to 8 foot depth and analyzed for temperature, E_H , pH, conductivity, color (Munsell), TOC, grain size, moisture and solids, TAL/TCL constituents and pH.

In addition, soil samples will be collected from the 0 to 1 foot depth and 6 to 8 foot depth at B10 (southeast of B9; Figure 3-1). Soil samples from B10 will be analyzed for SVOCs (includes aniline and nitrobenzene, suspected residuals from Buildings 31 and 35), mercury (a potential residual in the hydrogen gas from Allied's South Plant that was used by Allied

and Olin in Building 31), and pH. Olin installed a mercury removal system prior to operating this system.

3.1.3.2 Former Production Process Locations

Former process areas (and their associated tank parks) can essentially be divided into three areas: (1) aniline/nitrobenzene, (2) fumaric/maleic/malic acids, and (3) DNT/MDA/TDA/TDI. These are further discussed below and are shown on Figure 1-2.

3.1.3.2.1 Aniline/Nitrobenzene Area

This area includes Buildings 31 and 35 (not used by Olin) and Tank Park Nos. 1 and 2 (Figure 3-1). Nine soil borings, B11 through B19, will be advanced in this area as shown on Figure 3-1. Soil borings B13 and B17 will be sampled at the 0 to 1 and 6 to 8 foot depth intervals. Samples from B13 (essentially in the center of the aniline/nitrobenzene area) and B17 (adjacent and downstream of surface water runoff from former Building 35) will be analyzed for TAL/TCL constituents and pH. At the other soil boring locations in the area (B11, B12, B14 through B16, B18, and B19), a sample will be collected at the 0 to 1 foot and 6 to 8 foot depth intervals. These samples will be analyzed for SVOCs (includes aniline and nitrobenzene), mercury, and pH.

3.1.3.2.2 Fumaric/Maleic/Malic Acid Area

This area is centered on Building 42 and was not used by Olin for acids production. A review of the process chemistry was used to help determine sampling locations. Fumaric acid is the trans-isomer of maleic acid and is used as an FDA-approved flavoring agent. Maleic acid was produced by the catalytic oxidation of benzene over vanadium pentoxide catalyst. Most of the maleic acid was converted to maleic anhydride. One of the uses of maleic acid was to produce malic acid. Malic acid is used as a food additive. Consequently, the primary residuals of concern that may be present in this area are not the food-grade fumaric and malic acids, but the benzene used as a reactant.

Soil borings B20 through B22 will be advanced in this area as shown on Figure 3-1. At each of these locations, one sample will be collected at the 0 to 1 and one at the 6 to 8 foot depth intervals and analyzed for VOCs (includes benzene), SVOCs (includes nitrobenzene which was reportedly stored in this area), and pH. Soil boring B23 will be placed within the former diked area of Tank Park No. 3. This location is downgradient with respect to surface water runoff from this process area and from Tank Park No. 3. Soil borings from B23 will be collected at the 0 to 1 and 6 to 8 foot depth intervals and analyzed for TAL/TCL constituents and pH.

One boring (B24) will also be advanced at the "Salt Dump" (Figure 3-1). Salts reportedly consisted of potassium nitrite and sodium nitrate and were used in the benzene converter (maleic acid process) cooling system by Allied prior to cessation of this process in 1973.

Approximately 30,000 pounds of these salts were reportedly buried by Allied about thirty feet due north of Building 41. Samples from this boring will be collected at the 0 to 1 foot and 6 to 8 foot depth intervals and analyzed for metals, nitrite, nitrate, and pH.

3.1.3.2.3 DNT/MDA/TDA/TDI Area

The DNT/MDA/TDA/TDI area corresponds to the area around Buildings 52, 53, 55, 61, and 63 through 68. Borings B25 through B35 will be advanced at this area. At locations B26, B30, and B33, one sample will be collected from the 0 to 1 and one from the 6 to 8 foot depth intervals and analyzed for TAL/TCL constituents and pH. At locations B25, B27 through B29, B31, B32, B34 and B35, samples will be collected from the 0 to 1 and 6 to 8 foot depth intervals and analyzed for VOCs, SVOCs, and pH. In addition, mercury will be analyzed in samples from B27 and B28 (locations around Building 52 where hydrogen gas, and possibly entrained mercury, from the South Plant was used).

3.1.3.3 Former Process Support Locations

A number of process support activities were necessary during production. These included (with potential residuals in parentheses) transformers at electrical substations (PCBs), hydrogen gas bags/filters (mercury metal), cooling towers (chromium salts), general maintenance (oil, degreasers), waste water treatment (process chemicals in the Equalization and Settling Ponds), underground fuel storage tanks (gasoline, diesel), and underground sewers (miscellaneous chemicals).

3.1.3.3.1 Transformers

There were six (approximately 20 by 20 feet) electrical substations that reportedly contained transformers with PCB-containing fluids. Although there were no reportable quantities of PCBs spilled and the transformers and soil were remediated during decommissioning, samples will be collected and analyzed to confirm the previous remediation. Because of the small area, soil sample compositing will be conducted. At each of these six locations (B36 through B41), one composite sample will be collected from five sub-locations (one in the center and four 10 feet away in each compass direction) from the 0 to 1 foot depth and one composite from the 6 to 8 foot depth interval. Samples will be analyzed for PCBs, SVOCs, and pH.

3.1.3.3.2 Hydrogen Gas Bags/Filters

Hydrogen gas from the Allied South plant was piped to the Olin Area near Tank Park No. 2. Prior to 1975, there is a possibility that some trapped mercury was released from the hydrogen pipes and valves in the area south of Tank Park No. 2 during Allied's operation. Granular activated carbon (GAC) was used after about 1975 by Allied (and always by Olin) to absorb residual mercury prior to the hydrogen gas going into Buildings 31 and 52 (aniline and TDA processes, respectively).

At this location (B42), one composite sample will be collected from five sub-locations (one in the center and four 20 feet away in each compass direction) from the 0 to 1 foot depth and one composite from the 6 to 8 foot depth intervals. The resultant two composite samples will be analyzed for mercury and pH.

3.1.3.3.3 Cooling Towers

There were at least three cooling towers (Figure 3-1). Chromium compounds were reportedly used in the non-contact cooling water (water did not contact organic chemicals in the process area being cooled). Some of this water and the dissolved chromium compounds may have migrated from the cooling towers as liquid leaks or as a spray. Consequently, soil sampling will be done under and around the three former cooling tower locations.

At each of these three locations (B43, B44, and B45), composite samples will be collected. At the cooling tower between Tank Parks No. 1 and 2 (B43), there will be three sub-locations (B43a, B43b, B43c) sampled for a composite; at the former cooling tower near Tank Park No. 9 (B44), three sub-locations; and at the cooling tower near Building 67 and the RCRA drum storage area (B45), two sub-locations will be sampled. At each of these locations, one sample will be collected from the 0 to 1 foot depth and one from the 6 to 8 foot depth intervals for compositing. Samples will be analyzed for total chromium and pH.

3.1.3.3.4 General Maintenance/Construction

Building 23 was reportedly the maintenance facility and Building 26 a construction office. Used equipment, pipes, valves, and other scrap were primarily placed in the Storage Area (Figure 3-1). Borings will be advanced at B46 (near Building 23), B47 (near Buildings 25 and 26), B48 (at the Storage Area), and B49 (Process Equipment Yard). At locations B46 through B48, one sample will be collected from the 0 to 1 foot and one from the 6 to 8 foot depth intervals and analyzed for VOCs, SVOCs, and pH. At location B49, one sample will be collected from the 0 to 1 foot and one from the 6 to 8 foot depth intervals and analyzed for TAL/TCL constituents and pH.

3.1.3.3.5 Equalization and Settling Ponds

The Equalization and Settling Ponds were built in 1977 by Allied in the southeastern corner of the Lime Pond (Figure 3-1). RCRA clean closure of the Equalization Pond was completed in 1986 and closure of the Settling Pond was also completed in 1986 as part of Olin's decommissioning efforts. For both ponds, the EPDM rubber liner and related systems were removed and the ponds filled with soil from the dike walls and soil from the Grove's Pile as needed. Because of the RCRA clean closure of the Equalization Pond (as recognized by the WVDNR), and because the existing, downgradient RCRA wells will be sampled as part of this EE/CA (see Section 4.0), no soil sampling will be conducted for the EE/CA.

However, one boring (B50) will be advanced at the former inorganic treatment building (Building 57; Figure 3-1). One sample will be collected from the 0 to 1 foot and one from the 6 to 8 foot depth intervals. Samples will be analyzed for TCL/TAL constituents and pH.

3.1.3.3.6 Fuel Storage Tanks

Two areas were reportedly used to store fuel: gasoline and diesel were stored underground in an area between Buildings 1, 2, and 3 and fuel oil above ground in an area about 30 feet north of the boiler house (Building 44; Figure 3-1). At each of these locations (B51 and B52), one sample will be collected from 0 to 1 and 6 to 8 foot depth intervals. Samples will be analyzed for VOCs, SVOCs, and pH.

3.1.3.3.7 Underground Sewers

Underground sewers are shown on Figure 3-1. Since a number of borings will be adjacent to former sewers and will go beneath the level of the sewers, no additional sewer sampling locations are proposed.

3.2 IDENTIFICATION OF SENSITIVE ENVIRONMENTS AND ECOSYSTEMS

Following is a discussion of the objectives, guidance, and methodology for identifying sensitive environments and ecosystems.

3.2.1 Objectives

The objective of this section is to present the methodology to identify sensitive environments and ecosystems potentially affected by the Olin Area. As appropriate for achieving the objective stated in Section 3.1, the methodology to identify sensitive environments and ecosystems was drawn from a number of guidance documents (listed in the reference section of this Work Plan).

In addition, a checklist provided by EPA entitled "Economically and Environmentally Sensitive Areas" will be used in the assessment. A copy is included as Appendix A.

3.2.2 Methodology

This methodology is essentially the same as the EPA screening level risk assessment approach (EPA, July 1994) for developing environmental effects quotients (EEQ).

- (1) Based on interpretation of aerial photographs (taken in August and September 1994), major ecological habitats (e.g., ponds, drainage ditches, etc.) will be identified and delineated on a topographic map, based on the presence of dominant plant species. A reconnaissance will be conducted in the spring to verify and further define habitat boundaries. Notes regarding animal species also will be made based on sightings and other evidence such as tracks, scat, nests, and burrows.

- (2) Conduct a threatened, endangered, and sensitive (TES) species literature search using published resources such as those from the U.S. Forest Service, the Fish and Wildlife Service, and the WVDNR.
- (3) Use the collected field and literature information to identify potentially sensitive habitats and species. Professional judgment will be used in considering the ecological significance and uniqueness of the habitat.
- (4) Develop a conceptual model to evaluate the potentially complete exposure pathways for ecological receptors, if any (locations of soil samples shown on Figure 3-1).
- (5) Examine the surface soil analytical data to determine if there are any chemicals of potential concern (COPCs) for any complete exposure pathways and habitats identified in the previous steps. This determination will consider background values, potential for exposure to residuals (e.g., sensitive organisms present, routes of exposure, estimated exposure duration, exposure frequency), and the predicted biochemical behavior of a chemical of potential concern (e.g., persistency, bioaccumulation).
- (6) Calculate environmental effects quotients (EEQ) for chemicals of potential concern using the methods outlined by EPA Region III (EPA, July 1994). Values above unity (one) will be considered to indicate a potential for risk, and these chemicals will thereby be classified as ecological chemicals of concern.
- (7) Develop cleanup levels for the specific chemicals of concern (EEQ greater than one) and the sensitive habitats identified.
- (8) Discuss the identification of sensitive environments and ecosystems potentially affected by the Olin Area and the proposed cleanup levels (if any) in the EE/CA Report.

3.3 METHODOLOGY TO DETERMINE SOIL CLEANUP LEVELS

Based on a knowledge of past processes, a list of potential chemicals was prepared for the FSP, QAPjP, and HASP in Sections 5.0, 6.0, and 7.0, respectively. However, the actual chemicals found may vary somewhat and will not be known until after Phase 1 and 2 soil sampling, analysis, and data validation are completed. For this reason, and others discussed below, it is premature to determine soil cleanup levels at the Work Plan stage. Soil cleanup levels will be proposed in the EE/CA Report using the methodology described in the following sections. These methods are based primarily on the EE/CA guidance document (EPA, August 1993; i.e., Section 2.5 "Identification of Removal Action Scope, Goals, and Objectives").

3.3.1 ARARs

The preparation of the EE/CA Report will include an examination of applicable or relevant and appropriate requirements (ARARs) set forth under State or Federal environmental laws as stated in

the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, the National Oil and Hazardous Substances Contingency Plan (NCP) of November 20, 1985 (50 Federal Register 47973, the Superfund Amendments and Reauthorization Act (SARA) of October 17, 1986, and the amended NCP of March 8, 1990 (55 Federal Register 8666).

ARARs may be classified as action-specific, location-specific, or chemical specific. Action-specific ARARs set controls or restrictions on the design, performance, and other aspects of implementation of specific remedial activities. Examples include RCRA regulations for off-site disposal of hazardous residuals and Clean Water Act standards for discharge of treated groundwater to surface water. Other action specific ARARs may include potential impacts of any proposed actions such as noise from equipment or emissions from equipment or excavations.

Location-specific ARARs will consider requirements that reflect physiographical and environmental characteristics. Remedial actions may be restricted or precluded depending on the location or characteristics of the area and the resulting requirements. Examples include a consideration of flood plains, wetlands, and groundwater classification.

Chemical-specific ARARs are environmental concentration limits promulgated by government agencies. One example are PCB limits for soil as promulgated by the Toxic Substances Control Act (TSCA). Another consideration will be the EPA Region III risk-based concentration (RBC) table, which is periodically updated.

3.3.2 Human Health

This approach to setting cleanup levels will employ the streamlined risk evaluation as provided in Section 2.4 of the EE/CA guidance document (EPA, August 1993):

The streamlined risk evaluation is a new type of evaluation, intermediate in scope between the limited risk evaluation undertaken for emergency removal actions and the conventional baseline assessment normally conducted for remedial actions. This streamlined risk evaluation can help justify taking a removal action and identify what current or potential exposures should be prevented. The risk evaluation uses sampling data from the site to identify the chemicals of concern, provides an estimate of how and to what extent people might be exposed to these chemicals, and provides an assessment of the health effects associated with these chemicals. A streamlined risk evaluation projects the potential risk of health problems occurring if no cleanup action is taken at a site. Therefore, the results of the streamlined risk evaluation help EPA decide whether to take a cleanup action at the site, what exposures need to be addressed by the action, and in some cases define appropriate cleanup levels.

This evaluation will be based primarily on the results from surface soil sampling (land surface to one foot below land surface). In addition, current zoning and potential future use will be considered in this assessment. However, based on Phase 1 and 2 data, Olin may conduct a standard baseline risk assessment.

3.3.3 Sensitive Environments and Ecosystems

As discussed in Section 3.2, sensitive environments and ecosystems potentially affected by the Olin Area will be identified. In addition, this will include an identification of chemicals of potential concern for potential ecological receptors, calculation of an environmental effects quotient (EEQ) for each COPC, identification of ecological chemicals of concern, and finally, proposed soil cleanup levels to achieve acceptable EEQs for any chemicals of concern and identified habitats.

3.3.4 Groundwater

The potential impact of constituents in the vadose zone soil (unsaturated soil zone; includes surface and subsurface soil above the water table) on the groundwater quality can be predicted using a variety of vadose zone models. The basic procedure for these models is to estimate the volume of flow from the vadose zone soil per horizontal area and the constituent concentration within the flow from the vadose zone. The vadose zone flux is then blended with groundwater beneath it and then compared to a chemical-specific remediation level.

Vadose zone models range in complexity from the simplistic to more sophisticated models. Common, primary model input parameters include:

- (1) depth from the residual to groundwater;
- (2) residual soil concentration profile;
- (3) infiltration rate of precipitation;
- (4) chemical transformation kinetics;
- (5) equilibrium sorption coefficients (e.g., K_d); and
- (6) volume of groundwater available for blending.

Items 1 and 2 will be determined during implementation of this Soil Study Plan. Precipitation data for item 3 will be obtained from the National Weather Service and an infiltration rate calculated based on topography (slope) and ground cover. Items 4 and 5 will be determined from literature searches about fate processes such as biodegradation and sorption. In addition, select soil samples will be analyzed for total organic carbon (TOC) to determine the fraction of organic carbon (foc). Those data, along with a chemical's K_{oc} (adsorption coefficient based on the organic carbon content of a solid phase), can be used to estimate K_d values for a specific chemical. Item 6 will be determined based on previous groundwater studies and those conducted for the EE/CA as described in the Hydrogeological Study Plan in Section 4.0.

Results of vadose zone modeling will be compared to actual groundwater data. Furthermore, the groundwater data may be used to modify vadose zone model inputs to better reflect specific conditions.

NOTE: Oversize Figure 3-1 is at the end of this Work Plan.

Section 4.0

AR300095

4.0 HYDROGEOLOGICAL STUDY PLAN

This section, which presents the Hydrogeological Study Plan, describes plan objectives, site hydrogeologic characteristics, and investigation strategy. Procedures for evaluating collected data are also discussed.

4.1 PLAN OBJECTIVES

This plan has been developed to meet the following objectives:

- Investigate and sample all potentially impacted aquifers to determine groundwater flow direction, sources of chemicals, and migration potential;
- Delineate bedrock topography and geology;
- Assess condition/suitability of existing groundwater monitoring well network for collecting representative groundwater samples;
- Identify and sample all existing wells for analysis of site specific substances plus a certain percentage to be analyzed for target analyte list (TAL) and target compound list (TCL) parameters;
- Identify locations of new wells, if any, to be installed in order to complete the study;
- Evaluate Ranney Well effects on groundwater flow;
- Evaluate migration of chemicals from the Allied Park Area to the Olin Area; and
- Propose a schedule for completion of the hydrogeological study.

This Hydrogeological Study Plan references and complements the other sections of the EE/CA Work Plan. Field and laboratory procedures associated with the proposed investigation are described in detail in the associated Field Sampling Plan (FSP) (Section 5.0) and Quality Assurance Project Plan (QAPjP) (Section 6.0). Health and safety and handling of wastes associated with this plan are covered in detail in the Health and Safety Plan (HASP) (Section 7.0) and Disposal Plan (Section 8.0), respectively.

4.2 SITE HYDROGEOLOGIC CHARACTERISTICS

Development of a hydrogeological study plan is dependent on a clear understanding of available hydrogeological data including: aquifer type, groundwater flow patterns, and groundwater quality. Also, potential sources of contamination in groundwater and the fate and migration characteristics of known or suspected sources must be considered. These conditions are summarized following an

evaluation of the usefulness of the existing monitoring well network for collecting representative groundwater samples.

4.2.1 Existing Monitoring Well Network

In May 1994, Olin conducted a groundwater monitoring well inventory at the site. The purpose of the inventory was to identify monitoring wells present, to assess visible condition of the wells, and capability of a bailer to pass through the wells. Well characteristics covered by the inventory included diameter, materials of construction, presence of protective casing and condition of exposed casing and concrete collars. Figure 3-1 shows the locations of existing site monitoring wells. Table 4-1 presents depth and well construction data for the wells in the monitoring well network and indicates condition based on the well inventory.

There are a total of 45 wells on the property grouped as follows: 2 three-well clusters, 15 two-well clusters, and 9 individual wells. Olin performs annual groundwater level measurements in the on-site wells; however, routine groundwater sampling is not conducted. Based on historic groundwater flow patterns, wells 19 and 39 are in upgradient positions to former operational and waste management areas. As indicated on Table 4-1, the wells are a combination of 2-inch diameter steel (numbered series) and 4-inch diameter PVC (lettered series) wells. The numbered series well clusters were installed by Allied between 1977 and 1978. These wells have 3-foot galvanized steel screens that were installed at the base of the unconsolidated aquifer ("A" wells), and at the middle of the aquifer ("B" Wells) and/or 5 feet beneath the groundwater table ("C" Wells), depending upon thickness of the aquifer. Where the aquifer is thinner, only two screens were set, one at the base and one 5 feet beneath the water table. Each of these wells was completed by placing sand around the well screens, setting a bentonite seal above the screen and then backfilling the remaining borehole with drill cuttings. Figure 4-1, copied from a Geraghty & Miller report, shows typical well cluster construction.

Available data indicate that most of the 4-inch diameter PVC wells were installed by Olin between 1981 and 1982. Available well construction data indicate that the 18 "B" series wells were installed in 9 two-well clusters. The wells are constructed of 4-inch PVC and have 25-foot screens set on top of bedrock (deep wells), or at top of the saturated interval (shallow wells). Screen slot size is 0.04-inch. A coarse sand sandpack was placed around the screen followed by a bentonite seal above the screen. A bentonite/cement grout was installed from the top of the bentonite seal to ground surface.

Six of the "R" series wells, R1A, R1B, R2A, R2B, R3A and R3B are mentioned in an Olin RCRA groundwater assessment plan for the Equalization Basin. The plan states that the deeper A wells are screened from bedrock through the lower 25 feet of the aquifer, and the shallow B wells are screened from the top of the screen of the A wells up through the water table (approximately 25 feet). No other construction details are given. Construction details for wells D2, D3, D4, D5, R4A, R4B, R5A, R5B and U1 could not be found.

As part of conducting the well inventory, a 1.66" diameter bailer passed to the bottom, or very near the bottom, of all but 6 wells (see Table 4-1). Potential exists for lowering a smaller diameter bailer

into these wells in an attempt to obtain a sample. (The well cap could not be removed from Well 19 precluding a determination of whether a bailer could pass through the well.) Groundwater was not removed from any of the wells inspected during the well inventory; therefore, the potential for the wells to produce adequate volumes of water for groundwater sampling was not evaluated. According to recent groundwater level measurements, wells B6B, 35 and 36 have been dry.

As discussed above, inspections indicated that many wells may not meet present EPA standards for the condition of concrete collar and casing and presence of locking protective casing. Therefore, prior to groundwater sampling, the following upgrades/repairs will be made to wells as necessary:

- For most of the wells, the concrete collars are cracked or broken and will be repaired.
- Most of the wells do not have protective casing and locking caps; these will be installed at wells not having them.
- Repair the PVC casing to well R5A which was broken off above grade. Other wells having cracked PVC casing will also be repaired.

Although the construction and condition of the existing monitoring well network may not meet all EPA criteria for new well construction, existing network wells are considered adequate for providing useful groundwater samples, provided well construction (e.g. material, screen placement, etc.) is considered when interpreting results. Use of the existing wells will provide the most expeditious means of gathering valuable information for completing the EE/CA. The steel casing/screen wells are not well suited for providing samples for certain metals analysis because of potential for metals (e.g. iron and zinc) to leach from the galvanized screens. As discussed later, mercury and chromium are the only metal parameters that may be of concern at the site. Since the wells are made of carbon steel and galvanized steel, mercury and chromium would not be expected to leach from well construction materials. After field evaluation of sample quality and volume, those wells with unacceptable construction, condition or quality will be plugged and abandoned.

Also shown on Figure 3-1 is Ranney Well E, a former plant production well which is currently pumped at a rate of approximately 450 gallons per minute to maintain capture of groundwater (discussed on next page). Water pumped from Ranney Well E is discharged to an on-site sump which flows to the Ohio River via Outfall 004. Ranney Well E, which had a design capacity of 3,000 gallons per minute, has a depth of 70 feet and includes 7 laterals. The laterals range in length from 64 to 128 feet. Ranney Well E has an interior diameter of 13 feet and the laterals are 8 inches in diameter. As stated earlier, a key point of the hydrogeology study is to evaluate the effects of the Ranney well on groundwater flow patterns and migration characteristics.

4.2.2 Findings of Previous Hydrogeologic Investigations

In previous years, several groundwater studies and subsurface investigations have been conducted at the Hanlin-Allied-Olin Site. The following were reviewed in preparing this plan:

- Groundwater Contamination at Allied Chemical Corporation (South) Plant Site, Moundsville, West Virginia, September 19, 1977, Geraghty & Miller, Inc., Port Washington, New York 11050.
- Groundwater Contamination at Allied Chemical Corporation, (North) Plant Site, Moundsville, West Virginia, May 1978, Geraghty & Miller, Inc., Port Washington, New York 11050.
- Ranney Well Inspection for Olin Corporation of Moundsville, West Virginia, August, 1982, the Ranney Company, Westerville, Ohio.
- Aquifer Flow Simulation Using Computer Models for Moundsville, West Virginia, November, 1982, Olin Chemicals Group, Environmental Affairs Department, Charleston, Tennessee.
- Baseline Groundwater Study Moundsville Plant, Moundsville, West Virginia, April 4, 1983, Olin Chemicals Group, Environmental Affairs Department, Charleston, Tennessee.
- Evaluation Of The Ground-Water Monitoring And Containment System At The Allied-Signal, Inc., Hanlin Chemicals-West Virginia, Inc., And Olin Corporation, Inc. Sites, Moundsville, West Virginia, 1990, Geraghty and Miller, Inc.
- Site Investigation Report for Allied Chemical/Olin Corp. Moundsville, Marshall County, West Virginia (Wvdd004374021 Wv-091/Wv-025), January 30, 1991, Site Investigation and Response Office, Waste Management Section West Virginia Division of Natural Resources.

Data and findings from these investigations have proved valuable in identifying key hydrogeologic characteristics for the Olin Area. Boring logs and water level measurements indicate that groundwater beneath the site occurs in an unconfined heterogeneous alluvial aquifer comprised of silts, sands and gravels. Depth to groundwater across the site varies between approximately 15 and 70 feet. Groundwater flow is generally towards the Ohio River, with a strong influence by the pumped Ranney Wells A, D and E resulting in a flow toward these Ranney wells. The alluvial sediments overlie bedrock which dips toward the Ohio River. In general, the alluvial sediments become coarser with depth and thicker toward the river. Figures 4-2 and 4-3, developed based on available boring log data, show bedrock topography and unconsolidated (alluvial) sediment thickness. As indicated on Figure 4-3, for most of the site, depth to bedrock (i.e. thickness of alluvial sediment) ranges from approximately 60 to 90 feet. (Alluvial sediment thickness data was not available for the southeastern portion of the map.) Boring log data indicate that the uppermost bedrock unit consists of red, brown, or gray shale, of the Pennsylvanian Monongahela Group which consist of non-marine cyclic sequences of sandstone, siltstone, shale, limestone and coal. The Lower Pittsburgh Formation and Upper Uniontown Formation comprise the Group. It extends from the base of the Pittsburgh Coal to the base of the Waynesburg Coal.

The first two investigations were groundwater contamination studies conducted for Allied by Geraghty & Miller, Inc. at the Allied Chemical South Plant and North Plant areas in 1977 and 1978, respectively. The first study in 1977 was restricted to Allied's South Plant and included the installation of 14 groundwater monitoring wells around 5 treatment ponds. The second study in 1978 was primarily on the Allied Chemical property north and west of the site and consisted of installing 53 monitoring wells (however, some wells were installed on what was later to become the Olin Area). The primary objective of these two studies was to determine whether contaminated groundwater beneath these areas could migrate to off-site wells or to the Ohio River.

The results of the 1977 and 1978 Allied/Geraghty & Miller studies indicated that groundwater was not migrating off-site because groundwater was being captured by the pumped Ranney wells. Natural groundwater flow was toward the river, but the Ranney wells created cones of groundwater depression that directed flow towards the wells. Figure 4-4, Potentiometric Surface Map for October 1, 1990, developed by Geraghty & Miller shows a similar pattern to that reported in 1978. This is to be expected since Ranney Wells A, D & E are pumped as they were in 1978.

As part of the Allied/Geraghty and Miller studies, groundwater samples from the wells were collected and analyzed. Various organic chemicals were identified in groundwater including aniline, monochlorobenzene, dichlorobenzene, nitrobenzene and dinitrotoluene. Isoconcentration maps of aniline, dichlorobenzene, nitrobenzene and total organic carbon were developed. These maps, which plot average parameter concentrations for all wells in each cluster, show that the highest concentrations of constituents of concern in groundwater at that time were primarily situated around the chemical trash dump and adjacent ponds. A secondary area of lesser concentration was around Well 21. Figure 4-5 presents analytical results from the 1978 Allied Geraghty and Miller Study for each well in the cluster for key detected organic compounds.

Groundwater samples from the 1978 study were also analyzed for various heavy metals. Cadmium, chromium and mercury were not detected. Lead and nickel were detected in a few wells.

In July, 1982, the Ranney Company conducted an inspection of Ranney Well E on the Olin Area to evaluate its maximum yield. The conclusion of this study was that the well was still capable of producing its maximum design yield.

In 1982, Olin performed a computer model simulation of the groundwater flow at the Hanlin-Allied-Olin site. The model used was the USGS "Finite Difference Model for Aquifer Simulation of Three Dimensional Groundwater Flow." Hydraulic conductivities from "slug" tests performed on 13 wells were used as input for the model. These conductivity values ranged from approximately $10E-5$ to $10E-2$ cm/sec. For purposes of the model, a conductivity of $10E-2$ cm/sec was assumed along the river and $10E-4$ cm/sec away from the river. The modeling supported previous conclusions that groundwater along the Allied-Olin property line is captured by the Ranney wells, thereby preventing direct migration to the Ohio River and off-site.

In 1983, Olin conducted a baseline groundwater study to determine the groundwater quality of the North Plant Area. Eleven two-well clusters were installed as part of this study. New wells, and

certain previously existing wells, were sampled three times during 1982. The study detected the following seven groundwater constituents (with range of concentrations): aniline (0.013 to 20 mg/L), dichlorobenzene (0.01 to 84 mg/L), monochlorobenzene (0.02 to 14 mg/L), toluene diamines (0.08 to 16 mg/L), dinitrotoluene (0.03 to 45 mg/L), toluidines (0.03 to 5.9 mg/L), toluenes (0.01 to 3.4 mg/L) and carbon tetrachloride (0.018 to 17 mg/L). The average concentrations for key organic compounds reported in the 1983 Olin study are shown on Figure 4-6.

The most recent investigation of the Hanlin-Allied-Olin property was conducted in 1990 by the West Virginia Division of Natural Resources. That report focused on a toxicological evaluation of constituents detected in groundwater samples collected during the study. Overall, nine wells were sampled of which three (27A, 27B, and 36) were on the Olin property. Well 36 was dry. Organic compounds were not detected in Wells 27A or 27B. EPA Reference Doses (RfDs) were exceeded at two sampling locations, Well 18 and Well 24A. Both wells are on Allied property. Well 18 is southwest of the National Aniline Division (NAD) Pond, and Well 24A is north of the Chemical Trash Dump.

In December 1990, Geraghty and Miller, Inc. completed an evaluation of the groundwater monitoring and containment system at the Hanlin-Allied-Olin site. Groundwater elevations measured on October 1, 1990 indicate that Ranney Wells A, D, and E were preventing direct off-site migration of groundwater (Figure 4-4). The study also concluded that the existing monitoring well network provides representative groundwater samples, but some well clusters are not situated to provide source-specific data for the former remediated solid waste management units.

4.2.3 Potential Sources of Chemicals in Groundwater

Potential sources of soil and groundwater chemicals were discussed in detail in Section 3.0. In addition to the above on-site potential sources of groundwater chemicals, off-site sources also exist. As discussed above, pumping of Ranney Well E results in migration of groundwater eastward from the Allied Park Area across a portion of the Olin Area to Ranney Well E. Resultant groundwater patterns are such that Ranney Well E is downgradient of certain contaminant source areas on the Allied Park property including the former chemical trash dump and TDI residue pile as well as the former NAD, Blackwater and Formaldehyde ponds. These areas were known to contain various constituents including aniline, nitrobenzene, dichlorobenzene, monochlorobenzene, dinitrotoluene, toluenediamine, methylene dianiline, benzene, toluene and mercury.

4.2.4 Fate and Migration Characteristics

Table 4-2 presents the list of potential organic chemicals and summarizes the key physical and chemical characteristics of each chemical which may affect fate and migration. The mobility of the chemical in soils and groundwater can be controlled by water solubility, vapor pressure, octanol-water coefficient (Kow), absorption coefficient based on organic carbon (Koc), and specific gravity of the compound. In general, higher Kow and Koc values indicate greater potential for the chemicals to become adsorbed onto soils. Grain size distribution, total organic carbon concentration levels of

aquifer materials, and other factors will also affect actual chemical migration of dissolved constituents.

4.3 HYDROGEOLOGICAL INVESTIGATION STRATEGY

This section presents the hydrogeological investigation strategy developed in light of plan objectives and known or anticipated site hydrogeological conditions. The phased approach to field activities is discussed along with specific strategies for measuring water levels, sampling groundwater, and selecting new well locations and construction requirements. Detailed descriptions of field and laboratory procedures are provided in the associated FSP (Section 5.0) and QAPjP (Section 6.0).

4.3.1 Overview of Phased Approach

At present, insufficient data are available to strategically locate new monitoring wells which will meet EE/CA objectives. Therefore, a phased approach will be implemented so that new monitoring wells may be properly located. Phase 1 of the EE/CA investigation will consist of 1) measuring water levels and collecting and analyzing groundwater samples from Ranney Well E and wells in the existing groundwater monitoring well network and 2) implementation of shallow soil sampling program (discussed in the Soil Study Plan in Section 3.0). Following evaluation of soil and groundwater analytical results and other data collected as part of Phase 1, additional soil sample locations, new monitoring well locations, and potential recommendations for abandoning certain existing wells, will be proposed as an EE/CA Work Plan Addendum. Following approval by EPA of the Work Plan Addendum, Phase 2 will include installation of new monitoring wells and sampling new and "existing" wells.

4.3.2 Groundwater Sampling and Analysis

Groundwater sampling and analysis strategy will consists of obtaining water level measurements in monitoring wells, collecting groundwater samples, and analyzing samples for strategically selected parameters.

4.3.2.1 Water Level Measurements

Water level measurements in existing monitoring wells and new monitoring wells will be made to evaluate groundwater flow direction, horizontal and vertical gradients and other hydrologic parameters. Two sets of water level measurements will be recorded. One set of measurements will be taken of the existing monitoring wells prior to new well installation (as part of Phase 1), and one set taken of all on-site wells following installation of the new wells (as part of Phase 2). Measurements will be made while the Ranney wells are being pumped to evaluate their influence on groundwater flow. (Per the Purchase and Sale Agreement and agreement with the state of West Virginia, the Ranney Well E is continuously pumped.) The depth to water in each well will be measured to the nearest hundredth (0.01) of a foot. The depth measurement will be subtracted from the surveyed well casing elevation to give the groundwater elevation at each

well in feet above sea level. River level measurements will also be taken or obtained from the Army Corps of Engineers during the groundwater sampling events.

4.3.2.2 Groundwater Sampling

Sediment free groundwater samples will be collected following low flow purging of the monitoring well casing. Temperature, specific conductance, and pH measurements will be taken until indicator parameters have stabilized and adequate purging has been accomplished prior to sampling. More detailed groundwater sampling procedures are presented in the FSP (Section 5.3.2.3).

4.3.2.3 Sample Analysis

Table 4-3 presents the analytical parameters and methods for groundwater analysis which include EPA Contract Laboratory (CLP) Statement Of Work parameters. All existing wells will be analyzed for site-specific substances plus a proposed percentage will be analyzed for target analyte list (TAL) and target compound list (TCL) parameters. Table 5-1 summarizes the groundwater analytical program for Phase 1 sampling. Site-specific constituents, which consist of VOCs, semi-volatile organic compounds, mercury and chromium, were identified on the basis of 1) chemicals previously identified in groundwater, and 2) chemicals potentially present based on operational history. (Potential sources of chemicals and groundwater analytical results were discussed in Sections 3.0 and 4.2, respectively.) In addition, groundwater samples from all wells will be analyzed for pH, specific conductance, and temperature.

Five wells (or approximately 10 percent of the wells) plus Ranney Well E will be analyzed for the full range of TAL/TCL parameters. The five monitoring wells are as follows: 19, 20A, 21A, 27A, R1A. Well 19 was selected because it is located upgradient of major process and process support areas. The remaining wells were selected because they are strategically located downgradient of suspected source areas. To investigate potential impact of the former salt storage area (near Building 41), samples from upgradient well 19 and downgradient wells U1, B4A, B4B, R1A and R1B will also be analyzed for nitrate nitrogen.

Analytical parameters for Phase 2 groundwater sampling will be proposed to EPA in the Work Plan Addendum following review of Phase 1 soil and groundwater data. All existing network wells will be sampled again as part of the Phase 2 groundwater sampling. Details on sample handling, analytical procedures, and data validation for groundwater samples are discussed in detail in the QAPjP (Section 6.0).

4.3.3 Soil Boring and Monitoring Well Installation

The following describes the strategy for selecting new well locations and well development and documentation procedures during the site investigation. Details on selecting new well locations and construction will be proposed in the EE/CA Work Plan Addendum (Phase 2).

4.3.3.1 New Well Locations and Construction

The potential presence of non-aqueous phase liquids (NAPL) will be evaluated utilizing hydrogeologic and groundwater chemical data. Following sampling of existing groundwater wells as part of Phase 1, concentrations of organic compounds detected in groundwater will be compared to theoretical solubilities to assess the potential presence of NAPL. New wells (installed as part of Phase 2) will be strategically located and designed to further investigate for the presence of NAPL. Field observations for NAPL will also be made during soil sampling in the vadose zone and during installation of new monitoring wells. The presence of any impermeable strata within the aquifer, as well as the nature and depth of bedrock will also be noted.

As discussed above, the location of new monitoring wells will be proposed in an EE/CA Work Plan Addendum after the Phase 1 data have been reviewed. In general, wells will be placed downgradient of potential chemical sources identified by the Phase 1 investigations. It is anticipated that one or possibly two new wells will be placed upgradient of chemical sources to evaluate background conditions. Most of the new wells will probably be part of two well clusters consisting of deep and shallow well pairs. Well depths and construction details (e.g. material type, screen length, etc.) will also be proposed in the Addendum. Well locations and elevations will be surveyed after completion and referenced to a USGS benchmark. It is anticipated that proposed new wells will include wells drilled to bedrock. Wells will be 4 inches in diameter and have a minimum 10-foot screen. Shelby tube samples of aquifer materials will be analyzed to characterize permeability, Total Organic Carbon (TOC) and grain size distribution. Proposed drilling and soil sampling procedures associated with monitoring well installation will be similar to those described for performing Phase 1 soil sampling (Section 5.0). Specific drilling and soil sampling procedures will also be described in the EE/CA Work Plan Addendum.

4.3.3.2 Well Development

All new monitoring wells will be developed to create an effective filter pack around the well screen, to remove fine sediments near the borehole, and to assist in restoring representative water quality of the aquifer in the vicinity of the well. Wells will be developed by pumping or bailing in combination with surging with a surge block. Wells will be developed until the turbidity of the discharge water remains low. Turbidity measurements will be made following well development.

4.3.3.3 Well Documentation

Information on the design, construction and development of each monitoring well will be recorded. Such information will include: (1) a boring log that documents geologic materials penetrated and associated sampling, (2) a well construction diagram, and (3) a well development form.

4.3.4 Decontamination and Waste Handling

A designated decontamination area will be established in the former employee parking lot. The location was selected because it has an asphalt surface and is located near the site access gate which makes it suitable for staging and shipment of wastes. Drilling equipment and tools that contact soils (e.g. augers, tremie pipes, etc.) will be decontaminated between boreholes and decontamination fluids containerized. Decontamination procedures are outlined in Section 5.0. Contaminated disposable materials (e.g. Tyveks, gloves, boots, etc.) will also be containerized at each drilling location, labeled, and transferred to the decontamination area for temporary storage. Soil and groundwater wastes generated from drilling and sampling activities will be containerized at each borehole/well site, labelled, and then transported to and stored in the waste staging area pending subsequent characterization and proper disposal. The handling, storage, and disposal procedures are discussed in detail in Section 8.0, Disposal Plan.

4.4 DATA EVALUATION PLAN

This section presents the manner in which data will be evaluated to meet objectives of characterizing site hydrogeologic conditions, determining the nature and extent of contaminants, and assessing contaminants migration potential. As discussed above, groundwater sampling will be conducted in two phases: one prior to (Phase 1), and one following, installation of any new groundwater monitoring wells (Phase 2). Groundwater flow pattern and nature and extent of contaminant evaluations will be performed after each phase. Following Phase 2, the hydrogeologic characteristics and contamination migration potential will also be assessed. Findings from these evaluations will be presented in the EE/CA Report.

4.4.1 Groundwater Flow Patterns

Groundwater level measurements will be presented on tables along with surveyed well casing elevations, and the groundwater elevations calculated. The calculated groundwater elevations will be plotted and contoured to construct a potentiometric surface map for the aquifer. This map will be used to evaluate groundwater flow directions and patterns and to determine approximate hydraulic gradients. Also, a comparison will be made among groundwater elevations in individual wells in well clusters to identify any vertical gradients which may exist. Groundwater levels near the Ohio River will be compared to the river level as measured during groundwater sampling to assess flow conditions between the river and the aquifer.

4.4.2 Geologic/Hydrogeologic Characteristics

Geologic cross-sections will be developed utilizing well borehole logs as well as shallow soil sampling logs developed from implementing the Phase 1 and 2 soil sampling. Ground surface, water table surface, stratigraphic contacts and the top of bedrock will be plotted on the cross-sections. A more detailed contour map of the bedrock surface will also be developed by integrating data from existing wells with data from the new wells. Groundwater flow velocity will be calculated by utilizing hydraulic gradient, hydraulic conductivity data, and porosity data. The hydraulic conductivity and

porosity values used will be those identified from previous studies and possibly from any Shelby tube sample testing conducted as part of this investigation.

4.4.3 Nature and Extent of Contaminants

Groundwater analytical results will be presented in tabular form, the range of concentrations indicated, and comparisons made between upgradient and downgradient concentrations of constituents. Well samples exhibiting significantly elevated concentrations above background will be flagged. Groundwater concentrations of key constituents will be presented on maps and potentially on the geologic cross-sections to show the distribution of constituents of concern in the aquifer system. Significant contaminants in soils (based on field screening/observations or soil analytical results) encountered while boring will also be shown. Isopleth maps may be drawn to depict the concentration distribution and lateral extent of selected constituents. Finally, comparisons will also be made with previous groundwater analytical results from the 1978 Geraghty and Miller and 1983 Olin Chemical study to identify changes in groundwater quality over the past 16 years.

4.4.4 Contaminant Migration Potential

Contaminant migration potential will be assessed by integrating findings of all the above data. Should this assessment indicate computer modeling is appropriate, such modeling will be undertaken.

TABLE 4-1
CONSTRUCTION DETAILS AND CONDITION OF EXISTING MONITORING WELLS *
Hanlin-Allied-Olin Site
Moundsville, West Virginia

Well ID	Installation Date (Mo/Yr)	Well Casing Dia/Mat/Cond	Protective Casing Dia/Mat/Cond	Total Depth (Feet)	Screen Length/Interval (Feet)	Open to Bottom **	Remarks
B1A	12-81	4"/PVC/Good	None	36.8	25/11.8-36.8	Yes	
B1B	12-81	4"/PVC/Good	None	40.7	25/15.7-40.7	Yes	
B2A	1-82	4"/PVC/Good	None	49.1	25/24.1-49.1	Yes	
B2B	1-82	4"/PVC/Fair	None	33.0	25/8.0-33.0	Yes	Well Casing Loose
B3A	1-82	4"/PVC/Fair	None	64.2	25/39.2-64.2	Yes	Well Casing Slightly Loose
B3B	1-82	4"/PVC/Good	None	42.0	25/17.0-42.0	Yes	
B4A	1-82	4"/PVC/Fair	None	78.0	25/53.0-78.0	Yes	Well Casing Cracked at Top
B4B	1-82	4"/PVC/Good	None	61.7	25/36.7-61.7	Yes	
B5A	1-82	4"/PVC/Good	None	65.7	25/40.7-65.7	Yes	
B5B	1-82	4"/PVC/Good	None	46.5	25/21.5-46.5	Yes	
B6A	1-82	4"/PVC/Poor	None	44.4	25/19.4-44.4	Yes	Well Casing Broken
B6B	1-82	4"/PVC/Fair	None	36.8	25/11.8-36.8	Yes	Well Casing Loose
B7A	1-82	4"/PVC/Fair	None	45.6	25/20.6-45.6	Yes	Well Casing Tilted
B7B	1-82	4"/PVC/Fair	None	66.3	25/41.3-66.3	Yes	Well Casing Loose
B8A	1-82	4"/PVC/Good	None	58.7	25/33.7-58.7	***	
B8B	1-82	4"/PVC/Good	None	42.3	25/17.3-42.3	***	

* Condition of monitoring wells based on inspections by REI staff conducted on August 3, 1994 and November 9, 1994

** Determined by lowering 1.66" OD bailer into well casing.

*** Not determined

U = Unknown

December 27, 1994

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TABLE 4-1 (Cont.)
CONSTRUCTION DETAILS AND CONDITION OF EXISTING MONITORING WELLS *
Hanlin-Allied-Olin Site
Moundsville, West Virginia

Well ID	Installation Date (Mo/Yr)	Well Casing Dia/Mat/Cond	Protective Casing Dia/Mat/Cond	Total Depth (Feet)	Screen Length/Interval (Feet)	Open to Bottom **	Remarks
B9A	12-81	4"/PVC/Fair	None	46.6	25/21.6-46.6	Yes	Well Casing Loose
B9B	12-81	4"/PVC/Fair	None	49.8	25/24.8-49.8	Yes	Well Casing Loose
D2	U	4"/PVC/Good	6"/Steel/Fair	49.9	U	Yes	Protective Casing Dented & Bent
D3	U	4"/PVC/Good	6"/Steel/Good	50.2	U	Yes	
D4	U	4"/PVC/Good	6"/Steel/Good	52.5	U	Yes	
D5	U	4"/PVC/Good	6"/Steel/Good	51.7	U	Yes	
R1A	U	4"/PVC/Good	None	71.8	25/46.8-71.8	Yes	
R1B	U	4"/PVC/Good	None	30.8	25/5.8-30.8	Yes	
R2A	U	4"/PVC/Good	None	71.2	25/46.2-71.2	Yes	
R2B	U	4"/PVC/Good	None	42.9	25/17.9-42.9	Yes	
R3A	U	4"/PVC/Good	None	65.3	25/40.3-65.3	Yes	
R3B	U	4"/PVC/Good	None	35.5	25/10.5-35.5	Yes	
R4A	U	4"/PVC/Good	None	62.9	U	Yes	
R4B	U	4"/PVC/Good	None	49.8	U	Yes	
R5A	U	4"/PVC/Poor	None	78.8	U	No	Well Casing Broken Off; Obstruction @24.5'
R5B	U	4"/PVC/Fair	None	58.7	U	Yes	Well Casing Cracked

* Condition of monitoring wells based on inspections by REI staff conducted on August 3, 1994 and November 9, 1994

** Determined by lowering 1.66" OD bailer into well casing.

*** Not determined

U = Unknown

TABLE 4-1 (Cont.)
CONSTRUCTION DETAILS AND CONDITION OF EXISTING MONITORING WELLS *
Hanlin-Allied-Olin Site
Moundsville, West Virginia

Well ID	Installation Date (Mo/Yr)	Well Casing Dia/Mat/Cond	Protective Casing Dia/Mat/Cond	Total Depth (Feet)	Screen Length/Interval (Feet)	Open to Bottom **	Remarks
U1	U	4"/PVC/Good	6"/Steel/Good	50.3	U	Yes	
19	3-78	2"/Steel/Good	None	39.5	3/36.5-39.5	No	Cap Stuck
20A	3-78	2"/Steel/Fair	None	75.3	3/72.3-75.3	Yes	Well Casing Loose
20B	3-78	2"/Steel/Good	None	62.1	3/59.1-62.1	No	Obstruction @32.9'
20C	3-78	2"/Steel/Good	None	51.2	3/48.2-51.2	No	Obstruction @38.9'
21A	3-78	2"/Steel/Fair	None	67.2	3/64.2-67.2	Yes	
21B	3-78	2"/Steel/Good	None	52.1	3/49.1-52.1	No	Obstruction @48.4'
27A	3-78	2"/Steel/Good	None	74.1	3/71.1-74.1	No	Obstruction @21.4'
27B	3-78	2"/Steel/Good	None	53.6	3/50.6-53.6	Yes	
27C	3-78	2"/Steel/Good	None	29.1	3/26.1-29.1	Yes	
35	3-78	2"/Steel/Good	None	34.1	3/31.1-34.1	No	Obstruction @32'
36	3-78	2"/Steel/Good	None	19.8	3/16.8-19.8	***	
39	3-78	2"/Steel/Good	None	43.9	3/40.9-43.9	No	Obstruction @38.5'

* Condition of monitoring wells based on inspections by REI staff conducted on August 3, 1994 and November 9, 1994

** Determined by lowering 1.66" OD bailer into well casing

*** Not determined

U = Unknown

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TABLE 4-2
CHEMICAL AND PHYSICAL PROPERTIES OF KEY POTENTIAL
ORGANIC CHEMICALS
Hanlin-Allied-Olin Site
Moundsville, West Virginia

<i>Constituent</i>	<i>Water Solub. (mg/L)</i>	<i>Vapor Pres. MM HG @ T (°C)</i>	<i>K_{oc} (mg/L)</i>	<i>K_{ow} (unitless)</i>	<i>Specific Gravity</i>
Aniline	34000	0.3 @20	25.7	7	1.02
Benzene	1780	76 @20	83	132	0.8787
Carbon Tetrachloride	800	90	437	537	1.59
o-DCB	145	1.5 @25	1700	3980	3.38
m-DCB	123	2.28	1700	3980	3.38
p-DCB	79	1.8 @25	1700	3980	3.39
2,4-DNT	270	0.0051	45	100	1.321
2,6-DNT	300	0.00035 @20	62	100	1.28
Monochlorobenzene (MCB)	500	9	330	692	1.107
Nitrobenzene	1900	0.15 @20	36	71	1.2
Toluene	535	28.1	300	537	0.866
o-Toluidine	16	0.1	407	19.5	1.008

REFERENCES:

- Montgomery & Welkom, Groundwater Chemical Desk Reference, 1990.
Montgomery, J.H., Groundwater Chemicals Field Guide, 1991.
Merck Index, 11th edition, 1989.
NIOSH Pocket Guide to Chemical Hazards, 1990.
Verschuere, K., Handbook of Environmental Data on Organic Chemicals, 2nd ed. 1983.

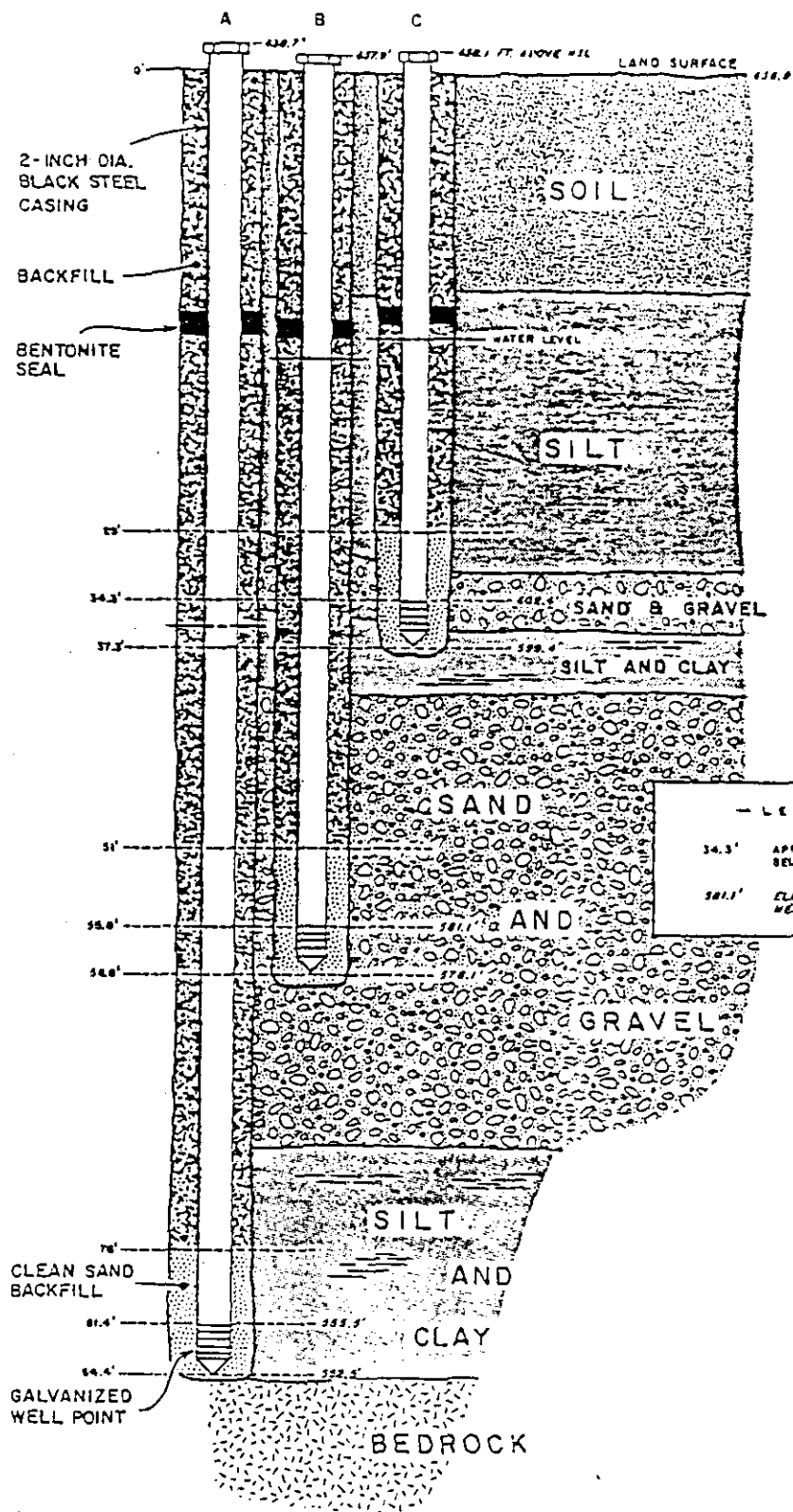
TABLE 4-3
ANALYTICAL PARAMETERS AND METHODS FOR
GROUNDWATER ANALYSIS
Hanlin-Allied-Olin Site
Moundsville, West Virginia

<i>Analytical Parameter</i>	<i>EPA Method</i>
TCL VOCs or Subset of	CLP 3/90 SOW
TCL SVOCs or Subset of	CLP 3/90 SOW
TCL Pesticide/PCB or Subset of	CLP 3/90 SOW
TAL Metals or Subset of	CLP SOW ILM0.21 3/90
Cyanide	9010
Nitrate/Nitrite Nitrogen	353.2

CLP Method is SOW ILM02.1 3/90.

NOTE: Oversize Figures 4-5 and 4-6 are at the end of this Work Plan.

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— LEGEND —

34.3' APPROXIMATE DEPTH BELOW LAND SURFACE.

438.9' ELEVATION ABOVE MEAN SEA LEVEL.

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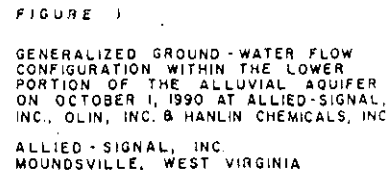
RUST ENVIRONMENT & INFRASTRUCTURE

PROJ. NO.: 32329.000 DATE: 11/94

RUST DWG. NUMBER: **FIGURE 4-1**

TYPICAL CONSTRUCTION
OF OBSERVATION WELL CLUSTERS
(FROM 1978 GERAGHTY & MILLER REPORT)

HANLIN-ALLIED-OLIN SITE
MOUNDSVILLE WEST VIRGINIA



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Section 5.0

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5.0 FIELD SAMPLING PLAN

This section presents the Field Sampling Plan (FSP). This FSP complements the Soil Study Plan (Section 3.0) and Hydrogeological Study Plan (Section 4.0) by describing field sampling procedures for implementing these plans.

5.1 PLAN OBJECTIVE AND ORGANIZATION

The FSP objectives are to describe the number, type, and location of samples, sampling procedures, and the type of analyses. Section 5.3 specifies soil and groundwater sampling procedures, and Section 5.4 describes sample analysis requirements.

5.2 PROJECT ORGANIZATION AND RESPONSIBILITY

A consultant organizational chart is presented in Figure 5-1. Responsibilities for individuals identified on the organizational chart (including the consultant Project Manager, consultant QA/QC Officer, consultant Health & Safety Officer, and consultant Field Team Leader) are outlined in detail in the QAPjP (Section 6.0).

5.3 SAMPLING PROCEDURES

As previously discussed in Sections 3.0 and 4.0, field activities will be conducted in two phases. Phase 1 will consist of sampling of soil and existing groundwater monitoring wells, Phase 2 will consist of a follow-up soil boring program, and installation of new groundwater monitoring wells and subsequent groundwater sampling. This section describes soil and groundwater sampling procedures associated with the phases of field work. Procedures for record keeping and equipment decontamination are also discussed.

5.3.1 Sampling Designations

The following presents soil and groundwater sample designation procedures which will be utilized for sample labeling, recordkeeping, and reporting.

5.3.1.1 Soil

As described in the Soil Study Plan (Section 3.0), a total of 52 soil locations will be sampled as part of Phase 1 soil sampling. Soil samples will be identified according to the soil sample location numbers shown on Figure 5-2 followed by the sample depth interval. Following the sample depth interval, the sampling date appears first using a month, day, and year format. This format will also serve to track samples chronologically. Two types of quality control samples will be denoted by a lower case letter following the sampling date: "t" for trip blanks or "MS/MSD" for matrix spike duplicate samples. (Remaining quality control samples will be

submitted as "blind" samples to the laboratory.) For example, a soil replicate sample taken on May 12, 1996 for the B8 6-8 foot sample, would have a sample ID as follows:

B8-6-8-051296MS

5.3.1.2 Groundwater

As previously described, groundwater samples will be collected from Ranney Well E and existing wells within the Olin Area as part of Phase 1. As part of Phase 2 activities, groundwater samples will also be collected from any new wells.

For existing wells, groundwater samples will be identified according to the well number shown on Figure 3-1 with "MW" placed in front of the well letter and/or number. The Ranney Well E groundwater sample will be identified as "Ranney Well E." Following the well identification, the sampling date appears first using a month, day, and year format. This format will also serve to track samples chronologically. Two types of quality control samples will be denoted by a lower case letter following the sampling date: "t" for trip blanks or "MS/MSD" for matrix spike duplicate samples. (Remaining quality control samples will be submitted as "blind" samples to the laboratory.) For example, a groundwater matrix spike sample taken from well 20A on July 28, 1996, would have a sample ID as follows:

MW20A-072896MS

5.3.2 Sampling Equipment and Methodology

The following are descriptions of the procedures and equipment that will be used to collect samples and other field data. Equipment will be calibrated per manufacturers instructions as discussed in Section 5.4.1.2. Field procedures will be conducted according to the HASP (Section 7.0), which includes PPE designations.

5.3.2.1 Soil Sampling

Because of the relatively large size of the Olin Area and general lack of visible landmarks, boring locations will be positioned by surveyors so that the locations are correctly positioned as shown on Figure 5-2. Locations will be marked in the field with high durable poles (at least 5 feet of stickup, steel conduit pipe or equivalent) such that they are clearly visible. Prior to advancing any borings, both a utilities locator and an Olin representative will approve proposed boring locations. In addition, locations will be marked at the completion and abandonment of a borehole. Proposed boring locations may be changed in the field due to utilities, etc.

As part of Phase 1, subsurface boreholes will be advanced to a depth of 8 feet using hollow-stem augers and a drill rig. (Additional locations and/or deeper borings may be conducted as part of Phase 2.) Prior to and between uses, augers, and sampling equipment will be decontaminated according to procedures described in Section 5.3.4. Where composite samples are collected, equipment will not be decontaminated between composite locations. Subsurface samples will be collected using a 5-foot long 3 inch ID split-barrel sampler. The split-barrel sampler will be

pushed into the soil in advance of the auger cutting head, thus obtaining a continuous 5 foot sample. The barrel will be retrieved through the augers, and opened for examination, field screening, and removal of the soil/unconsolidated sediment sample.

Split-barrel samples will be described and data recorded on the Boring Log Form (Appendix B). The logs will record depth in feet, interval over which the sampling was attempted, recovery, and sample number. The soil descriptions will include the following:

- Consistency/density based on visual examination
- Color using a Munsell soil color chart
- Unified Soil Classification system
- Moisture content, either dry, moist, or wet
- Plasticity
- Cohesiveness, either cohesive or non-cohesive
- Distinctive features, such as texture (gravel or clay content in percent, gravel size, etc.), mottling, bedding, etc.
- Visible staining, odor, or other evidence of residuals
- Results of field screening
- Other pertinent observations

Field screening of the soils/sediments will be conducted for each 5-foot interval recovered. Field screening will be primarily based on headspace screening with an Organic Vapor Analyzer (OVA) equipped with a Flame Ionization Detector (FID) and secondarily on visual inspection of the soils for staining or other indications of residuals. As a precaution for health and safety of the field personnel, phosgene will be screened during soil boring in the former phosgene area (B33-B37 and B45) and personnel will wear phosgene-specific dosimeter badges. Field screening procedures are described in detail in Section 5.4.1.

Samples will be selected for analyses from the 0-1-foot and 6-8-foot intervals and possibly at other intervals selected by the field geologist (based on field screening and observations). Samples selected for analysis (including the 0-1-foot sample) will be removed from the split-barrel sampler and placed in the appropriate laboratory provided sample containers. (Containers and preservatives are described in Section 6.0.) All sample jars will be securely closed, labeled according to the above sample designation procedures, and placed in the insulated shipping cartons. Chain-of-custody records indicating parameters will be completed for all samples. (Details on sample handling are discussed in Section 6.0.)

It is important that soil boring activities do not result in the downward migration of contaminants from the intervals in which they are originally encountered to lower soil intervals or groundwater. Of particular concern will be controlling the migration of liquids, if any, which may be encountered. Should the field geologist conclude that potential exists for migration of contaminants while conducting a soil boring, necessary precautions will be taken to include: 1) setting casing through contaminated soils, then sampling through the casing, or 2) plugging the borehole as discussed below and drilling a new location.

Upon completion of each borehole, the boring will be plugged with a cement bentonite grout to prevent creating conduits for any downward migration of contaminants. The grout mixture will be as follows: one bag (94 pounds) portland cement to two pounds bentonite and approximately eight gallons of water. The grout mixes will each be recorded on Grout Batch Record Forms (Appendix B).

Drill cuttings will be containerized in drums placed near each drill site and transferred to the decontamination and waste staging area shown on Figure 5-2. Containerized cuttings will then be analyzed and disposed according to the Disposal Plan (Section 8.0).

5.3.2.2 Groundwater Level Measurements

Groundwater level measurements will be made prior to sampling and associated well purging. Groundwater levels will be measured using an electronic water level indicator. Water levels will be measured to the nearest ± 0.01 foot from a surveyed datum on the top of the inner well casing. The groundwater elevation will be calculated by subtracting the depth measurement from the surveyed datum elevation. Water level measurements will be recorded on a Water Elevation form. The water level indicator tape and probe will be decontaminated between uses according to procedures in Section 5.3.4.

5.3.2.3 Groundwater Sampling

The groundwater sampling procedure will consist of well purging, field measurement of indicator parameters (groundwater temperature, pH, E_H , turbidity and specific conductivity), completion of Well Purging and Sample Collection forms (see Appendix B), and collection of groundwater samples for laboratory analysis.

To minimize sample turbidity and collect representative samples, low-flow purging of the wells will be conducted using a low-flow adjustable rate pump. The purging will be performed in accordance with the EPA Region III QA Directive - Recommended Procedures for Low-Flow Purging and Sampling of Ground Water Monitoring Wells (dated August 8, 1994). The above-referenced indicator parameters will be monitored during the well purging process to determine if purging has been adequately completed. The following describes the low-flow purging and sampling procedures:

1. Attach and secure the polyethylene tubing to the low-flow pump. As the pump is slowly lowered into the well, secure the safety drop cable, tubing, and electrical lines to each other using nylon stay-ties.
2. The pump will be set at approximately the middle of the screen. If the static water table is below the top of the screen, the pump will be lowered in the middle of the water column. Place the pump intake a sufficient distance above the bottom of the well to minimize mobilization of any accumulated sediments. Start purging the well at 0.2 to 0.5 liters per minute. Avoid surging. Observe air bubbles displaced from discharge tube to assess progress of steady pumping until water arrives at the surface.

3. A water-level probe will be lowered very slowly into the well behind the pump until it just touches the water. The water level in the well will be monitored during purging and sampling and the purge rate will not exceed the well recharge rate so that there is little or no drawdown in the well. (The water level should stabilize for the specific purge rate.) Record adjustments in the purge rate and changes in depth to water in the logbook. If the recharge rate of the well is so low that the well is purged dry, the sampling personnel will wait approximately four hours after water in the screened interval has recharged before collecting the appropriate volume of water for the sample with the pump.
4. During well purging, monitor the field parameters frequently (every three to five minutes) until all indicator parameters have stabilized to within 10 percent over minimum of three consecutive readings. If any parameter fails to stabilize, collect the sample after purging three well volumes or after the well has recovered from going dry. The following equation will be utilized to calculate three well volumes:

$$V = (\pi r^2 h) \times 7.481 \text{ gallons/cubic foot}$$

where:

$$\pi = 3.14159$$

$$r = \text{radius of borehole, in feet}$$

$$h = \text{height of water column, in feet}$$

$$V = \text{volume of water in well, in gallons}$$

Target Purge Volume = three well volumes

The height of the water column in the well is determined by subtracting the depth to water from the total well depth. The depth to water will be measured using an electronic water level tape.

5. Once the field parameters have stabilized, collect samples directly from the end of the discharge tube. All sample bottles will be filled by allowing the water from the discharge tube to flow gently down the inside of the bottle with minimal turbulence. Cap each bottle as it is filled.
6. The pump assembly will be carefully removed from the well. The tubing will be dedicated to each well and placed in a large plastic garbage bag, sealed, and labeled with the appropriate well identification number.
7. Close and lock the well.

Purge water will be containerized and transported to the waste staging area (Figure 3-1). Management of purge water and other wastes is discussed in the Disposal Plan, Section 8.0.

Samples will be collected and containerized according to the volatility of the target analytes. The order of collection will be volatile organics, semi-volatile organics, pesticides/PCBs and inorganics. Samples will be placed in the specific container provided by the laboratory for that

parameter. The temperature, pH, conductivity and turbidity of the sample will be taken in the field at the time of collection and readings recorded.

If the groundwater exceeds 1 Nephelometric Turbidity Unit (NTU), then both filtered and unfiltered samples will be collected for TAL metal analyses. If the turbidity is less than 1 NTU, then only unfiltered samples will be collected for TAL metals analyses. The filtering of groundwater samples will be in accordance with EPA Region III QA Directive Field Filtration Policy for Monitoring Well Ground Water Samples Requiring Metal Analysis. Filtration of groundwater samples will be conducted according to the following procedure:

1. Filtration will be initiated immediately after sample collection. Record both the time of sample collection and time of filtration in the field notebook. Filtration must be completed before preservation.
2. A 0.45 micron filter will be used.
3. Each filter and filtration apparatus will be prepared before use since they often contain trace amounts of metals. Filtration with approximately 20 ml of 25% nitric acid (HNO_3) solution (3 parts water and 1 part acid) followed by three 20 ml rinses of trace metal free deionized (DI) water is required to remove any trace amounts of metals. The filtered liquid will then be discarded before filtering each samples. Use the same DI water and dilute nitric acid solution (i.e., prepared from the same source, lot number an/or batch) to prepare the filters for all samples and the field blanks.
4. Samples and blanks will be preserved to a pH <2 with HNO_3) using a high quality acid such as Baker Instra-Analyzed or equivalent. Preservatives will be placed in samples bottles by the analytical laboratory prior to shipment to the site.

Samples to be analyzed for VOCs will be collected in 40 ml VOA vials. The VOA vials will be filled so that a positive meniscus forms above the top of the container. After the container cap is tightened, the vial will be inverted and gently tapped in order to check for air bubbles. If bubbles appear, the cap will be removed and another meniscus formed before recapping the vial. This method will be repeated until no air is contained in the vial. For semivolatiles, pesticide/PCBs and inorganic samples, the containers will be filled to within an inch of the cap. Groundwater samples will be labeled, stored, and transported as described in Section 6.0.

Ranney Well E will be sampled from the end of the discharge pipe.

5.3.3 Record keeping

Standardized field forms and field notebooks will be used to document collection of field data. Soil boring data will be recorded on the Boring Log Form, and boring plugging information will be recorded on a Grout Batch Record form. Groundwater sampling data will be recorded on the Well Purging and Sampling Form. Examples of field forms are included in Appendix B. Field notebooks will be used to record daily activities as described in the QAPjP (Section 6.0).

5.3.4 Decontamination

Disposable sampling equipment will be utilized to the greatest extent possible, thereby minimizing the need for decontamination of sampling equipment. Equipment used for drilling and associated sampling will be decontaminated prior to each use by steam cleaning. Decontamination of drilling equipment and tools will be conducted in a centralized decontamination area and the generated liquids/residue collected and containerized. Figure 3-1 depicts the approximate location of the decontamination and waste storage area near the former employee parking lot. Decontamination of other sampling equipment will take place at sampling location areas. Water for decontamination will be obtained from a potable water supply of known water quality and stored on-site in a tanker truck. The following cleaning procedures will be employed during decontamination:

Drilling Equipment

1. Drill rigs and support equipment will be free from excess grease, oils, and caked-on soils from previous work. Drill rigs will be steam cleaned upon arrival and prior to leaving the site.
2. Equipment or materials not used immediately after decontamination will be placed on a plastic sheet, covered with plastic, and secured to avoid potential contamination.
3. Solid material resulting from decontamination of drilling equipment will be containerized and handled according to the Disposal Plan (Section 8.0).

Sampling Equipment

1. Clean with tap water and phosphate-free laboratory detergent (Liquinox or equivalent) using a brush, if necessary, to remove particulate matter and surface films.
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with deionized water.
4. Equipment such as pumps, flow lines, etc., will be flushed thoroughly with potable water from a municipal water supply prior to use.

Decontamination water from sampling equipment decontamination will be containerized and managed according to the Disposal Plan (Section 8.0). Clean, disposable gloves will be worn while handling sampling equipment or downhole tools during the final stages of decontamination.

5.4 SAMPLE ANALYSIS

This section describes the field screening and laboratory analysis procedures for environmental samples collected during this sampling effort. Laboratory analysis will be conducted by Katahdin Analytical Services, Westbrook, ME. Sample handling procedures including those pertaining to

sample containers and preservation, sample packaging and shipment and documentation are covered in the QAPJP (Section 6.0).

5.4.1 Field Screening

Field screening for temperature, pH, E_H and specific conductance of aqueous samples, and for volatile organic vapors from soil headspace will be conducted. Field screening of soils for mercury vapors and phosgene will be conducted as required by the HASP (Section 7.0). Preliminary volatile organic vapor screening will be performed with an Organic Vapor Analyzer (OVA) equipped with a Flame Ionization Detector (FID). Mercury vapor concentrations will be measured using a mercury vapor analyzer. Phosgene will be screened in open boreholes using a Draeger, Sensidyne (or equivalent) detector tube during soil boring activities in the former phosgene area (B33 - B37 and B45).

For headspace screening, a scoop of soil will be collected from the split-barrel sampler using a stainless steel cook's spoon or equivalent, and placed into a quart size, sealable plastic bag such that the bag is half full of soil. The sample will be allowed to equilibrate for at least five minutes, and then a hole just large enough to accommodate the FID sensor (approximately 0.25-inch diameter) will be made in the upper section of the bag (portion not touching soil). The FID sensor will be inserted into the bag, and the reading recorded on the boring log.

The QA objectives for the calibration of field screening procedures are summarized in Table 5-2. Criteria for accuracy and precision are provided. The following sections describe the field equipment standards, as well as calibration procedures for specific conductance and pH and oxidation-reduction potential (ORP) meters, FID (for VOC screening), turbidity meter, mercury vapor analyzer, and phosgene detector tubes.

5.4.1.1 Field Equipment Standards

Field equipment calibration standards are received, stored, prepared and used following procedures that allow tracing of the standard from suppliers, through storage and preparation, to instrument calibration and use of the instrument in the field. These procedures are described below.

Receipt and Traceability

Small amounts of standards are received on an as-needed basis. These standards are stored in the contractor's equipment shop according to the suppliers' specifications, with the lot number of supplier's identification number, the date that the standard was received, and the expiration date of the standard written on the standard storage container. This procedure references the standards to specific lots of suppliers.

Sources and Preparation

Standards for field instruments are received directly from the equipment manufacturer, analytical laboratory, or commercial laboratory supplier. Standards are received either pre-prepared or are

prepared as needed, typically in association with instrument calibration. Then the instrument is calibrated and recorded in the instrument log book.

5.4.1.2 Field Equipment Calibration Procedures

Calibration procedures for the field instruments are described on the following page.

pH-ORP Meter

1. Rinse the pH probe in distilled water.
2. Insert probe in pH 7.00 buffer solution.
3. Adjust the instrument until the display reads 7.00.
4. Remove and rinse probe, and insert in pH 4.00 or pH 10.00 buffer solution, whichever is closer to the expected pH of the samples.
5. Adjust the instrument until the display reads 4.00 or 10.00, per the respective buffer.
6. Rinse probe and re-insert in pH 7.00 buffer solution to confirm this first point. Repeat adjustment sequence as necessary.
7. Prior to using the ORP electrode, rinse in distilled water and allow to air dry.

Specific Conductance Meters

The specific conductance meter is calibrated in the manner described for specific conductance values less than 2000 micromhos/centimeter:

1. Rinse probes, wipe off, and allow to air dry;
2. Measure the conductance in air; it should read 0.00;
3. If meter does not read 0.00, adjust the ZERO potentiometer to show 0.00;
4. Immerse the probe in the 100 or 1413 standard;
5. Adjust the instrument to read 100 or 1413, respectively;
6. For samples with a specific conductance greater than about 2000 micromhos/centimeter, a standard approximating the sample specific conductance should be used in step 4, above.

Organic Vapor Analyzers

Century Systems Model OVA-128

The Century Systems Model OVA-128 flame ionizing detector (FID) is calibrated in the following manner:

GAIN ADJUSTMENT

1. Place instrument in normal operation with calibrate switch set to X10 and gas select control set to 300.
2. Use the calibrate adjust (zero) knob and adjust the meter reading to zero.
3. Introduce a methane sample of a known concentration (near 100 ppm) and adjust trimpot R-32 on circuit board so that meter reads equivalent to the known sample.
4. This sets the instrument gain for methane with the panel mounted gain adjustment (gas select) set at a reference number of 300.

BIAS ADJUSTMENT

1. Leave calibrate switch to X10 position and use calibrate adjust (zero) knob to adjust meter reading to 4 ppm.
2. Place calibrate switch in X1 position and, using trimpot R-31 on circuit board, adjust meter reading to 4 ppm.
3. Move calibrate switch to X10 position again. Use calibrate adjust (zero) knob to adjust meter to a reading of 40 ppm.
4. Move calibrate switch to X100 position and use trimpot R-33 on circuit board to adjust meter reading to 40 ppm.
5. Move calibrate switch to X10 position and use calibrate adjust (zero) knob to adjust meter reading to zero.
6. Unit is now balanced from range to range, calibrated to methane, and ready to be placed in normal service.

Mercury Vapor Analyzer

1. Visually check to ensure mercury in calibration vessel has not been covered with an oxide layer.
2. Install rubber stopper and thermometer into the calibration vessel containing 1/2 cc mercury. Allow to stand for 2 hours.
CAUTION: WHEN REPLACING INTAKE FILTER DISKS, DO NOT HANDLE "CLEAN" FILTERS WITH BARE HANDS.
3. Replace intake filters.
 - a. Unscrew the intake from the mercury vapor analyzer.
 - b. Push the old filter disk out using the trimmer tool
 - c. Use tweezers to insert the new filter disk.
 - d. Using trimmer tool, seat the filter disk firmly against the inner ledge of the intake
 - e. Screw the intake back on the mercury vapor analyzer.
4. Perform Status Check
5. Place a new rubber septum on the septum assembly.
 - a. Unscrew the septum holder assembly's cap and use the trimmer tool to push the old septum out.
 - b. Insert a new septum (yellow side toward the small hole) in the cap.
6. Plug the septum assembly into the instruments intake and tighten the intake nut to ensure a tight seal.
7. Attach zero air filter system to the septum assembly.

8. Turn power on and note the temperature of the calibration vessel.
9. Ensure that the syringe assembly bar stop is set at exactly 1 cc.
10. Insert syringe into calibration vessel and pump the plunger 3 times.
11. Hold the plunger firmly against the bar stop and remove the syringe from the calibration vessel.
12. Insert the syringe through the rubber septum, press SAMPLE and release SAMPLE button.
13. Record the meter reading on the data sheet.
14. When the display flashes, release the plunger so that gravity feeds mercury vapor into the airstream.
NOTE: IT MAY BE NECESSARY TO PUSH PLUNGER IF GRAVITY FEED DOES NOT TOTALLY RELEASE CONTENTS OF SYRINGE.
15. Remove syringe needle from septum.
16. Record the meter reading on the data sheet.
17. Compare the readings with the acceptable values for the vessel temperature.
18. If the three readings are not within an acceptable range of values, repeat the functional test procedure from the beginning.
19. If the meter readings continue to fail the acceptance criteria, then refer to the manufacturer's technical manual. Tag the machine as broken.

Turbidity Meter (DRT-ISCE, manufactured by HF Scientific, or equivalent)

The turbidity meter will be calibrated in the following manner:

To operate the turbidity meter, switch to the "20" range and place the Reference Standard (5.0 NTU) in the optical well. Standards will be purchased from the instrument manufacturer.

With the light shield in place over the well, adjust the Reference Adjust knob to cause the meter to read the reference standard value on the scale. The unit is now ready for use in either range.

The EPA recommends that cuvettes used for instrument calibration or sample measurement be matched or indexed. Extreme care should be taken when handling the Reference Standard or sample cuvettes as surface scratches or finger smudges will cause analysis errors. Handle these items by the top only.

Detector Tubes (Draeger, Sensidyne or equivalent)

The detector tubes will be calibrated by the manufacturer. No field calibration is required.

5.4.1.3 Calibration Frequency

pH - ORP Meter: The pH - ORP meter will be calibrated at the beginning and in the middle of each work day.

Specific Conductance Meter: The specific conductance meter will be calibrated at the beginning and in the middle of the work day.

Temperature: Temperature will be measured in all aqueous samples with a thermometer calibrated against an NIST traceable thermometer, or with a platinum electrode, factory calibrated, coupled to the pH meter.

OVA/FID: The OVA/FID will be calibrated at the beginning and in the middle of each work day.

Mercury Vapor Analyzer: The mercury vapor analyzer will be calibrated at the beginning and in the middle of each work day.

Turbidity Meter: The turbidity meter will be calibrated at the beginning and in the middle of each work day.

Detector Tubes: The manual air pump associated with the detector tubes will be calibrated at the beginning and in the middle of each work day.

5.4.1.4 Calibration Documentation Requirements

The following information must be recorded in the field notebook for each instrument calibration:

- Date of calibration
- Identification of standards used
- Personnel performing calibration
- Results of calibration (raw data and summary statistics)
- Corrective actions taken (if necessary)

5.4.1.5 Field Methods

Procedures for utilizing field measurement devices are presented below.

Temperature: To measure temperature in aqueous samples, the analog thermometer is cleaned and inspected for cracks and gaps in the fluid. The thermometer is then immersed in the sample and swirled in the liquid so that the thermometer bulb is completely covered by the sample. The thermometer remains in the sample until the temperature reading stabilizes, typically for no more than one minute. The temperature is then read directly from the instrument in degrees Celsius or Fahrenheit to the nearest 0.5 degree.

Water pH and Oxidation Reduction Potential: To field screen aqueous samples for pH and oxidation-reduction potential, the pH/ORP electrodes, controller and recorder are inspected and allowed to equilibrate to ambient temperatures. After calibration of the instrument, the probe is simply inserted into the sample so that the sensing area is fully covered by the sample. The pH values are sensed by the probe and are read directly off the analog or digital scale (to ± 0.1 pH

units), as the log (to the base 10) of the hydrogen ion concentration of the sample. The ORP values are also sensed by the probe and read directly off the analog or digital scale in millivolt (MV) units.

Specific Conductance: To measure aqueous samples for specific conductance, the analog meter is inspected for cracks, and is allowed to equilibrate to ambient temperatures. The instrument is then calibrated and the probe is rinsed with deionized water. On instruments that are not temperature compensating, the temperature setting must be adjusted to the approximate temperature of the sample. The probe is then inserted into the sample so that the sensing area is fully covered by the sample. The specific conductance value is read directly from the analog or digital scale, as micromhos per centimeter. For results less than 100 micromhos/centimeter, the values are read to the nearest 10 units; for results greater than 100 micromhos/centimeter, the values are read to the nearest 100 units.

Detector Tubes: Detector tubes and accompanying air sampling pumps shall be operated in the following manner:

1. Break the ends of the solid sorbent tube immediately before sampling to provide an opening at least one-half of the internal diameter at each end.
2. Detector tube is inserted in designated location on manually operated air pump. Position the solid sorbent tube vertically during sampling to avoid channeling and premature breakthrough.

Turbidity: The turbidity meter shall be operated in the following manner:

To make a measurement of a sample, clean one of the cuvettes and fill to within approximately 0.5-inch of top with the sample. Place the top on the cuvette and carefully clean the outside surface of the cuvette with a lint free wiper such as Kimwipes. Place the sample in the well and place the light shield over the well. Select the appropriate range for best readability.

If the instrument has been subjected to cold (below 10 degrees Celsius) and then brought indoors, it should be allowed to warm up before use, since condensation may form on the various lenses. This can be aided by leaving the case open and the instrument on for approximately a half hour.

For accurate measurements in the low range rotate the cuvettes in the well to obtain the minimum reading. Mark the cuvette with one of the adhesive dots provided with the instrument so that orientation of the cuvette will be identical each time it is placed in the instrument.

Organic Vapor Analyzers (OVA)/FID:

The flame ionizing detector is operated in the following manner:

STARTUP PROCEDURE

1. Move pump switch to on and check battery condition by moving the instr switch to the batt position.
2. Move instr switch to on and allow five (5) minutes for warm-up.
3. Set alarm level adjust knob on back of readout assembly to desired level.
4. Set calibrate switch to X10 position, use calibrate knob and set meter to read 0.
5. Move pump switch to on position then place instrument panel in vertical position and check sample flow rate indication.
6. Open the H2 tank valve and the H2 supply valve.
7. Depress igniter button until burner lights. Do not depress igniter button for more than six (6) seconds. (If burner does not ignite, let instrument run for several minutes and again attempt ignition.)
8. Use calibrate knob to "zero" out ambient background. For maximum sensitivity below 10 ppm, set calibrate switch to X1 and readjust zero on meter. To avoid false flame-out alarm indication, set meter to 1 ppm with calibrate knob and make differential readings from there.

SHUTDOWN PROCEDURE

1. Close the H2 supply valve and the H2 tank valve.
2. Move the instrument switch and pump switch to off.
3. Instrument is now in shut down configuration.

Mercury Vapor Analyzer

Perform Status Check:

1. Press "Power On." If the "LO BAT" is indicated in the upper left corner of the LCD, recharge or replace battery.
2. Allow instrument to warm up for 1 minute.
3. Attach zero air filter assembly to the intake valve.
4. Attach AC line cord to the instrument and plug into AC power.
5. Turn power on and press REGEN. This cycle takes 20 minutes.
6. Allow the film to cool for 20 minutes.
7. While pressing ZERO, turn the ZERO ADJUST using the trimmer tool until the digital meter reads 0.
 - a. If the meter reads H, turn the ZERO ADJUST counter clockwise
 - b. If the meter reads L, turn the ZERO ADJUST clockwise.
8. Turn power off and disconnect AC line cord.

Perform measurements:

1. Turn power on.
2. Allow instrument to warm up for 1 minute.

3. For areas where concentrations are expected to be below 100 ug/m³, press the SAMPLE BUTTON and release. After 12 seconds, the measurement is displayed in concentration of mg/m³.
4. For areas where concentrations are expected to be greater than or equal to 100 µg/m³, press the SAMPLE BUTTON and hold. The display flashes the concentration every 3 seconds. Release the SAMPLE BUTTON to discontinue survey.
5. During the sampling, note the number of bars (dashes) on the sample display. If three or more occur, discontinue sampling and perform status check.
6. Upon completion of measurements, turn off meter.
7. Attach AC power cord to instrument and plug into AC power. A complete battery recharging takes 14 hours.

5.4.2 Soil Sample Analysis

Soil sample analyses will be based on the historical uses at locations from which a soil sample is collected. Depending on sample location, soils will be analyzed for various site-specific substances or the full TCL/TAL list of parameters. Table 5-1 summarizes the analytical program by location. A discussion of EPA methodologies used for this effort is presented in the QAPjP (Section 6.0). Soil samples also will be analyzed in the laboratory for pH; selected soil samples will be analyzed for total organic carbon (TOC), oxidation-reduction potential (E_H), conductivity, color (munsell), grain size, moisture and solids.

As noted on Table 6-9 of the QAPjP, some of the site-specific constituents are not TCL constituents and do not currently have EPA-approved methods. Thus method validation studies will be conducted for these non-TCL constituents, and EPA Region III approval will be obtained prior to initiating sample collection activities.

5.4.3 Analysis of Groundwater Samples

During Phase 1 groundwater sampling, groundwater from existing wells in the Olin Area will be analyzed for site-specific substances, with five wells (approximately 10 percent) and Ranney Well E analyzed for the target analyte list (TAL) and target compound list (TCL) parameters. Both total and dissolved concentrations of the TAL metals will be evaluated if the sample exceeds 1 NTU. All well samples will also be analyzed for non-TCL parameters on Table 6-9. Table 5-1 summarizes the analytical program for groundwater samples. Samples from six wells will be analyzed for nitrate/nitrogen. Groundwater samples will be analyzed in the field for pH, E_H , temperature and specific conductivity.

5.4.4 Laboratory and Field Quality Control Samples

As discussed in the QAPjP (Section 6.0), a variety of laboratory and field quality control samples will be collected for this effort. Tables 6-10 and 6-11 in the QAPjP present the type and frequency of laboratory and field quality control samples, respectively.

TABLE 5-1
ANALYTICAL PARAMETERS BY LOCATION
Hanlin-Allied-Olin Site
Moundsville, West Virginia

Soil Samples													
Boring No.*	Site Specific Parameters							Sediment (I) Parameters	TCL/TAL Parameters				
	VOCs**	SVOCs**	PCBs	Mercury	Chromium	TOC	pH		NO ₃ /NO ₂	VOCs **	SVOCs **	Pest/PCB	Metals
B1-B3						X	X			X	X	X	X
B4							X			X	X	X	X
B5							X			X	X	X	X
B6						X	X		X	X	X	X	X
B7						X	X			X	X	X	X
B8-B9						X	X		X	X	X	X	X
B10		X		X			X						
B11-B12		X		X			X						
B13							X			X	X	X	X
B14-B16 B18-B19		X		X			X						
B17							X			X	X	X	X
B20-B22	X	X					X						

(1) Sediment Parameters include temperature, pH, E_h, conductivity, color (Munsell), total organic carbon, grain size, moisture and solids, to be analyzed in shallow sample only (0-1 foot interval).

* Soil Samples will be collected from depths of 0-1 foot and 6-8 feet in all Phase 1 soil borings; location B3 will also have a sample collected at the 14-16 foot depth interval.

** Includes non-TCL parameters which are listed on Table 6-9.

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TABLE 5-1 (Cont'd)
ANALYTICAL PARAMETERS BY LOCATION
Hanlin-Allied-Olin Site
Moundsville, West Virginia

Soil Samples													
Boring No.*	Site Specific Parameters								Sediment (I) Parameters	TCL/TAL Parameters			
	VOCs**	SVOCs**	PCBs	Mercury	Chromium	TOC	pH	NO ₃ /NO ₂		VOCs**	SVOCs**	Pest/PCB	Metals
B23							X			X	X	X	X
B24							X	X					X
B25	X	X					X						
B26							X			X	X	X	X
B27-B28	X	X		X			X						
B29 B31, B32, B34, B35	X	X					X						
B33							X			X	X	X	X
B30							X			X	X	X	X
B36-B41		X	X				X						
B42				X			X						
B43-B45					X		X						

(1) Sediment Parameters include temperature, pH, E_h, conductivity, color (Munsell), total organic carbon, grain size, moisture and solids, to be analyzed in shallow sample only (0-1 foot interval).

* Soil Samples will be collected from depths of 0-1 foot and 6-8 feet in all Phase 1 soil borings; location B3 will also have a sample collected at the 14-16 foot depth interval.

** Includes non-TCL parameters which are listed on Table 6-9.

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TABLE 5-1 (Cont'd)
ANALYTICAL PARAMETERS BY LOCATION
Hanlin-Allied-Olin Site
Moundsville, West Virginia

Soil Samples												
Boring No.*	Site Specific Parameters						Sediment (1) Parameters	TCL/TAL Parameters				Metals
	VOCs**	SVOCs**	PCBs	Mercury	Chromium	TOC	pH	NO ₃ /NO ₂	VOCs**	SVOCs**	Pest/PCB	
B46-B48	X	X					X					
B49							X		X	X	X	X
B50							X		X	X	X	X
B51-B52	X	X					X					
Groundwater Samples												
Well No.												
19								X	X	X	X	X
20A, 21A, 27A, R1A									X	X	X	X
U1, B4A, B4B, R1A, R1B	X	X			X			X				
Remaining Existing Wells	X	X			X							
Ranney Well E									X	X	X	X

TCL: Target Compound List TAL: Target Analyte List

(1) Sediment Parameters include temperature, pH, E_h, conductivity, color (Munsell), total organic carbon, grain size, moisture and solids, to be analyzed in shallow sample only (0-1 foot interval).

* Soil Samples will be collected from depths of 0-1 foot and 6-8 feet in all Phase 1 soil borings; location B3 will also have a sample collected at the 14-16 foot depth interval.

TABLE 5-2
QUALITY ASSURANCE OBJECTIVES FOR FIELD SCREENING METHODS
Olin Area
Allied-Hanlin-Olin Site
Moundsville, West Virginia

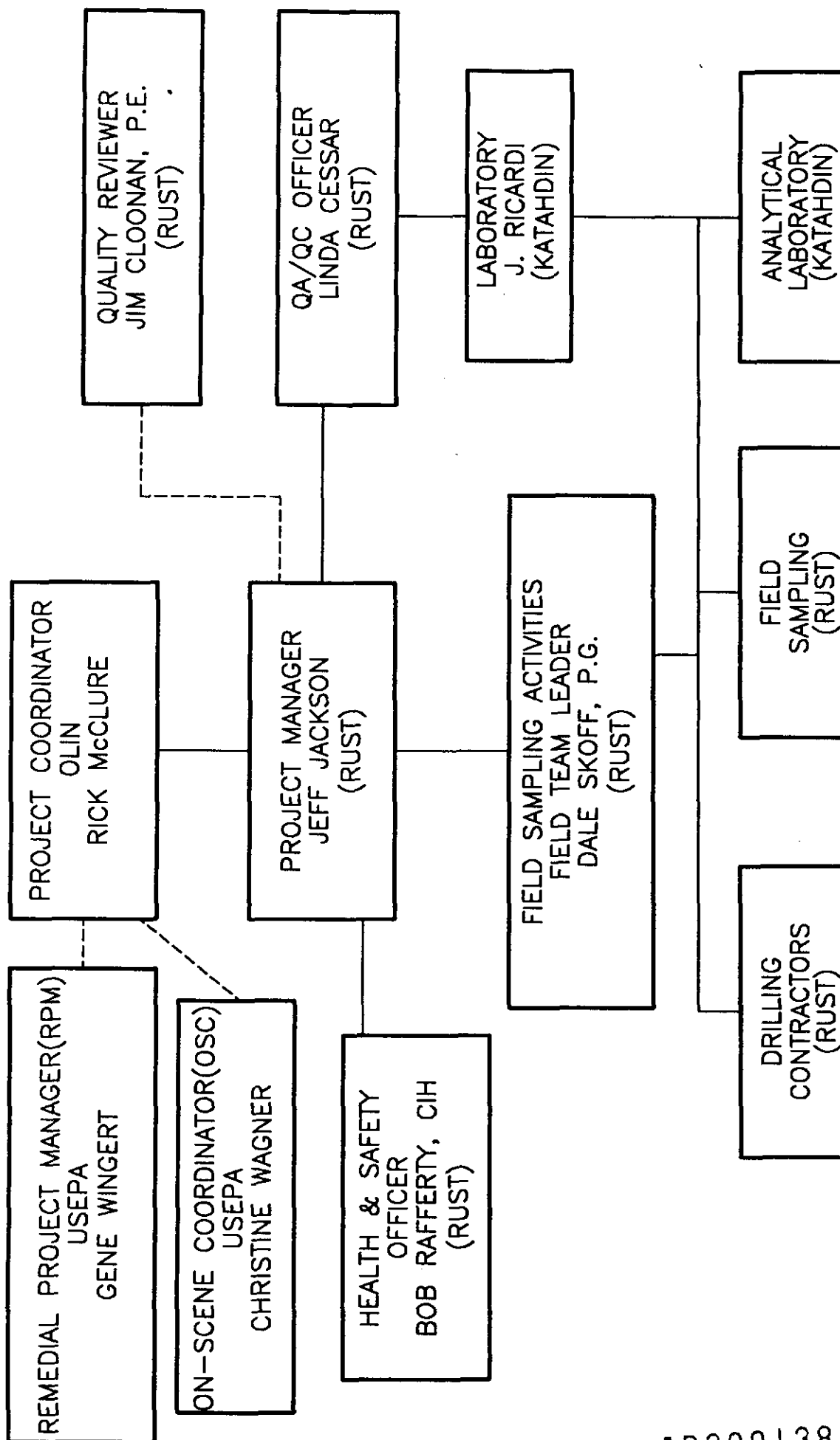
Analyte	Matrix	Method	Precision	Accuracy
Temperature	Water	Any high quality alcohol-filled thermometer or thermistor with analog or digital read-out device (1); U.S. EPA Method 170.1 (3).	Not determined (1)	Not determined (1)
pH	Water	Electromagnetically using either a glass electrode in combination with a reference potential or a combination electrode, and a pH meter (1); U.S. EPA Method 150.1 (3).	± 0.1 pH unit (1) in laboratory test ± 0.5 pH unit in field conditions	± 0.1 pH unit (1) in laboratory test ± 0.5 pH unit in field conditions
Specific Conductance	Water	Measured by use of a self-contained conductivity meter, wheatstone bridge-type or equivalent (1); U.S. EPA Method 120.1 (3).	$\pm 1\%$ of true value (1) in laboratory test $\pm 5\%$ of true value in field conditions	$\pm 1\%$ of true value (1) in laboratory test $\pm 5\%$ of true value in field conditions
Organic Vapor	Air	Century Systems Model CVA-R8 (or equivalent) Measures concentration of trace volatile gases present in the atmosphere by photoionization (2).	Characteristic of particular species of gas being ionized (2)	Relative to calibration gas used; range can be adjusted (2)
Mercury Vapor Analyzer	Air	Mercury vapor analyzer (or equivalent) Measures concentration of mercury vapor present in the atmosphere	Not determined (4)	Not determined (4). Minimum detectable concentration of 0.03 mg/m ³ when used in portable survey mode.
Phosgene	Air	Draeger, Sensidyne or equivalent chemical detector tubes indicate presence of phosgene by a color change	Not determined	Not determined (5). Minimum detectable level of 0.02 ppm for Draeger tubes and 0.05 ppm for Sensidyne tubes.
Turbidity	Water	Measures turbidity in aqueous samples	Not determined	Not determined

References:

- (1) U.S. EPA SOP and Quality Assurance Manual, Region IV, April 1, 1986
- (2) Instruction Manual Model OVA 128 Century Organic Vapor Analyzer
- (3) U.S. EPA Methods for Chemical Analysis of Water and Wastes, 3rd Edition, 1979.
- (4) 431 Gold Film Mercury Vapor Analyzer Manual
- (5) Draeger Detector Tube Product Literature

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NOTE: Oversize Figure 5-2 is at the end of this Work Plan.



TRUST ENVIRONMENT & INFRASTRUCTURE

PROJECT TEAM ORGANIZATION CHART

PROJ. NO.: 32329.300 DATE: 11/94

RUST DWG.
NUMBER: **FIGURE 5-1**

MOUNDSVILLE

HANLIN-ALLIED-OLIN SITE

WEST VIRGINIA

6.0 QUALITY ASSURANCE PROJECT PLAN

6.1 PLAN OBJECTIVES

Section 6.0 comprises the Quality Assurance Project Plan (QAPjP) for the sample collection and analysis activities to be conducted at the Olin Area. This QAPjP outlines data quality objectives and sets quality acceptance criteria for data generated for this effort. This QAPjP is to be used in conjunction with the Field Sampling Plan (FSP), which outlines the sample collection procedures necessary to implement the objectives outlined in the Soil Study Plan (Section 3.0) and Hydrogeological Study Plan (Section 4.0).

6.2 PROJECT ORGANIZATION AND RESPONSIBILITIES

A project organization chart is presented in Figure 5-1. It notes the personnel involved and the lines of authority. A description of the key personnel and their responsibilities is presented below. Resumes for consultant/contractor personnel have been provided to EPA in an earlier submittal.

Olin Project Coordinator: Richard W. (Rick) McClure (615-336-4576)

The Olin Project Coordinator, located at 1186 Lower River Road NW, Charleston, TN 37310 will have overall responsibility for overseeing the investigation, including representing Olin on all technical and administrative matters with USEPA and WVDNR.

RUST E&I Project Manager: Jeff Jackson (834-234-2281)

The Project Manager, located at 15 Brendan Way, Greenville, SC 29615, will be responsible for the day-to-day activities of the investigation and will provide overall direction of the technical and administrative functions within the program. He will be responsible for the implementation of and modification to all program plans and the coordination of, and communication among, groups involved. He is also responsible for project deliverables.

RUST E&I QA/QC Officer: Linda Cessar (412-934-2602)

The QA/QC Officer, located at 103 Bradford Road, Pittsburgh, PA 15090 will have overall responsibility for assuring the integrity of the QAPjP and will coordinate all QA specific activities. The QA/QC Officer will coordinate all functions with the field team and assure that appropriate analytical procedures are employed by the laboratory. The QA/QC Officer will be responsible for data validation and will advise the Project Manager with respect to data management and statistical evaluation of the data. The QA/QC Officer will supervise all of the quality aspects of the field team and determine and fulfill recordkeeping requirements. The QA/QC Officer also will be responsible for performance and/or systems audits of the laboratory, should they be required.

RUST E&I Field Team Leader: Dale Skoff (412-934-2610)

The Field Team Leader will be located at the Olin Area during field activities and will coordinate the technical field activities in accordance with approved plans, including the work plan, QAPjP and

Health and Safety Plan. He is responsible for verifying that the field work (to include sampling operations and sampling QC) is performed within the approved guidelines. The Field Team Leader is responsible for implementing and maintaining overall operating standards and quality assurance management. He coordinates all safety and technical activities occurring at the site, and conducts daily briefing sessions prior to work on the site. Although various field functions will be performed by individuals, it is the Field Team Leader who will provide signature approvals to all field activities and bear all field responsibilities.

Laboratory QA Officer: Ms. J. Ricardi (207) 874-2400

The Katahdin Analytical Services QA Officer, located at 340 County Road, No. 5, Westbrook, Maine, 04092, will be responsible for the day-to-day management of the laboratory work (to include data processing and data processing QA), verification that all laboratory QA/QC procedures are being maintained, and technical review of all reports. Although various laboratory functions will be performed by different individuals, it is the Laboratory QA officer who will provide signature approvals to all laboratory generated information and bear all laboratory responsibilities.

6.3 QUALITY ASSURANCE OBJECTIVES

Presented below is a discussion of the Data Quality Objectives for the project, along with the methods used to evaluate data quality.

6.3.1 PARCC Review

This Quality Assurance (QA) program addresses both field and laboratory activities. The measurement of quality for this application includes the PARCC parameters (precision, accuracy, representativeness, comparability and completeness). The procedures described herein are designated to obtain PARCC data for each field procedure and analytical method. To ensure that quality data continue to be produced, systematic checks must show that test results and field procedures remain reproducible and that the analytical methodology is actually measuring the quantity in each sample. The PARCC parameters are indicators of data quality and are described in Sections 6.3.1.1 to 6.3.1.5.

The reliability and credibility of analytical laboratory results can be corroborated by the inclusion of a program of scheduled replicate analyses, analyses of standard or spiked samples, and analyses of method blanks. Regularly scheduled analyses of known duplicates, standards and spiked samples are a routine aspect of data reduction, validation and reporting procedures.

Specific PARCC measurements will be addressed to satisfy the QA objectives. These measurements (precision, accuracy, representativeness, completeness and comparability) are discussed in the following subsections. Data quality acceptance criteria are presented in Section 6.12.

6.3.1.1 Precision

Whereas accuracy measures the average properties of an analytical method, precision examines the spread of the reported values about their mean. The spread of reported values refers to how different the individual reported values are from the average reported value. Precision is a measure of the magnitude of errors which can be measured in a variety of ways.

Precision will be determined from replicate samples; thus, precision is expressed as relative percent difference (RPD). This quantity is defined as follows:

$$\%RPD = \frac{X1-X2}{(X1+X2)/2} \times 100$$

where X1 and X2 are the reported concentrations for each replicate sample.

6.3.1.2 Accuracy

Accuracy is a determination of how close the measurement is to the true values. When applied to a set of observed values, accuracy will be a combination of a random component and of a common systematic error (or bias) component. Bias is defined as the deviation due to matrix effects of the measured value from a known spiked amount. Sampling accuracy may be assessed by evaluating the results of rinseate and trip blanks, and analytical accuracy may be assessed through the use of known and unknown QC samples and spike samples.

Accuracy will be determined from spiked samples, using the following relationship:

$$\frac{\text{Spiked sample conc.} - \text{sample conc.}}{\text{Spike conc. added}} \times 100$$

6.3.1.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter which is most concerned with the proper design of the sampling program. The representativeness criterion is best satisfied by making certain that sampling locations are selected properly and a sufficient number of samples are collected.

Representativeness is addressed by describing sampling techniques and the rationale used to select sampling locations. Sampling locations can be biased (based on existing data, instrument surveys, observations, etc) or unbiased (complete random or stratified-random approaches). Either way, the rationale used to determine sampling locations must be explicitly explained. Representativeness will be assessed by the use of duplicate samples.

6.3.1.4 Completeness

Completeness is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is essentially the same of all data uses in that a sufficient amount of valid data be generated. Completeness will be determined using the following relationship:

$$\frac{\text{Number of valid measurements}}{\text{Total number of measurements}} \times 100\%$$

There is limited historical data on the completeness achieved by individual methods. However, the Contract Laboratory Program (CLP) data have been found to be 80-85 percent complete on a nationwide basis. As noted in Section 6.12.4, this is the completeness objective for this sample collection effort.

6.3.1.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. Sample data should be comparable with other measurement data for similar samples and sample conditions. This goal will be achieved through using standard techniques to collect and analyze representative samples and reporting analytical results in appropriate units.

6.3.2 Data Quality Objectives and Levels

To generate data that will meet the project objectives, it is necessary to define the types of decisions that will be made, identify the intended uses of the data, and design a data collection program. Data Quality Objectives (DQO) are defined as an integrated set of thought processes which define data quality requirements based on the intended use of the data. Data Quality Objectives are necessary in obtaining sufficient data of known defensible quality for the intended use. The DQO process will assist in determining appropriate quantitation, detection, and reporting limits by defining analytical methods, sample handling procedures and data assessment requirements.

Validation of all data collected during this program will be performed to ensure that quality procedures have been followed and that the quantity of data will adequately support the intended use. The QA/QC evaluation will determine whether data meet requirements of the QAPjP and will include a validation of the laboratory data, when appropriate or applicable.

6.3.2.1 Intended Uses of Data

The four intended uses of the data are as follows:

1. Characterize the nature and extent of chemical residuals.
2. Evaluate removal action alternatives.
3. Perform field screening.
4. Conduct health and safety monitoring.

6.3.2.2 Levels of Data Quality

The following two descriptive data categories will be used for this project to assist in the interpretation of data:

- Screening data
- Definitive data.

These categories are defined below.

Screening Data

Definition of Screening Data

Screening data are generated by rapid, less precise methods of analysis with less rigorous sample preparation. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data provide analyte identification and quantification, although the quantification may be relatively imprecise.

Screening Data QA/QC Elements

- Sample documentation (location, date and time collected, batch, etc.);
- Sampling design approach (systematic, simple or stratified random, judgmental, etc.);
- Initial and continuing calibration;
- Determination and documentation of detection limits;
- Analyte(s) identification;
- Analyte(s) quantification;

Definitive Data

Definition of Definitive Data

Definitive data are generated using rigorous analytical methods, such as approved EPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce tangible raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files. Data may be generated at the site or at an off-site location, as long as the QA/QC requirements are satisfied. For the data to be definitive, either analytical or total measurement error must be determined.

Definitive Data QA/QC Elements

- Sample documentation (location, date and time collected, batch, etc.);
- Chain-of-custody (when appropriate);
- Sampling design approach (systematic, simple or stratified random, judgmental, etc.);
- Initial and continuing calibration;
- Determination and documentation of detection limits;
- Analyte(s) identification;
- Analyte(s) quantification;
- QC blanks (trip, method, rinsate);
- Matrix spike recoveries;
- Performance Evaluation (PE) samples (when specified);
- Analytical error determination (measures precision of analytical method): Matrix spike and matrix spike duplicate samples are analyzed, and standard laboratory QC parameters (such

as accuracy and precision) are calculated and compared to method-specific performance requirements.

The data categories to be utilized in this investigation for the various project objectives are presented in Table 6-1. A summary of the project specific data quality objectives (DQOs) is provided in Table 6-2.

The DQOs for this project will incorporate both categories. As noted in Table 6-2, laboratory samples will be used to generate definitive data.

The overall data quality objective for this effort is to limit the chance that sample data will lead to an incorrect conclusion for each of the various data uses. An important aspect of this objective is to minimize the chance for data which indicate that environmental matrices are "clean" when they are not (false negatives) and to minimize the chance for data which indicate that environmental matrices are "dirty" when they are not (false positives). To achieve this objective, control limits on precision, accuracy, representativeness, comparability and completeness (PARCC parameters) have been established, based on the intended uses of the data. The DQOs for accuracy, precision and completeness are also presented in Table 6-2.

6.3.2.3 QA/QC Samples

Quality assurance and quality control field and laboratory samples are collected or prepared to check the accuracy and precision of the measurement system. Laboratory QA/QC techniques consist of method blanks, matrix spike and matrix spike duplicate samples, surrogate recovery and laboratory control samples. Field QA/QC techniques consist of duplicate samples, rinseate samples and trip blanks. A description of these techniques and the frequency of their use is provided in Section 6.9.

6.4 SAMPLING PROCEDURES FOR FIELD ACTIVITIES

Field activities impacting data quality and any deviation from Standard Operating Procedures (SOPs) will be documented. Activities impacting data quality include, but are not limited to, sample management, reagent/standard preparation, decontamination, sample collection, field measurements, equipment calibration and maintenance, and corrective action, each of which are components of this QAPjP.

Sample location and collection frequency are described in the FSP. Sampling methods and sampling equipment also are described in the FSP.

6.4.1 Sample Containers, Preservation and Storage

Sample containers will be furnished by the laboratory or will be supplied by a commercial laboratory supply vendor. For those samples which require preservation, preservatives will be added to the appropriate container by the laboratory prior to shipment of the containers. Container, preservation and storage requirements for groundwater samples and soil samples are presented in Tables 6-3 and 6-4, respectively.

6.4.2 Decontamination

Decontamination of groundwater and soil sampling equipment will take place at sampling locations. Decontamination of drilling equipment and tools will be conducted in a centralized area. Prior to arrival on-site, all down-hole drilling equipment will be steam-cleaned. Equipment used for drilling and sampling will be decontaminated prior to each use and in accordance with the following cleaning procedures:

Sampling Equipment Decontamination Procedures

1. Clean equipment with potable water and phosphate-free laboratory detergent (Liquinox or equivalent) using a brush, if necessary, to remove particulate matter and surface films.
2. Rinse thoroughly with potable (tap) water.
3. Tap water rinse
4. Deionized water rinse
5. Air dry

Drilling Equipment Decontamination

1. Drill rigs and all support equipment will be free from excess grease, oils, and caked-on soils from previous work prior to arrival.
2. Equipment or materials not used immediately after decontamination will be placed on a plastic sheet, covered with plastic, and secured to avoid potential contamination.
3. Augers and any other equipment that will enter the borehole will be steam-cleaned with a high pressure system on a decontamination pad prior to drilling each borehole.

Clean, disposable gloves will be worn while handling sampling equipment or downhole tools during the final stages of decontamination. Deionized water will be stored in either glass or Teflon containers and applied via Teflon squeeze bottles or decanted directly from their storage containers.

6.4.3 Documentation/Data Management

Data management involves maintaining and controlling field data, laboratory analytical data, and any other data relevant to the project. Bound field log books will be used for recording field data. This project will have dedicated field log books which will not be used for other projects. Entries in the field log book will be dated and the time of entry will be recorded. Sample collection data as well as visual observations will be documented on forms or when forms are not available, in the field log book. To the extent possible, field data will be recorded on field forms and not repeated in the field notebook. Any sample collection equipment, field analytical equipment, and equipment used to make physical measurements will be identified in the field log book. Calculations, results, equipment usage, maintenance, repair and calibration data for field sampling, field analytical and field physical

measurement equipment will also be recorded in field log books. Once completed, the field forms and field log book will become part of the project file.

Office data management will involve establishing and maintaining a project file. The project file will include the following:

- External and Internal Correspondence
- Notes/Minutes of Meetings and Phone Conversations
- Personnel Organization and Responsibilities
- Planning and Scheduling
- QA Auditing and Inspection Reports
- Field Sampling
- Project Operations
- Calculations
- Laboratory Analytical Data
- Field Analytical Data
- Contract/Purchase Orders
- Change Orders
- Bid Evaluations
- Drawings

All project-related information will be routed to the Contractor Project Manager who will be responsible for routing the information to appropriate personnel.

6.5 SAMPLE CUSTODY PROTOCOL

Sample collection and sample custody are designed so that field custody of samples is maintained and documented. These procedures provide identification and documentation of the sampling event and the sample chain-of-custody from shipment of sample bottleware, through sample collection, to receipt of the sample by the subcontracted laboratory. When used in conjunction with the laboratory's custody procedures and the sample bottleware documentation, these data establish full legal custody and allow complete tracking of a sample from preparation and receipt of sample bottleware to sample collection, preservation, and shipping through laboratory receipt, sample analysis and data validation.

6.5.1 Laboratory Procedures

Katahdin Analytical Services, (the designated laboratory) has an established program of sample custody which is designed to ensure that each sample is accounted for at all times. The objectives of the laboratory's sample custody program include:

1. Unique identification of all samples, as appropriate for the data required;
2. Analysis of the correct samples, and traceability to the appropriate records;
3. Preservation of sample characteristics;
4. Protection of samples from loss or damage;
5. Documentation of any sample alteration (e.g., filtration, preservation); and
6. Establishing a record of sample integrity for legal purposes.

Standard Operating Procedures (SOPs) for sample custody protocol are maintained by the laboratory and adhered to by laboratory personnel.

6.5.2 Field Custody Procedures

Field custody procedures are described below. Sample collection procedures concerning sample identification and documentation, field log book, sample containers, sample packing and sample shipping are described. Examples of the various forms and labels used to track custody are provided in Appendix B.

The persons responsible for sample custody, and a brief description of their duties, are as follows:

1. Katahdin Analytical Services Representative (Ms. J. Ricardi) or Commercial Supplier: Verifies that the bottleware is certified clean; arranges for bottleware shipment to field sampling personnel or the contractor's equipment shop;
2. Consultant Equipment Manager: Receives and stores bottleware that is shipped from a laboratory or a commercial supplier; relinquishes bottleware to field sampling personnel; initiates chain-of-custody from bottleware in storage;
3. Consultant Field Staff: Receive sample bottleware from laboratory, inspect bottleware for physical integrity; retain bill of lading from shipping courier as documentation of transfer of bottleware; record manufacturer and lot number of bottleware for each sample; collect and preserve samples; retain bottleware and samples under custody until sample shipment; relinquish samples to shipping courier or to lab representative.
4. Consultant Project Manager: Verifies reported laboratory analyses to the sample chain-of-custody form; assures that chain-of-custody documentation is incorporated into the project file.

6.5.2.1 Sample Identification and Documentation

After sample collection, all sample containers will be labeled with an identification number that uniquely identifies the sample. Each sample container will have a sample label. The sample identification number will be logged in the field log book, along with the following information:

1. Sampling personnel
2. Date and time of collection
3. Field sample location and depth (if appropriate)
4. Observations on ambient conditions
5. Type of sampling (composite or grab)
6. Method of sampling
7. Sampling matrix or source
8. Results of field screening
9. Intended analyses

6.5.2.2 Field Log Book and Forms

Sampling personnel will use a bound field log book with moisture resistant pages to record pertinent sampling information with waterproof ink. The log book identifies project name, project number and principal street address or geographic location of the site. Daily field activities and sampling information are entered in the log book on serially-numbered pages. At the end of each day's entries, sample collection personnel shall sign and date the entry. Corrections are made to entries by initialed and dated line-out deletions. A diagonal line is drawn across the remaining blank space of the last page of each day's entry. As discussed above, pertinent field forms will be used to the extent possible to record field data.

6.5.2.3 Sample Containers

The contractor shall use sample containers furnished by Katahdin Analytical Services, or a commercial supplier. Sample container cleaning procedures are documented by Katahdin Analytical Services, in their Quality Assurance Program Plan (QAPP). The contractor shall verify that the commercial supplier furnishes laboratory grade, certified clean containers. The source of sample containers used in the sampling event are recorded in the project field log book for each sample collected. When bottleware is shipped directly from the supplier to the field, a formal chain-of-custody is not normally initiated. In this instance, the airway bill receipt of packing slip serves as the initiation of the chain-of-custody.

6.5.2.4 Sample Packing

Samples are packed for shipping in waterproof ice chests and coolers. The sample containers may be individually sealed in Zip-loc® or other similar plastic bags, prior to packing them in the cooler with bubble wrap, or styrofoam packing. Wet ice sealed in plastic bags (to inhibit cross contamination of sample by meltwater) is placed with the samples in the cooler to maintain the samples at a temperature of about 4 degrees Celsius during shipping.

The Chain-of-Custody form (Appendix B) that identifies the samples is signed as "relinquished" by the principal sampler or responsible party. Requested analyses that identifies the samples and instructs the laboratory on their analyses, are also indicated on the Chain-of-custody form. This form is sealed in a waterproof plastic bag and is placed inside the cooler, typically by taping the bag to the inside lid of the cooler.

Following packing, the cooler lid is sealed with strapping tape. Two custody seals are signed, dated and affixed about two corners of the cooler, across the seal of the lid, and are additionally covered with clear tape.

6.5.2.5 Sample Shipping

The sample coolers are typically shipped by overnight express courier to the laboratory. A copy of the bill of lading is retained by the Contractor and becomes part of the sample custody documentation.

6.6 CALIBRATION PROCEDURES AND FREQUENCY

The calibration procedures and frequencies are discussed below.

6.6.1 Laboratory Procedures

All laboratory instruments will be calibrated according to the specified methodology as appropriate.

6.6.1.1 Standard/Reagent Preparation

A critical element in the generation of quality data is the purity/quality and traceability of the standard solutions and reagents used in the analytical operations. The preparation and maintenance of standards and reagents will be performed per the specified analytical method. The quality of reagents and standard solutions will be monitored through a series of well-documented procedures. Details regarding primary referenced standard sources and preparation of standard solutions are provided in Katahdin Analytical Services' Quality Assurance Program Plan (QAPP) which is provided as Appendix C to this document.

6.6.1.2 Instrument Calibration and Tuning

Calibration of instruments is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established reporting limits. Each instrument will be calibrated with standard solutions appropriate to the type of instrument and the linear range established for the given analytical method. The frequency of calibration and calibration verification and the concentration of calibration standards are determined by the manufacturer's guidelines and the analytical method. Details regarding instrument calibration and tuning are provided in the laboratory QAPP (Appendix C).

6.6.2 Field Procedures

Calibration of field instrumentation is discussed in Section 5.4.1.2 of this document.

6.7 ANALYTICAL METHODS

A percentage of the soil and groundwater samples will be analyzed for the full Target Compound List (TCL) and Target Analyte List (TAL) for organics and inorganics, respectively. The TAL is presented in Table 6-5. The volatile, semi-volatile and pesticide/PCB compounds on the TCL are presented in Tables 6-6, 6-7, and 6-8, respectively. In addition to the TCL constituents, samples scheduled for the full TCL/TAL analysis will also be analyzed for the non-TCL constituents presented on Table 6-9 (comprised of SVOCs). The majority of samples, however, will be analyzed for those specific constituents which may be present in given soil and groundwater samples based on a historical process knowledge. This will include selected VOCs, SVOCs and metals presented in Tables 6-5 through 6-9.

Laboratory and field data gathering techniques have been specified for meeting the data quality objectives presented in Table 6-2. Data quality objectives will be accomplished in conformance with

a quality assurance program, laboratory standard operating procedures and applicable regulatory requirements. Specific objectives are to:

1. Establish a protocol for estimating the quality of each analytical method.
2. Assist in early recognition of deficiencies affecting data quality.
3. Provide a system by which action can be taken to correct and document out-of-control conditions.
4. Enhance data usefulness for reporting and decision making by defining and documenting limitations on the quality of the data.

The quality assurance program will provide for traceable documentation of an adequate level of project records; that reports and documentation are technically accurate; availability of proper equipment, which is correctly calibrated and used; adherence to scope of work. This section lists parameters to be evaluated in both the field and laboratory, quantitation limits to be achieved, and the analytical methodology to achieve these limits with necessary levels of control to produce data of known and desired quality.

6.7.1 Laboratory Methods

Katahdin Analytical Services, located at 340 County Road, No. 5, Westbrook, Maine, 04092, will be performing the laboratory analyses for the project. A description of the laboratory facilities, equipment, supplies, and credentials is provided in Appendix C.

6.7.1.1 Laboratory Standard Operating Procedures

Parameters identified for laboratory analysis include inorganics, volatile organic constituents (VOCs), semi-volatile organic constituents (SVOCs) and other TCL constituents. Katahdin Analytical Services maintains and follows a documented quality assurance program which conforms to EPA guidance document "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," (QAMS-005/80, December 1980). A copy of Katahdin Analytical Services Quality Assurance Program Plan (QAPP) is provided in Appendix C.

6.7.1.2 Analytical Methods

Tables 6-5 through 6-9 list specific parameters for which data will be reported. Each table provides methods references which will be specified for this work. Consistent use of these methods throughout the project will allow comparability among the samples collected, and will achieve the data quality objectives for the project. Analytical methods to be used for this effort are EPA's Contract Laboratory Program (CLP) Statement of Work (SOW) methods. Non-CLP methods to be used for the analysis of selected samples (per the Soil and Hydrogeological Study Plans) are described below.

Total Organic Carbon - EPA SW-846 Method 9060: This method is used to measure the concentration of organic carbon in soil and groundwater samples.

Soil pH - EPA SW-846 Method 9045: This electrometric procedure is used to measure pH in soil samples.

Nitrate Nitrogen - EPA Method 353.2: This cadmium reduction method measures the concentration of nitrate/nitrite nitrogen in groundwater samples. A modified version of EPA Method 300.0 (ion chromatography) will be used to determine nitrate and nitrite nitrogen in soil samples.

Moisture - EPA 160.3 modified: This procedure measures the level of soil moisture.

Solids - EPA Method 160.3: This procedure will measure percent solids in the sample.

Grain Size - ASTM Method D-422: This method measures the various grain sizes present in soil and sediment samples.

As noted in Table 6-9, some of the non-TCL/TAL constituents do not currently have EPA-approved methods. However, the majority of constituents are expected to be compatible with the volatile or semi-volatile methods selected for this effort. Thus, method validation studies will be conducted, and EPA Region III approval will be obtained prior to initiating sample collection activities. If unacceptable results are obtained for these non-TCL constituents, then their continued designation as a compound of concern will be discussed with EPA.

6.7.1.3 Required Detection Limits

Noted in Tables 6-5 through 6-9 are Practical Quantitation Levels (PQLs) associated with the previously described methods which will be utilized during the Project.

Practical Quantitation Level represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard PQL as a result of sample matrix and compound concentration.

6.7.2 Field Methods

Procedures for utilizing field measurement devices are presented in Section 5.4.1 of the Field Sampling Plan.

6.8 DATA REDUCTION, VALIDATION AND REPORTING

The analyst who generates the analytical data has responsibility for the correctness and completeness of the data. All data are generated and reduced following protocols specified in laboratory SOPs. Each analyst reviews the quality of his or her work based on an established set of guidelines. QC data validation criteria set forth in the corresponding methods will be used to evaluate the data.

6.8.1 Data Reduction

Raw analytical data generated in the laboratory is collected on printouts from the instruments and associated data system or manually in bound notebooks. Analysts review data as it is generated to determine that the instruments are performing within specifications. This review includes calibration checks, surrogate recoveries, blank checks, retention time reproducibility, and other QC checks. If any problems are noted during the analytical run, corrective action is taken and documented.

Each analytical run is reviewed for completeness prior to interpretation and data reduction. The following calculations are used to reduce raw data to reportable results.

GC/MS calculation used by the data system to determine concentration in extract for semivolatiles or in the sample itself for volatiles:

$$Q = (A_x)(I_s)/(A_{I_s})(RRF)(V_i)$$

Where A_x = Peak Area
 A_{I_s} = Internal Standard Peak Area
 I_s = Amount of Internal Standard Injected (ng)
RRF = Relative Response Factor
 V_i = Volume of Extract Injected (ul) or Volume of Sample Purged (ml)
 Q = Concentration in Extract

The extract concentration is further reduced by considering the initial sample weight or volume and the final extract volume:

$$\text{Concentration} = (Q)(D)(F)(1000)/(I)$$

Where Q = Concentration determined by the data system ($\mu\text{g/L}$)
 D = Dilution Factor (if needed)
 F = Final Extract Volume
 I = Initial Sample Weight (g) or Volume (ml)

Results are reported in $\mu\text{g/L}$ for water samples and $\mu\text{g/kg}$ for solid samples. Soil samples are reported on a dry weight basis.

The results for inorganic analyses are calculated using the following equation:

$$\text{Concentration} = (A)(D)(E)(1000)/(F)$$

Where A = Concentration determined by AA or ICP (mg/L)
 D = Dilution Factor (if needed)
 E = Final Extract Volume (ml)
 F = Initial Sample Volume (ml) or Weight (g)

Results are reported in mg/L for water samples and in mg/kg for solid samples. Soil samples are reported on a dry weight basis.

6.8.2 Data Validation by the Laboratory

Following interpretation and data reduction by an analyst, data are transferred to the laboratory sample management system either by direct data upload from the analytical data system or manually. The data are reviewed by the Group Leader or another analyst and marked on the sample management system as being verified. The person performing the verification step reviews all data including quality control information prior to verifying the data. If data package deliverables have been requested, the laboratory will complete the appropriate forms summarizing the quality control information, and transfer copies of all raw data (instrument printouts, spectra, chromatograms, etc.) to the Data Packages Group. This group will combine the information from the various analytical groups and the analytical reports from the laboratory sample management system into one package. This package is reviewed by the Quality Assurance Department for conformance with SOPS and to ensure that all QC goals have been met. Any analytical problems are discussed in the case narrative, which is also included with the data package deliverables.

6.8.3 Data Validation by Consultant

Following data validation by the laboratory, data validation will then be conducted by the consultant. The September 1994 Region III Modifications to National Functional Guidelines for Organic Data Review (OLM 01.0-OLM 01.9) will be used for the validation of organic data. The April 1993 Region III Modifications to the National Functional Guidelines for Inorganic Data Review will be used for the review of inorganic data.

6.8.4 Data Reporting

Laboratory reports will contain the following:

General Discussion: Description of sample types, tests performed, any problems encountered and general comments are given.

Analytical Data: Data are reported by sample or by test. Pertinent information including dates sampled, received, prepared and extracted are included on each results page. The reporting limit for each analyte is also given.

Laboratory Performance QC Information: The results (Percent Recovery and Relative Percent Difference) of the Laboratory Control Samples analyzed with the project are listed, together with the control limits. Also, the analytical results for method blanks generated during analysis of organic and metals parameters are given.

Matrix-Specific QC Information: Results of any sample duplicates, matrix spikes, matrix spike duplicates or other project-specific QC are requested are also reported.

Methodology: Reference for analytical methodology used is cited.

Custom Services: Special services including data interpretation special consultation, and raw data packages will be provided (when requested).

The reporting scheme from collection of raw data through document storage is as follows:

Raw data collected by laboratory technical personnel

Data reviewed/checked by laboratory supervisor

Data receive QA/QC review and approval from laboratory QA director

Written report, which accompanying QC data, is submitted to contractor for data validation

If data are accepted by contractor, then prepare data assessment summary report

If data are not accepted by contractor, then implement corrective action procedures, and data review process reinitiated

Data summary report, including data validation review and laboratory QA/QC deliverables, are presented to EPA.

6.9 INTERNAL QUALITY CONTROL

An internal QC system is a set of internal procedures by the laboratory for assuring that the data output of a measurement system meets prescribed criteria for data quality. A well-designed internal QC program must be capable of controlling and measuring the quality of the data, in terms of precision and accuracy. Precision reflects the influence of the inherent variability in any measurement system; and accuracy reflects the degree to which the measured value represent the actual or "true" value for a given parameter, and includes elements of both bias and precision.

This section addresses QC procedures associated with analytical efforts. Included are general QC considerations as well as specific QC checks which provide ongoing control and assessment of data quality, in terms of precision and accuracy.

6.9.1 Laboratory Quality Control

Table 6-10 summarizes the laboratory QC samples which will be analyzed for this effort, based on the methods selected. A description of these QC samples is provided below.

6.9.1.1 Method Blanks

A method blank is prepared at the frequency specified by the referenced method (typically one per analytical batch). The purpose of the method blank is to ensure that contaminants are not introduced by the glassware, reagents, standards, personnel, or sample preparation environment.

For volatile analyses, an instrument blank is also analyzed during each calibration shift to verify that contaminants are not being introduced by components of the instrumentation or analytical laboratory.

Various routine QC checks are in place to verify that new lots of glassware, reagents and standards, decontaminated glassware, sample storage areas (including refrigerators) and water purification systems are contaminant-free.

6.9.1.2 Matrix Spikes and Matrix Spike Duplicates

A Matrix Spike (MS) is an environmental sample to which known concentrations of analytes have been added. The MS is taken through the entire analytical procedure and the recovery of the analytes is calculated. Results are expressed as percent recovery. The MS is used to evaluate the effect of the sample matrix on the accuracy of the analysis.

A Matrix Spike Duplicate (MSD) is an environmental sample that is divided into two separate aliquots, each of which is spiked with known concentrations of analytes. The two spiked aliquots are processed separately and the results compared to determine the effects of the matrix on the precision and accuracy of the analysis. Results are expressed as relative percent difference (RPD) and percent recovery.

One MS/MSD set will be analyzed for every 20 investigative samples. The MS/MSD will be site-specific and thus, field personnel will be responsible for collecting additional sample volumes to account for the MS/MSD samples.

6.9.1.3 Surrogate Recovery

Surrogate standards are added to each organic sample requiring GC/MS analysis for volatile or semi-volatile compounds in accordance with the particular method being utilized. Surrogate recoveries must meet method acceptance criteria before the analytical data will be released. In some instances the sample matrix may produce interferences which adversely affect recoveries. Surrogate recovery interferences must be confirmed by preparation and reanalysis of the sample. In addition, organic MS samples and laboratory control samples (LCS) are fortified with spike standard solutions containing target analytes of interest. The recovery of these standards is quantitatively measured during analysis, and historical records maintained on the percent recovery for each sample. When a MS test fails spike recovery criteria, the LCS must be analyzed. If the LCS fails, the batch must be reprocessed; if it passes, the matrix effect is confirmed and the affected data are qualified as appropriate.

6.9.2 Field Quality Control Samples

Table 6-11 summarizes the field QC samples will be collected and forwarded for analyses, based on the methods selected. The following sections define each field QC sample. A summary of the sampling analytical and QC program is presented in the Field Sampling and Analysis Plan.

6.9.2.1 Field Duplicates

Duplicate samples collected in the field provide precision information for the entire measurement system including sample acquisition, homogeneity, handling, shipping, storage, preparation and analysis. Samples for duplicate analyses will be selected at random and submitted to the laboratory for analyses. This procedure is useful in determining the total (sampling and

analytical) error as well as the analytical error since it evaluates the sample collection, sample preparation and analysis steps.

6.9.2.2 Equipment Blanks

Equipment blanks are defined as samples which are obtained by pouring analyte-free or deionized water through non-dedicated sample collection equipment (pump, auger, etc) after decontamination, and placing it in appropriate sample containers for analysis. These samples are used to determine if decontamination procedures have been sufficient. Equipment blanks will be collected from the various sampling devices to provide a representative indication of the success of field cleaning procedures. Equipment blanks will be submitted at a rate of one per 20 investigative samples for each matrix being sampled. No equipment blank will be required for disposable sampling equipment.

6.9.2.3 Trip Blanks

Trip blanks are prepared in the laboratory, shipped with the sample containers to the Olin Area, and are kept (unopened) with the investigative samples throughout the sampling event. They are then packaged for shipment with the other samples and submitted for analysis. A trip blank will be included with each sample cooler containing samples requiring volatile analyses.

6.10 SYSTEMS AND PERFORMANCE AUDITS

The contractor QA/QC officer may conduct both performance and systems audits of field and laboratory activities, as necessary. Following is a discussion of both field and laboratory audits.

6.10.1 Systems Audit

A systems audit consists of evaluation of key components of the measurement systems to determine their proper selection and use. This audit includes a careful evaluation of both field and laboratory quality control procedures. When required by EPA or alternative regulatory authority, systems audits are performed prior to or shortly after systems are operational.

6.10.1.1 Laboratory Systems Audit

The laboratory systems audit is a review of laboratory operations to verify that the laboratory has the necessary facilities, equipment, staff and procedures in place to generate acceptable data.

Specific activities vary with the scope of the audit, but can include review of:

1. Equipment suitability and maintenance/repair;
2. Background and training of personnel;
3. Laboratory control charts and support systems;
4. QC samples, including performance evaluation samples;
5. Chain-of-custody procedures;
6. Data logs, data transfer, data reduction and validation.

6.10.1.2 Field Systems Audits

This on-site audit focuses on data collection systems, using this QAPjP as a reference. Specific activities vary with the scope of the audit, but can include a review of:

1. Sample collection activities;
2. Equipment calibration techniques and records;
3. Decontamination and equipment cleaning;
4. Background and training of personnel;
5. Sample containers and preservation techniques;
6. Chain-of-custody procedures

6.10.2 Performance Audits

After systems are operational and generating data, EPA may request that a performance audit be conducted to determine the accuracy of the total measurement system(s) or component parts thereof.

6.10.2.1 Laboratory Performance Audits

Katahdin Analytical Services, participates in a variety of federal and state programs that subject the laboratory to stringent performance audits on a regular basis. Quality assurance policies and procedures currently in place at Katahdin Analytical Services, include the following:

Quarterly systems audits conducted by the Divisional QA Director

Periodic (at least annually) audits conducted by the Corporate QA Office

Special audits by the Divisional QA Director or Corporate QA Office when a problem is suspected

Laboratory control samples analyzed at a frequency equal to at least 10% of the total number of samples analyzed.

Laboratory performance in these areas will be monitored by Olin.

6.10.2.2 Field Performance Audit

Performance audits of field screening and sampling activities shall be conducted using the contractor's field instrument calibration procedures and QC samples.

Proper measurement accuracy of field screening instruments is verified by daily and periodic instrument calibration procedures. This information is recorded in the field log book and the instrument log book. This information is reviewed by the QA/QC Officer, who audits the calibration accuracy of a field screening instrument and consequent field screening accuracy.

An inspection for suitability of the samples for proper laboratory analysis serves at the performance audit of the sample collection procedures. Volatiles necessitating free air (i.e., a

bubble in an aqueous sample vial), insufficient sample volume for analysis, or improper preservation of samples will be noted by the analytical laboratory. Such reports of unsuitable samples will indicate that the sampling procedures are poor or unacceptable. These analytical results are reviewed by the Project Manager and the QA/QC Officer to assess the performance and adequacy of sample collection procedures.

Proper execution of the field screening and sampling procedures is audited by the Project Manager and the QA/QC Officer who audit these project operations on a regular basis over the life of the project, through review of the field log book and audit forms, and through discussion with the Field Team Leader.

6.10.3 Audit Reports

Should audits be requested by EPA, the corresponding audit reports will be distributed to the following project personnel, as appropriate.

Consultant Project Manager
Consultant Field Team Leader
Laboratory QA/QC Officer

6.11 PREVENTIVE MAINTENANCE

Preventive maintenance is monitored in the laboratory by a system of logbooks kept for each instrument recording appropriate maintenance activities and schedules. Both daily and weekly tasks serve to maintain instrumentation in proper working order. Validation of optimal instrument performance by acceptable calibration and tuning criteria further support satisfactory data quality. Review of these logs and effective internal communications between QA/QC personnel allows for discovery and correction of problems.

6.11.1 Laboratory Maintenance

To minimize downtime and interruption of analytical work, preventive maintenance is routinely performed on each analytical instrument. Designated laboratory personnel are trained in routine maintenance procedures for all major instrumentation. When repairs are necessary, they are performed by either trained staff or trained service engineers employed by the instrument manufacturer. A description of the laboratory's equipment and supplies is provided in Appendix C.

6.11.2 Laboratory System Backup

Katahdin Analytical Services, has detailed SOPs on file that describe preventive maintenance procedures and schedules. The laboratory shall also maintain detailed log books documenting the preventive maintenance and repairs performed on each analytical instrument.

6.12 DATA QUALITY ASSESSMENT

The effectiveness of a QA program is measured by the quality of data generated by the laboratory. Data quality is judged in terms of its PARCC parameters (as defined in Section 6.1). This section describes protocols which will be used to evaluate data quality.

6.12.1 Precision

Precision is the degree to which a measurement is reproducible. Precision is usually stated in terms of standard deviation but other estimates, such as the coefficient of variation (relative standard deviation), range (maximum value minus minimum values), and relative range are common, and may be used pending review of the data.

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; there are more historical data related to individual method performance and the "universe" is not limited to the samples received in the laboratory. In contrast, sampling precision is unique to the project.

Sampling precision will be determined by collecting field replicate samples. Analytical results from laboratory replicate samples will provide data on overall measurement precision. Precision will be determined from replicate samples; it will be expressed as the relative percent difference (%RPD):

$$\%RPD = \frac{X1 - X2}{(X1 + X2)/2} \times 100$$

where X1 and X2 are reported concentrations for each replicate sample and subtracted differences represent absolute values.

Precision objectives for the listed methods are presented in Table 6-2.

6.12.2 Accuracy

Accuracy is a determination of how close the measurement is to the true value. Accuracy will be assessed through use of laboratory control samples, standard reference materials and spiked environmental samples.

Accuracy values can be presented in variety of ways. The average error is one way of presenting this information. However, more commonly accuracy is presented as percent recovery.

Percent recovery will be defined as:

$$\frac{\text{Spiked sample conc.} - \text{sample conc.}}{\text{Spike conc. added}} \times 100$$

QA objectives for accuracy are presented in Table 6-2.

6.12.3 Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Analytical data should represent the sample analyzed regardless of the heterogeneity of the original sample matrix.

6.12.4 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under normal conditions. To be considered complete, the data set must contain all analytical results and data specified for the project. It is important the critical samples are identified and plans made to achieve valid data for them.

The percent completeness for each set of samples will be calculated as follows:

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

The QA objective for completeness for all parameters will be 80 percent.

6.12.5 Comparability

Comparability expresses the confidence with which one data set can be compared to another data set measuring the same property. Comparability is ensured through the use of established and approved analytical methods, consistency in the basis of analysis (wet weight, volume, etc), consistency in reporting units ($\mu\text{g/L}$, mg/L) and analysis of standard reference materials.

6.13 CORRECTIVE ACTION FOR MEASUREMENT SYSTEMS

When a problem situation arises regarding any significant impediment to the progress of the activities detailed in the Work Plan, corrective action will be implemented to identify the problem and its source. Appropriate documentation of this action will be recorded in the project file.

Personnel responsible for the initiation and approval of corrective action will be the laboratory QA officer (for corrective action at the laboratory), and the contractor QA/QC officer (for corrective actions identified during field activities and/or during the data validation effort). RUST E&I's Project Manager and Olin's Project Coordinator will be responsible for approving of corrective action measures.

6.13.1 Laboratory Corrective Action and Response

When the analysis of any sample indicates the system may be out of control, a QC check sample is analyzed. If the analysis of the check sample indicates a problem, the Group Leader is notified and corrective action taken. This corrective action includes, but is not limited to the following:

Removal of the instrument from service

- Isolate the source of the problem
- Correct the problem
- Reanalyze the check sample

The instrument cannot be put back into service until the check sample meets QA specifications. Also, the Group Leader must sign the maintenance log book and enter all the information related to the check sample.

To minimize the chances for an out-of-control situation to occur, the laboratory will be provided feedback on performance evaluations in a timely manner.

6.13.2 Field Measurement Corrective Action and Response

All technical staff shall be responsible for reporting all suspected technical nonconformances by initiating a nonconformance report. All staff shall be responsible for reporting all suspected QA nonconformances by referencing any nonconformance items on the daily log.

6.14 QUALITY ASSURANCE REPORTING PROCEDURES

Presented below are the quality assurance reporting procedures which will be implemented for this project.

6.14.1 Reporting Responsibility and Recordkeeping

Comprehensive records shall be maintained by the Contractor to provide evidence of QA activities. These records shall include the following documentation:

- Results of performance and systems audits
- Data validation summary reports
- Significant QA problems and proposed corrective action
- Changes to this QAPjP

The proper maintenance of QA records is essential to provide support in any evidentiary proceedings. The original QA records will be kept in the program QA/QC officer's records.

Access to working files will be restricted to project personnel. Access to all files containing QA records will be restricted to listed personnel as shown on the limited access form. Upon termination of an individual task or work assignment, working files will be processed for storage as QA.

6.14.2 Monthly Progress and Quality Assurance Reports

Tasks completed to date will be forwarded to the EPA Regional Project Manager as part of the monthly progress report for the Olin Area.

6.15 REFERENCES

US EPA, Office of Emergency and Remedial Response, "Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA," EPA/540-R-93-057, August 1993.

US EPA, Office of Emergency and Remedial Response, "Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan and Data Validation Procedures," EPA/540-G-90-004, April 1990.

US EPA, "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," QAMS-005/80, December 1980.

Administrative Order by Consent for the Hanlin-Allied-Olin Site, Moundsville, West Virginia, Docket No. III-94-29-DC, September 1994.

TABLE 6-1
DATA QUALITY LEVELS
FOR SPECIFIC PROJECT OBJECTIVES
Allied-Hanlin-Olin Site
Moundsville, West Virginia

<i>Project Objective</i>	<i>Objective Approach</i>	<i>Data Collection</i>	<i>Data Category</i>
Characterize nature and extent of potential chemical residuals	Soil and groundwater sampling and analysis	VOCs, SVOCs, inorganics	Definitive
Evaluate remedial alternatives	Soil and groundwater sampling and analysis	VOCs, SVOCs, inorganics	Definitive
Health and Safety	On-site monitoring	Organic, Mercury Vapor and Phosgene Concentration	Screening
Field Measurements	Groundwater sampling	Specific Cond., pH, temperature, turbidity, E _H	Screening

VOCs Volatile Organic Constituents
SVOCs Semi-Volatile Organic Constituents
PCBs Polychlorinated Biphenyls

TABLE 6-2
SUMMARY OF DATA QUALITY OBJECTIVES
Allied-Hanlin-Olin Site
Moundsville, West Virginia

<i>Objective</i>	<i>Data Category</i>	<i>Accuracy¹</i>	<i>Precision²</i>	<i>Completeness</i>
Characterize nature and extent of chemical residuals	Definitive	VOCs, SVOCs, Metals, and Pesticides/PCBs per corresponding Statement of Work (SOW); Nitrate-Nitrogen and Total Organic Carbon per corresponding analytical method	VOCs, SVOCs, Metals, and Pest./PCBs per corresponding SOW; Nitrate-Nitrogen and Total Organic Carbon per corresponding analytical method	80%
Evaluate remedial alternatives	Definitive	VOCs, SVOCs, Metals and Pesticides/PCBs per corresponding SOW; Nitrate-Nitrogen and Total Organic Carbon per corresponding analytical method	VOCs, SVOCs, Metals and Pest./PCBs per corresponding SOW; Nitrate-Nitrogen and Total Organic Carbon per corresponding analytical method	80%
Field measurements	Screening	NA	NA	80%
Health and Safety	Screening	NA	NA	80%

NA Not Applicable

¹ As percent recovery of matrix spike

² Given as relative percent difference of field duplicate

TABLE 6-3
SAMPLE CONTAINERS, PRESERVATIVES AND HOLDING TIMES
GROUNDWATER SAMPLES
Hanlin-Allied-Olin Site
Moundsville, West Virginia

Matrix	Parameters	Container	Preservation	Maximum Holding Times ⁽¹⁾	
				Extraction	Analysis
Water	TCL Volatiles	2 x 40 ml G Septa vial	HCl to pH <2 Ice to 4°C	---	14d
Water	TCL Semivolatiles	2 x 1 L Amber G	Ice to 4°C	7d	40d ⁽²⁾
Water	TCL Pesticides/PCBs	1 x 1 L P	Na ₂ S ₂ O ₃ Ice to 4°C	7d	40d ⁽²⁾
Water	TAL Metals	1 x 1 L P	HNO ₃ pH <2, Ice to 4°C	---	6 mo ⁽³⁾
Water	Cyanide	1 x 500 ml P	NaOH to pH>12 Ice to 4°C	---	14d

⁽¹⁾ From VTSR - Validated Time of Sample Receipt

⁽²⁾ Following Extraction

⁽³⁾ 28 Days for Mercury

d Day

mo Month

HCl Hydrochloric Acid

HNO₃ Nitric Acid

Na₂S₂O₃ Sodium Thiosulfate

NaOH Sodium Hydroxide

TCL Target Compound List

TAL Target Analyte List

G Glass

P Plastic

TABLE 6-4
SAMPLE CONTAINERS, PRESERVATIVES AND HOLDING TIMES
SOIL SAMPLES
Hanlin-Allied-Olin Site
Moundsville, West Virginia

<i>Matrix</i>	<i>Parameters</i>	<i>Container</i>	<i>Preservation</i>	<i>Maximum Holding Times⁽¹⁾</i>	
				<i>Extraction</i>	<i>Analysis</i>
Soil	TCL Volatiles	1 x 8 oz G	Ice to 4°C	---	14d
Soil	TCL Semivolatiles	1 x 8 oz G	Ice to 4°C	10d	40d ⁽²⁾
Soil	TCL Pesticides/PCBs	1 x 8 oz G	Ice to 4°C	10d	40d ⁽²⁾
Soil	TAL Metals	1 x 4 oz G	Ice to 4°C	---	6 mo ⁽³⁾
Soil	Cyanide	1 x 8 oz G	Ice to 4°C	---	14d

(1) From VTSR - Validated Time of Sample Receipt
(2) Following Extraction
(3) 28 Days for Mercury
d Day
mo Month

TCL Target Compound List
TAL Target Analyte List
G Glass
P Plastic

TABLE 6-5
INORGANIC TARGET ANALYTE LIST
(ILM03.0)

Constituent	CRDL Water (mg/L)	CRDL Soils (mg/kg)
Aluminum	0.20	20
Antimony	0.06	6.0
Arsenic	0.01	1.0
Barium	0.20	20
Beryllium	0.005	0.5
Cadmium	0.005	0.5
Calcium	5.0	500.
Chromium	0.010	1.0
Cobalt	0.05	5.0
Copper	0.025	2.5
Iron	0.10	10.
Lead	0.003	0.3
Magnesium	5.0	500.
Manganese	0.015	1.5
Mercury	0.0002	0.02
Nickel	0.04	4.0
Potassium	5.0	500.
Selenium	0.005	0.5
Silver	0.010	1.0
Sodium	5.0	500
Thallium	0.010	1.0
Vanadium	0.050	5.0
Zinc	0.020	2.0
Cyanide	0.010	1.0

CRDL = Contract Required Detection Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard CRDL as a result of sample matrix and compound concentration.

TABLE 6-6
TCL VOLATILE ORGANIC CONSTITUENTS
(3/90 STATEMENT OF WORK)

Constituent	CRQL	CRQL
	Water ($\mu\text{g/L}$)	Soil ($\mu\text{g/kg}$)
Acetone	10	10
Benzene	10	10
Bromodichloromethane	10	10
Bromoform	10	10
Bromomethane	10	10
2-Butanone	10	10
Carbon Disulfide	10	10
Carbon Tetrachloride	10	10
Chlorobenzene or Monochlorobenzene (MCB)	10	10
Chloroethane	10	10
Chloroform	10	10
Chloromethane	10	10
Dibromochloromethane	10	10
1,1-Dichloroethane	10	10
1,2-Dichloroethane	10	10
1,1-Dichloroethene	10	10
1,2-Dichloroethene (total)	10	10
1,2-Dichloropropane	10	10
cis-1,3-Dichloropropene	10	10
trans-1,3-Dichloropropene	10	10
Ethylbenzene	10	10
2-Hexanone	10	10
Methylene Chloride	10	10
4-Methyl-2-pentanone	10	10
Styrene	10	10
1,1,2,2-Tetrachloroethane	10	10
Tetrachloroethene	10	10
1,1,1-Trichloroethane	10	10
1,1,2-Trichloroethane	10	10
Trichloroethene	10	10
Toluene	10	10
Vinyl Chloride	10	10
Xylenes (Total)	10	10

CRQL = Contract Required Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard CRQL as a result of sample matrix and compound concentration.

TABLE 6-7
TCL SEMI-VOLATILE ORGANIC CONSTITUENTS
(3/90 STATEMENT OF WORK)

<u>Constituent</u>	<u>CRQL Water ($\mu\text{g/L}$)</u>	<u>CRQL Soil ($\mu\text{g/kg}$)</u>
Acenaphthene	10	330
Acenaphthylene	10	330
Anthracene	10	330
Benzo(a)anthracene	10	330
Benzo(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330
Benzo(ghi)perylene	10	330
Benzo(a)pyrene	10	330
bis(2-Chloroethoxy)methane	10	330
bis(2-Chloroethyl)ether	10	330
bis(2-Ethylhexyl)phthalate	10	330
4-Bromophenyl phenyl ether	10	1600
Butyl benzyl phthalate	10	330
p-Chloroaniline	10	330
p-Chloro-m-cresol	10	330
2-Chloronaphthalene	10	330
2-Chlorophenol	10	330
4-Chlorophenyl phenyl ether	10	330
Chrysene	10	330
o-Cresol/2-Methylphenol	10	330
p-Cresol/4-Methylphenol	10	330
Di-n-butyl phthalate	10	330
Dibenz(a,h)anthracene	10	330
Dibenzofuran	10	330
o-Dichlorobenzene	10	330
m-Dichlorobenzene	10	330
p-Dichlorobenzene	10	330
3,3-Dichlorobenzidine	10	330
2,4-Dichlorophenol	10	330
D-ethyl phthalate	10	330
2,4-Dimethylphenol	10	330

CRQL = Contract Required Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard CRQL as a result of sample matrix and compound concentration.

TABLE 6-7 (cont.)

Constituent	CRQL Water ($\mu\text{g/L}$)	CRQL Soil ($\mu\text{g/kg}$)
Dimethyl phthalate	10	330
4,6-Dinitro-o-cresol	25	800
2,4-Dinitrophenol	25	800
2,4-Dinitrotoluene	10	330
2,6-Dinitrotoluene	10	330
Di-n-octyl phthalate	10	330
Fluoranthene	10	330
Fluorene	10	330
Hexachlorobenzene	10	330
Hexachlorocyclopentadiene	10	330
Hexachloroethane	10	330
Hexachlorobutadiene	10	330
Indeno(1,2,3-cd)pyrene	10	330
Isophorone	10	330
2-Methylnaphthalene	10	330
Naphthalene	10	330
o-Nitroaniline	25	800
p-Nitroaniline	25	800
Nitrobenzene	10	330
o-Nitrophenol	10	330
p-Nitrophenol	25	800
n-Nitrosodiphenylamine	10	330
n-Nitrosodi-n-propylamine	10	330
2,2'-Oxybis(1-chloropropane)	10	330
Pentachlorophenol	25	800
Phenanthrene	10	330
Phenol	10	330
Pyrene	10	330
1,2,4-Trichlorobenzene	10	330
2,4,5-Trichlorophenol	25	800
2,4,6-Trichlorophenol	10	330

CRQL = Contract Required Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard CRQL as a result of sample matrix and compound concentration.

TABLE 6-8
TCL PESTICIDE/PCBs
(3/90 STATEMENT OF WORK)

<u>Constituent</u>	<u>CRQL</u> <u>Water ($\mu\text{g/L}$)</u>	<u>CRQL</u> <u>Soil ($\mu\text{g/kg}$)</u>
Aldrin	0.05	1.7
alpha-BHC	0.05	1.7
beta-BHC	0.05	1.7
gamma-BHC	0.05	1.7
delta-BHC	0.05	1.7
alpha-Chlordane	0.05	1.7
gamma-Chlordane	0.05	1.7
4,4-DDT	0.10	3.3
4,4-DDE	0.10	3.3
4,4-DDD	0.10	3.3
Dieldrin	0.10	3.3
Endosulfan I	0.05	1.7
Endosulfan II	0.10	3.3
Endosulfan sulfate	0.10	3.3
Endrin	0.10	3.3
Endrin aldehyde	0.10	3.3
Endrin ketone	0.10	3.3
Heptachlor	0.05	1.7
Heptachlor epoxide	0.05	1.7
Methoxychlor	0.50	17
Aroclor 1016	1.0	33
Aroclor 1221	2.0	67
Aroclor 1232	1.0	33
Aroclor 1242	1.0	33
Aroclor 1248	1.0	33
Aroclor 1254	1.0	33
Aroclor 1260	1.0	33
Toxaphene	5.0	170

nd: Not Determined, as noted in Method.

CRQL = Contract Required Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard CRQL as a result of sample matrix and compound concentration.

TABLE 6-9
LIST OF NON TCL CONSTITUENTS
Hanlin-Allied-Olin Site
Moundsville, West Virginia

<i>Semi-Volatile Organic Constituent</i>	<i>Method</i>
Diphenyl	No documented method ⁽¹⁾
Methylcyclohexanone	No documented method ⁽¹⁾
Methylcyclohexylamine	No documented method ⁽¹⁾
Methylene Dianiline (MDA)	No documented method ⁽¹⁾
Monoethanolamine (MEA)	No documented method ⁽¹⁾
Toluenediamine (TDA)	No documented method ⁽¹⁾
2,6-Dinitrophenol	No documented method ⁽¹⁾
Aniline	No 3/90 SOW method ⁽²⁾
o-Toluidine	No 3/90 SOW method ⁽²⁾

- (1) Method validation studies will be conducted, and EPA Region III approval will be obtained prior to initiating sample collection activities.
- (2) SW-846 Method 8270A has been documented for these constituents, and is very similar to the 3/90 GC/MS SOW Method to be used for the TCL SVOCs. However, the 3/90 SOW Method is not a documented method for these constituents. A method validation study will be required to use the 3/90 SOW Method for these constituents.

TABLE 6-10
LABORATORY QUALITY CONTROL SAMPLES
Hanlin-Allied-Olin Site
Moundsville, West Virginia

<i>Parameter</i>	<i>Matrix</i>	<i>Method Blanks</i>	<i>MS/MSD</i>	<i>Surrogate Recovery</i>
TCL Volatiles or subset of	Water/Soil	1 per analytical batch	1 per 20 samples	Per method
TCL Semivolatiles or subset of	Water/Soil	1 per analytical batch	1 per 20 samples	Per method
TAL Metals or subset of	Water/Soil	1 per analytical batch	1 per 20 samples	Per method
Cyanide	Water/Soil	1 per analytical batch	1 per 20 samples	Per method
TCL Pesticides/PCB or subset of	Water/Soil	1 per analytical batch	1 per 20 samples	Per method

NA: Not Applicable

TABLE 6-11
FIELD QUALITY CONTROL SAMPLES
Hanlin-Allied-Olin Site
Moundsville, West Virginia

<i>Parameter</i>	<i>Matrix</i>	<i>Trip Blanks</i>	<i>MS/MSD⁽¹⁾</i>	<i>Equipment Blanks⁽²⁾</i>	<i>Duplicate Samples</i>
TCL Volatiles or subset of	Water/Soil	1 per cooler of VOC samples	1 set/20 samples	1 per 20 samples	1 per 20 samples
TCL Semivolatiles or subset of	Water/Soil	NA	1 set/20 samples	1 per 20 samples	1 per 20 samples
TAL Metals or subset of	Water/Soil	NA	1 set/20 samples	1 per 20 samples	1 per 20 samples
Cyanide	Water/Soil	NA	1 set/20 samples	1 per 20 samples	1 per 20 samples
TCL Pesticides/PCB or subset of	Water/Soil	NA	1 set/20 samples	1 per 20 samples	1 per 20 samples

(1) Field personnel must collect triple volume to account for MS/MSD sample.

(2) No equipment blanks are required for disposable field sampling equipment.

NA: Not Applicable

Section 7.0

AR300176

7.0 HEALTH AND SAFETY PLAN

This section is the Health and Safety Plan (HASP) for the Olin Area of the Hanlin-Allied-Olin Site in Moundsville, West Virginia.

7.1 INTRODUCTION

This site-specific Health and Safety Plan (HASP) describes the procedures to protect on-site personnel involved in field activities associated with investigative and sampling activities. Personnel involved with these activities are required to become familiar with, and conform to, the provisions of this HASP. A HASP review and sign-off sheet is provided in Appendix D for this purpose. The drilling contractor will provide the necessary safety equipment to their personnel and any other safety training that is presented in this HASP, and shall be responsible for safety associated with the operation of their equipment.

RUST E&I shall maintain copies of employee training certificates, medical approval, and fit test records. This documentation will be used to verify that each employee meets the requirements of 29 CFR 1910.120 prior to the start of work.

The purpose of this HASP is to present the project organization and responsibilities; establish standard operating procedures (SOP's) for preventing accidents, injuries, and illnesses; identify hazards; list required Personal Protective Equipment (PPE); identify training requirements; summarized required air monitoring; establish emergency procedures; and list other health and safety requirements.

Compliance with this HASP is required of all personnel who participate in site activities. Assistance in implementing this plan can be obtained from the RUST E&I's Regional Health and Safety Specialist (RHSS) or Corporate Health and Safety Manager (CHSM). Using the HASP Modification Form (Appendix D), the content of this HASP may change or undergo revision based on the actual conditions. Any changes must be approved by the Site Safety Officer (SO) and RHSS.

7.2 ASSIGNMENT OF HASP RESPONSIBILITY

This section describes the health and safety designations and general responsibilities which will be implemented for the investigation. It also lists specific personnel who will be assigned these roles.

- Project Manager - The Project Manager is responsible for the preparation, organization, and review of the project including the HASP. The Project Manager also obtains the necessary site access authorizations, coordinates with appropriate regulatory officials, serves as liaison with the client, coordinates all activities of site personnel, and coordinates preparation of any final reports and supporting documentation.
- Site Safety Officer - The SO reports to the Project Manager and is responsible for implementation of health and safety requirements at the job site. He/she has the authority and responsibility for stopping site work should activities jeopardize the health and safety of workers or the public. Additional responsibilities include selection of personal protective equipment

(PPE), control of entry and exit from the work area, monitoring of workers for adverse effects of hazardous contaminants, inspection of the work site on a periodic basis to assure compliance with the HASP requirements, direction of emergency response activities, and coordination of medical care. The SO will be certified in first aid/CPR and be present during site operations.

- Regional Health and Safety Specialist - The RHSS is responsible for ensuring that the HASP addresses potential hazards in a manner that will adequately protect employees from injury or overexposure to contaminants. The RHSS is the primary technical contact with regard to health and safety issues for the Project Manager.
- Corporate Health and Safety Manager - The CHSM is responsible for the development of company safety policies and standards necessary for field operations and is also responsible for the resolution of significant safety issues which arise during the course of the investigation.
- Employees - Project personnel, including subcontractors, are responsible for the performance of all assigned tasks in a safe manner which complies with the HASP and are responsible for bringing potential hazards or unsafe conditions to the attention of the Project Manager or SO.

<u>Title</u>	<u>Name</u>	<u>Phone</u>
RUST E&I Project Manager	Jeff Jackson	803-234-2281
RUST E&I SO	Jeff Jackson	803-234-2281
	Dale Skoff	412-934-2610
RUST E&I RHSS	Bob Rafferty	518-437-8374
RUST E&I CHSM	Pam Markelz	414-451-2779
RUST E&I Medical Director	Dr. David Barns	800-229-3674

7.3 EMPLOYEE TRAINING AND MEDICAL SURVEILLANCE

The following is a summary of the required employee training and medical surveillance programs.

7.3.1 Training Program

Personnel whose duties include participation in job-related activities on hazardous waste sites must have received a minimum of 40 hours of OSHA 1910.120 health and safety training and a minimum of three days of field experience under the direct supervision of a trained, experienced supervisor. Employees must also have annual 8-hour refresher training.

Prior to arrival on-site, it shall be verified that employees meet the training requirements. Training documentation will be included in project records for each employee. Supervisors, including the SO and Project Manager, will have an additional 8 hours of supervisory training. At least two employees, one of which must be the SO, will have current First Aid/CPR certification. These employees must also be trained on the requirements of the OSHA Bloodborne Pathogen standard.

Site-specific training will be carried out by the site SO prior to site entry. This consists of a review of the hazards of site contaminants, symptoms of overexposure, and an overview of this HASP including access to work zones, decontamination procedures, and emergency information. Also to be included in this site-specific briefing will be the following information:

- Correct use of phosgene indicator tubes and personal monitoring badges (for phosgene);
- The characteristics of phosgene, including the odor and possibility of delayed reactions;
- Contingency Plan in the event of phosgene detection (this Contingency Plan is included in Section 7.10.2.6.3).

Any employee not initially present will be provided a similar briefing at the site by the SO.

7.3.2 Medical Surveillance

RUST E&I personnel and contractors who are required to work in areas where the potential for toxic exposure exists and who may have to wear personal protective clothing and equipment shall have passed a pre-assignment and/or periodic medical examination as required in 29 CFR 1910.120(f).

Additional medical testing may be required by the CHSM in consultation with the company physician if an overexposure or signs and symptoms of exposure occur.

Contractors shall maintain the medical records for their own employees, but shall provide the SO with written documentation certifying that each employee at the site has met the requirements of the Medical Surveillance Program. This documentation will be provided before the first day of work for each employee assigned to the site. The pre-assignment and annual examinations are essentially the same in content and will include:

- An updated medical and occupational history
- A physical examination
- Blood and urine laboratory tests
- Chest x-ray
- Electrocardiogram
- Pulmonary function tests
- Audiometry
- Visual acuity test

7.3.3 Job Exposure Report

A Job Exposure Report Form (Appendix E) will be updated daily by the SO and placed in each employee's file at the end of the project. Job Exposure Reports are reviewed by the RUST E&I RHSS to ensure that any actual exposures are adequately defined to provide appropriate guidance to RUST E&I's Medical Director. The Job Exposure Reports provide documentation of actual and/or suspected job-related exposures. These reports may be reviewed by the RUST E&I Medical Director to evaluate if additional specific tests may be required during employee medical examinations.

7.3.4 Documentation

The contractor will maintain logs and reports sufficient to document the implementation and execution of the health and safety requirements. This documentation shall consist of employee medical surveillance and training files, daily logs, and accident reports.

Medical Surveillance

Confidential medical surveillance files of RUST E&I employees working at the site are maintained by RUST E&I's Medical Director. These files document employee participation in the medical surveillance program and fitness to work on hazardous sites. Access to these files and records is controlled by the RHSS.

Training

Documentation of employee training is maintained in contractor Health and Safety files under the direction of RUST E&I's RHSS. These files document employee attendance, level of training and follow-up or refresher instruction.

Work Logs

Daily work information will be maintained by the SO in a field logbook. The daily log shall contain:

- Date,
- Area(s) or site(s) worked,
- List of employees,
- Personal protective equipment utilized by employees,
- Air monitoring results,
- Waste materials removed from work area(s),
- List of equipment decontaminated,
- Description of special or unusual events or incidents, including all first aid treatments not otherwise reportable.

Accident Reporting

In addition to descriptions in the daily log, any accident and/or chemical exposure incidents will be investigated, analyzed and documented in a Supervisor's Incident Report (Appendix F) submitted to the Project Manager and RHSS. This process is applicable to both RUST E&I and contractors. These reports, prepared by the site SO, contain a full description and analysis of the incident, including all contributing causes and required corrective actions.

7.4 POTENTIAL ENVIRONMENTAL HAZARDS

7.4.1 Potential Soil and Groundwater Organic and Inorganic Compounds

Site history indicates the possibility for exposure to a variety of organic and inorganic compounds. Such compounds in soil and groundwater may pose some health hazards from skin contact, ingestion and inhalation. The following presents a variety of exposure limits applicable to workplace exposures for potential site organic and inorganic compounds that were identified from previous investigations or based on historical process information. The various exposure levels of possible contaminants are shown on Table 7-1.

The American Conference of Governmental Industrial Hygienists (ACGIH 1994-1995) Threshold Limit Values (TLV) are given for each potential compound. The Time-Weighted Average (TLV-TWA) is the time-weighted average concentration for a normal eight hour work day and a 40-hour work week to which nearly all workers may be repeatedly exposed, day after day, without adverse health effects. The Short-Term Exposure Limit (STEL) is the concentration to which workers can be exposed continuously for a short period of time without suffering from 1) irritation, 2) chronic or irreversible tissue damage, or 3) narcosis of sufficient degree to increase the likelihood of accidental injury, impairment of self-rescue or materially reduce work efficiency, and provided that the daily TLV-TWA is not exceeded. The STEL is a 15 minute TWA which should not be exceeded at any time during a workday even if the eight hour TWA is not exceeded. Exposures above the TLV-TWA up to the STEL should not be longer than 15 minutes, should not occur more than four times a day, and there should be at least 60 minutes between exposures in this range.

Also presented is the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL). The PEL values are presented either as an eight hour TWA (PEL-TWA), 15-minute STEL, or Ceiling (PEL-C) limit. The Immediately Dangerous to Life and Health (IDLH) value represents a maximum concentration from which one could escape within 30 minutes without any escape-impairing symptoms or any irreversible health effects.

7.4.2 Phosgene

The use of phosgene at the Olin Area was outlined in an August 4, 1995 letter from Mr. Richard McClure of Olin to Mr. Eugene Wingert of EPA. A copy of this letter is provided as Appendix I to this document.

Phosgene (carbonyl chloride or $\text{Cl}_2\text{C}=\text{O}$) is a colorless, highly toxic gas with a suffocating odor which when diluted with air has an odor reminiscent of moldy hay. Its boiling point at standard pressure is 8.2 degrees Centigrade (46.8 degrees Fahrenheit). Thus, at ambient temperatures above 46.8 degrees Fahrenheit and at normal atmospheric pressure, phosgene liquid would boil off into the gas phase. Its vapor pressure at 20 degrees Centigrade (68 degrees Fahrenheit) is 1215 mm Hg. This extremely high vapor pressure also indicates that phosgene would tend to partition from soil and into the atmosphere. It is slightly soluble in water, which slowly hydrolyzes it (The Merck Index, Eleventh Edition, 1989). It is non-combustible and its threshold limit value (TLV) is 0.1 ppm in air (Hawley's Condensed Chemical Dictionary, Eleventh Edition, 1987). It behaves as an acid chloride; that is, in the presence of water it hydrolyzes to carbon dioxide (CO_2) and hydrogen chloride (HCl ; Organic Chemistry, Morrison and Boyd, 3rd Edition, 1973).

Based on the physicochemical nature of phosgene gas (e.g., its vaporization and hydrolysis), Olin's years of experience in producing phosgene gas at Moundsville and other facilities, and professional judgement, it is believed that no phosgene gas is present in groundwater or soil at the Olin Area. However, as a precaution for health and safety of the investigators who will be doing the field work, during soil boring in the former phosgene area (B33 through B37 and B45), phosgene will be screened in the open boreholes or below ground surface using Draeger or Sensidyne (or equivalent) real-time sampling tubes. The detection limit for the Draeger tubes is 0.02 ppm while for the Sensidyne tubes it is 0.05 ppm. Since OSHA's TLV is 0.1 ppm, this precaution will protect field personnel from potential phosgene gas.

7.4.3 Qualitative Risk Assessment

Inhalation, ingestion, and contact exposure pathways may be associated with project activities. Since many of the potential contaminants are classified as severe skin irritants and known carcinogens, special care must be taken by site personnel to prevent skin contact and/or inhalation during the investigation. Relevant information is contained in the specific toxicity summaries in Appendix G.

In addition to site-specific compounds, personnel involved with well installation and groundwater / soil sampling may be at risk to physical safety hazards associated with drilling operations. During drilling and sampling operations, procedures and protective equipment must be utilized to reduce the possibility of exposure. Environmental monitoring will be conducted during all intrusive activities. (Detailed description in Section 7.7, Environmental Monitoring, of this document.)

Previous site activity has identified snake, tick and spider bites as potential physical hazards. Care should be taken by personnel to avoid areas typically inhabited by these animals (i.e., rock outcrops, high grass, etc.). If work activity does not permit this safeguard, snake proof leggings or boots should be worn. Any snakebite or spider bite should be treated as a medical emergency; therefore, proper medical attention must be provided immediately.

At the end of each day, personnel should conduct self checks for tick bites. If bitten by an infectious tick, Lyme disease may develop. The disease can be treated effectively with antibiotics. Lyme disease can cause fever, rashes and headaches and in later stages, arthritis and heart damage. If you have been bitten by a tick, please notify the RHSS as soon as possible.

Proper use of industrial hygiene and personnel protective equipment accompanied by sound hygiene practices outlined in this health and safety plan will minimize the potential risks at this site. However, failure of equipment or an individual to adhere to guidelines outlined in this document may increase the potential risk.

7.4.4 Heat Stress/Cold Stress

Heat Exposure

When the body temperature rises, the body seeks to dissipate the excess heat. The disorders due to heat stress are heat cramps, heat exhaustion, and heat stroke. Heat cramps are painful spasms which occur in the muscles of workers who sweat profusely in the heat and drink large quantities of water, but fail to replace the body's lost salts and electrolytes.

Heat exhaustion is characterized by extreme weakness or fatigue, dizziness, nausea, and headache. In serious cases, a worker may vomit or lose consciousness. The skin is clammy and moist, complexion pale or flushed, and the body temperature can be normal or slightly higher than normal. **Treatment consists of rest in a cool place and replacement of body water lost by perspiration.** Mild cases may recover spontaneously with this treatment. Severe cases may require care for several days. There are no permanent effects.

Heat stroke is caused by the breakdown of the body's heat regulating mechanism. The skin is very dry and hot with a red or bluish appearance. Unconsciousness, mental confusion, or convulsions may occur. Without quick and adequate treatment, the result can be death or permanent brain damage. Medical assistance should be given quickly. **The person should be moved to a cool place. Body heat should be reduced artificially by soaking the person's clothes with water and fanning them.** The following steps can be taken to reduce heat stress:

- Acclimate the body.
- Change work hours to coincide with the cooler periods of the day.
- Drink more liquids to replace body water lost during sweating.
- Slightly increase the amount of salt on food.
- Wear personal cooling devices.
- Wear supplied air suits or respirators equipped with a vortex tube that cools the air being supplied
- Self-monitor by counting the pulse rate during a 30-second period as early as possible in the rest break. If the heart rate exceeds 110 beats per minute at the beginning of the rest break, shorten the next work cycle by one-third and keep the rest break the same. If the heart rate still exceeds 110 beats per minute at the next rest break, shorten the following work cycle by one-third.

Cold Exposure

The human body is designed to function at a certain internal temperature. When the body temperature falls, the body compensates for the heat loss by increasing its rate of metabolism. Fatal exposures to cold among workers have almost always resulted from exposures involving failure to escape from low environmental air temperatures or from immersion in low temperature water. The single most important aspect of life-threatening hypothermia is the drop in the deep core temperature of the body. The deep core temperature should not fall below 96.8°F. Lower body temperatures will likely result in reduced mental alertness, reduction in rational decision-making capability, loss of consciousness, or death.

Mild to severe pain in the extremities may be the first early warning of cold exposure. During exposure to cold, maximum severe shivering develops when the body core temperature has fallen to 95°F. Useful physical and mental work is limited when severe shivering occurs. Since prolonged cold exposure at temperatures well above freezing can lead to dangerous hypothermia, whole body protection must be provided. **If work activities are performed in temperatures below 40°F, adequate insulating clothing to maintain core temperature must be worn by all workers.** Workers should be aware of the effect of wind chill on exposed skin. The higher the wind speed, the lower the perceived air temperature in the work area.

7.5 GENERAL WORK RULES

The following general operating procedures will be followed by field personnel. These operating procedures are designed to reduce the risks of accidental chemical exposure or injury during field operations.

Personal Precautions

- Be familiar with all standard operating safety procedures and adhere to instructions and requirements in the site-specific HASP.
- Eating, drinking, chewing gum or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in the Exclusion and Contamination Reduction Zones. Olin's tobacco-free policy prohibits the use of any tobacco product anywhere on the site. However, a supply of cold water and disposable cups will be located in the decontamination area such that employees will have access to water with only the removal of gloves, hat, and respirator.
- Contact lenses will not be worn in the Exclusion and Contamination Reduction Zones.
- Hands and face must be thoroughly washed upon leaving the work area. Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.
- No facial hair which interferes with a satisfactory respirator fit of the mask-to-face-seal is allowed on employees required to wear respirators.
- Avoid contact with contaminated or suspected contaminated surfaces. Whenever possible, avoid wading through puddles, pools, mud, etc. Avoid kneeling or sitting on the ground, equipment, or drums.
- Personal articles are prohibited in the Exclusion and Contamination Reduction Zones.
- Medicine and alcohol can increase the effects of exposure to toxic chemicals. Alcoholic beverage intake should be minimized or avoided during off-work hours during field operations. Any illnesses or use of prescription drugs should be reported to the SO.

Operational Requirements

- All employees going on the site will be adequately trained and thoroughly briefed on anticipated hazards, equipment to be worn, safety practices to be followed, emergency procedures, and communications.
- Employees must wear required PPE.
- Personnel on the site will use the buddy system when wearing respiratory protective equipment or working in the Exclusion Zone.

- Visual and/or voice contact will be maintained between paired individuals working at the site. Entry team members will remain close together to assist each other during emergencies.
- Personnel should practice new or unfamiliar operations prior to entering the Exclusion Zone.

Drilling Safety

Drilling safety is the responsibility of each member of the drilling crew. Standard operating safety procedures shall comply with guidelines/recommendations specified in the Drilling Safety Guide (National Drilling Federation), the Manual of Recommended Safe Operating Procedures and Guidelines for Water Well Contractors and Pump Installers (National Water Well Association) or other recognized drilling industry safety guidelines.

7.6 PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment (PPE) will be selected for each task according to 29 CFR 1910 Subpart I, "Personal Protective Equipment." The basic levels of protection will be selected according to the provisions of 29 CFR 1910.120(g)(3) and 29 CFR 1910.120, Appendix H. Specific PPE required for each task during this project are listed below. Protection may be upgraded or downgraded according to actual site conditions, as deemed appropriated by the SO and approved by the RHSS.

7.6.1 Respiratory Protection

Respiratory protection requirements for the project based on air monitoring data and possible contaminants are provided in Table 7-2.

7.6.2 Non-Respiratory PPE

At a minimum, site personnel performing intrusive activities shall wear tyvek protective clothing and neoprene boot coverings. Steel-toed boots will also be required. Chemical resistant gloves must be worn during all intrusive activities, sample handling and decon procedures. If the chemical resistant glove is torn or cut during sampling activities, personnel shall wear a cotton over-glove. If free-product or splash conditions exist, saranex suits and full face splash protection is required. Hearing protection shall be worn within 50 feet of all high noise sources. Hard hat use is mandatory during all drilling activity and when other overhead hazards exist. Items that must be available to all site personnel are listed in Appendix J.

7.7 ENVIRONMENTAL MONITORING

During all intrusive operations, the SO will monitor the breathing zone for VOCs, phosgene and airborne particulates continuously. During all non-intrusive operations at the site, the SO will monitor the breathing zone for VOCs and airborne particulates hourly.

7.7.1 Monitoring for Volatile Organic Constituents and Particulates

VOCs will be monitored using an OVA FID or an approved equivalent, and airborne particulates will be monitored using a mini-ram or approved equivalent. Periodic screening for mercury in the breathing zone will be conducted using a mercury vapor analyzer. If the OVA-FID or approved equivalent detects any concentration above background, periodic screening will be performed with methylene chloride and vinyl chloride detector tubes.

The FID (e.g., Century Systems Model OVA-128) was chosen over the PID (e.g., HNu) due to the greater response factor of the FID to nitrobenzene, a potential site residual.

7.7.2 Monitoring for Phosgene

Phosgene will be monitored continuously through the use of Draeger, Sensidyne (or equivalent) detector tubes and personal monitoring badges. Any positive detection on either the chemical indicator tubes or the badges will require that the Phosgene Contingency Plan be implemented (see Section 7.10.2.6.3).

7.8 WORK ZONES

Site work zones will be established to reduce the spread of hazardous substances by workers or equipment. The flow of personnel and equipment among these zones shall be controlled through designated access points. Control zones will be shown on a site map. The Control Zone map will be posted at the site.

7.8.1 Site Organization and Control

Site organization and control will be established and maintained according to the recommendations set forth in EPA's "Standard Operating Safety Guide," November 1984, and the NIOSH/OSHA/USCG/EPA "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," October 1985. Three general areas of operation will be established to reduce the risk of personnel exposure to hazardous substances. The three areas are:

- Exclusion Zone (Zone A)
- Contamination Reduction Zone (Zone B)
- Support Zone (Zone C)

The dimensions of each area and the safe working distances between each area will be balanced against practical work considerations and existing field conditions.

7.8.2 Exclusion Zone

The Exclusion Zone (Zone A) consists of the known and suspected contaminated areas. All personnel within the area must be dressed out in the prescribed levels of personal protection. A checkpoint will be established at the periphery of the Exclusion Zone to regulate the flow of personnel and equipment in and out of the area. The initial Exclusion Zone boundary (hotline) is based upon

the actual presence of wastes or spilled materials. The boundary will be readjusted based on subsequent observations and air monitoring measurements.

As defined in this health and safety plan, there may be some areas where the use of respiratory protection is not required during normal work activities. However, should a potential hazard become evident, respirators should be immediately available for use. These areas are identified by the following characteristics:

- No known airborne hazards are present and there is little or no potential for release of hazardous airborne contaminants,
- Work operations preclude splashing of hazardous materials.

Hard hats are required in the exclusion zone. Any item taken in the Exclusion Zone shall be considered to be contaminated until decontaminated. All vehicles, equipment, instruments and materials taken into the Exclusion Zone shall remain in the zone until no longer needed.

7.8.3 Contamination Reduction Zone

The Contamination Reduction Zone (Zone B) serves as a buffer between the Exclusion Zone and the Support Zone, and is intended to prevent the spread of contaminants from the Exclusion Zone. All decontamination procedures will be conducted within this area.

The boundary between the Support Zone and Contamination Reduction Zone is the contamination control line. This boundary separates the area of possible contamination from clean areas. Entry into the Contamination Reduction Zone from the Support Zone will be through a controlled access point. Personnel entering this area will wear the required PPE.

7.8.4 Support Zone

The Support Zone (Zone C) consists of a staging area in a non-contaminated or clean area. It contains the command post for field operations, a first aid station, and other elements necessary to support site activities. Normal work clothes and safety shoes are worn in this area. Location of access points and the command post shall be based upon favorable wind direction, topography and site accessibility, when conditions allow.

- Wind direction - Preferably, the command post should be located upwind of the site Exclusion Zone. However, wind direction shift and other conditions may be such that the ideal location based upon wind direction does not exist.
- Topography - The terrain, i.e., woods, water or hills, and available space may limit selection of command post sites.

7.8.5 Modifications to Site Control

The use of the three-area designation with access/exit control points coupled with established decontamination procedures provides reasonable assurance against the translocation of contaminants. This system of control is based on a "worst case" situation.

Less stringent site control and decontamination procedures may be utilized based upon field activities and results of monitoring data. Any modification must be authorized by the contractor RHSS and approved by the SO.

7.8.6 Site Access Control

Personnel and visitors entering the project site must sign and date the project field log upon each entry and exit. In addition, personnel and visitors must read and comply with the provisions of this HASP.

In the event that an individual does not adhere to the provisions of the HASP, he or she will be requested to leave the work area. All non-compliance incidents will be recorded in the project log and retained in project files.

7.9 DECONTAMINATION

Decontamination will be performed under the supervision of the SO. Personnel and portable field equipment decontamination will be carried out in the contamination reduction corridor. When working in the Exclusion Zone, care should be taken to avoid contamination of equipment (particularly instruments) whenever possible. Drill rigs, other heavy equipment and ancillary tools will be cleaned at the decontamination pad at the waste staging area in the former employee parking lot.

For all exit from the Exclusion Zone, decontamination stations shall consist of:

1. Equipment drop
2. Boot, glove and respirator wash
3. Boot, glove, and respirator rinse
4. Protective clothing disposal (into 55-gallon drum or other suitable container)
5. Respirator wash and rinse
6. Hand and face wash and rinse

NOTE: Persons subject to decontamination should shower daily as soon as practical after their work shift.

Monitoring instruments and protective equipment will be decontaminated if the equipment has been in contact with the ground or splashed with contaminated water, mud or other material. Decontamination solution will consist of detergent and water. Rinse solution will be potable water. Decontamination and rinse solutions will be disposed on site under the supervision of the SO and will be stored in a tank at the waste staging area.

Decontamination of drill rigs, vehicles, equipment and ancillary tools and sampling devices will consist of removal of contaminated soil and mud, and steam cleaning. Detailed procedures are in the Field Sampling Plan. Vehicles and equipment will be cleaned as appropriate before relocation to and use at other sampling locations.

7.10 EMERGENCY PROCEDURES

The following summaries are the first-aid procedures to be used at the Olin Area.

7.10.1 First-Aid

First-aid kits will be maintained at the site. If the victim cannot be moved safely from the Exclusion Zone, first-aid necessary to stabilize the victim may be administered at the accident location. Appropriate decontamination of all clothing and equipment should be done after leaving the contaminated area.

7.10.2 Emergency Response

The following summary specifies the emergency response procedures to be followed during the investigation.

7.10.2.1 Pre-Emergency Planning

During the site briefings held periodically, all employees will be informed of the emergency response plan, communication systems, and evacuation routes. The plan will be reviewed and revised, as necessary.

7.10.2.2 Lines of Authority

The SO has *primary responsibility for responding to and correcting emergency situations*. This includes taking appropriate measures to ensure the safety of site personnel and the public, such as evacuation of personnel from the site area. The Project Manager is responsible for ensuring that corrective measures have been implemented, appropriate authorities notified and follow-up reports completed. All project personnel are responsible for assisting the SO in responding to emergency situations within the capabilities of their skills, equipment and training.

7.10.2.3 Emergency Equipment/Facilities

All individuals shall be familiar with the investigation area and be able to identify the locations of the following emergency equipment:

- First-Aid Kit(s)
- Fire Extinguisher(s)
- Eye Wash
- Bloodborne Pathogen Kit(s)
- Telephone
- PPE

7.10.2.4 General Procedures

Any person who becomes ill or injured in the Exclusion Zone must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination will be completed. If the patient's condition is serious, partial or no decontamination will be completed. As a minimum, outer garments will be removed and clean coveralls or a blanket will be used to cover the victim. First-aid should be administered by the SO while awaiting an ambulance or paramedics.

In the event of an injury on-site, including any known or suspected exposure to phosgene all activities will be immediately and safely stopped until proper assistance has been provided to ambulance and/or hospital staff responsible for treating the injury. All injuries and illnesses must be immediately reported to the SO who will then notify appropriate off-site personnel and organizations as necessary. Individuals with known or suspected exposure to phosgene will require medical surveillance for 24-hours, even if the exposure is less than 20 ppm-minutes.

For ambulance, fire or police contacts, give the name of the road and the nearest intersection. Notify the client contact and Project Manager, after the primary emergency contacts have been made. Attending emergency physicians should be given the telephone number of the RUST E&I Medical Director to obtain immediate access to a RUST employee's medical records and for consultation purposes. If necessary, access to non-RUST employee's medical records will be obtained through their respective Medical Directors.

7.10.2.5 Emergency Contact/Notification Listing

FOR ALL EMERGENCY SITUATIONS CALL 911

Directions to Olin Area: Old Allied Site, just north of the golf course on Route 2, go into entrance and make first right to Olin Area.

Secondary Contacts

Olin Corporation - Rick McClure - 615-336-4576
Olin Corporation - Bob Higgins - 304-845-5670
RUST E&I RHSS - Bob Rafferty - 518-437-8374
RUST E&I Project Manager - Jeff Jackson - 803-234-2281
RUST E&I Medical Director - Dr. David Burns - 800-229-3674

Hospital Directions

Exit from the Olin Area and make a left-hand turn onto Route 2, North. Follow for approximately five miles - Reynolds Memorial Hospital is located on the right-hand side.

Reynolds Memorial Hospital
Glendale, West Virginia
304-845-3211

7.10.2.6 Specific Emergencies

7.10.2.6.1 Personal Injury

1. Notify the SO of the incident.
2. If the victim can be moved safely, remove from the contaminated zone to the decontamination zone using established control points.
3. Administer first-aid.
4. Call for ambulance transport, or transport victim to nearest hospital or emergency medical center, as appropriate.

NOTE: The SO shall direct the removal of injured personnel from the contaminated zone and shall approve any necessary deviation from established decontamination procedures. Such deviation shall be based upon the severity or life threatening nature of the injury.

7.10.2.6.2 Chemical Exposure

1. Move the victim from the immediate area of exposure or contamination, taking precautions to prevent additional exposure of other individuals.
2. Notify the SO of the exposure incident.
3. If victim can be moved safely, proceed to the decontamination zone through established control points.
4. Decontaminate clothing or remove if safe to do so.
 - For skin or eye contact, thoroughly wash affected areas with water (eyes should be flushed for at least 15 minutes).
 - For inhalation exposure, ensure that victim has adequate fresh air.
5. Call for ambulance transport, or transport victim to nearest hospital or emergency medical center, as appropriate.

7.10.2.6.3 Contingency Plan for Detection of Phosgene

In the unlikely event that phosgene is detected either on personal dosimeter badges or the detector tubes, the following actions will be taken:

- Stop work activities and evacuate personnel from immediate area.

- Identify any personnel which have suspected or confirmed exposures to phosgene (see Section 7.10.2.4).
- The SO will determine when it is safe to resume work activities.

7.10.2.6.4 Fire or Explosion

1. Immediately evacuate injured personnel and leave the area.
2. Administer first aid as appropriate
3. Notify emergency services.

7.10.3 Evacuation Routes and Procedures

Upon arrival at the site, the SO will determine the appropriate evacuation routes, include them on a posted site map and inform all employees of these routes.

TABLE 7-1
EXPOSURE LEVELS OF POSSIBLE ORGANIC AND INORGANIC COMPOUNDS
Hanlin-Allied-Olin Site
Moundsville, West Virginia

Potential Residual	TLV-TWA	TLV-STEL	PEL-TWA	PEL-STEL	IDLH
Aniline	2 ppm	---	2 ppm	---	100 ppm (Car)
Benzene	10 ppm	---	1 ppm	5 ppm	3000 ppm (Car)
Carbon Tetrachloride	5 ppm	---	2 ppm	---	300 ppm (Car)
Chloroform	10 ppm	---	2 ppm	50 ppm	1000 ppm (Car)
Chromium	0.5mg/m ³	---	0.5mg/m ³	---	---
o-Dichlorobenzene	50 ppm	---	---	---	1000 ppm
m-Dichlorobenzene	---	---	---	---	---
p-Dichlorobenzene	75 ppm	110 ppm	75 ppm	110 ppm	1000 ppm
Dinitrotoluene (traces of Trinitrotoluene)	1.5mg/m ³	---	1.5mg/m ³	---	200mg/m ³ (Car)
Diphenyl/Diphenyl oxide (Dowtherm)	---	---	1mg/m ³	---	300mg/m ³
Ethanolamine	3 ppm	6 ppm	3 ppm	6 ppm	1000 ppm
Formaldehyde	---	---	1 ppm	2 ppm	30 ppm (Car)
Hydrochloric Acid	---	5 ppm	---	5 ppm	100 ppm
Lead	0.15mg/m ³	---	0.05mg/m ³	---	700mg/m ³
Mercury	0.05 mg/m ³	---	0.05mg/m ³	---	28mg/m ³
Methylcyclohexanone	50 ppm	75 ppm	50 ppm	75 ppm	2500 ppm

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TABLE 7-1
EXPOSURE LEVELS OF POSSIBLE ORGANIC AND INORGANIC COMPOUNDS
Hanlin-Allied-Olin Site
Moundsville, West Virginia

Potential Residual	TLV-TWA	TLV-STEL	PEL-TWA	PEL-STEL	IDLH
Methylcyclohexylamine	---	---	---	---	---
Methylene Chloride	50 ppm	---	500 ppm	1000ppm	5000 ppm (Car)
Methylene Dianiline	0.1 ppm	---	---	---	---
Monochlorobenzene	10 ppm	---	75 ppm	---	2900 ppm
Naphthalene	10 ppm	15 ppm	10 ppm	15 ppm	500 ppm
Nitrobenzene	1 ppm	---	1 ppm	---	200 ppm (Car)
Phosgene	0.1 ppm	---	---	---	---
Polychlorinated Biphenyls	0.5 mg/m ³	---	0.5 mg/m ³	---	5 mg/m ³
Toluidines	2 ppm	---	2 ppm	---	100 ppm (Car)
Toluene	50 ppm	150 ppm	100 ppm	150 ppm	2000 ppm
Toluenediamine	---	---	---	---	---
Vinyl Chloride	5 ppm	---	1 ppm	5 ppm	---(Car)

Car - Carcinogen

TABLE 7-2
RESPIRATORY PROTECTION REQUIREMENTS
Hanlin-Allied-Olin Site
Moundsville, West Virginia

Instrument Reading	Respiratory Protection
OVA < 1ppm Mini-Ram <0.2 mg/m ³ Mercury Vapor Analyzer <0.05 mg/m ³ Methylene Chloride Detector tube <50 ppm Phosgene Detector tube <0.02 ppm * or 0.05 ppm ** Vinyl Chloride Detector tube <1 ppm	No Respirator Required
OVA 1-10 ppm	MSA Chin Strap Gas Mask with GMAC cartridge
Mini-Ram 0.2-2 mg/m ³	Apply Dust Suppressant
OVA >10 ppm Mini-Ram >2 mg/m ³ Mercury Vapor Analyzer >0.05 mg/m ³ Methylene Chloride Detector tube >50 ppm Phosgene Detector tubes >0.02 ppm* or >0.05 ppm** Phosgene Personal Monitoring Badges Vinyl Chloride Detector tube >1 ppm	Evacuate the Exclusion Zone. Notify SO and RHSS

* Draeger Tubes

** Sensidyne Tubes

Section 8.0

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8.0 DISPOSAL PLAN

This Disposal Plan outlines the general procedures for appropriately characterizing and managing waste materials generated from environmental investigation activities conducted during the EE/CA investigation.

8.1 OBJECTIVES

The procedures in this manual address the following waste management activities for investigation-derived waste:

- Decontamination
- Containerization
- Staging/Storage
- Characterization
- Disposal.

Waste materials will include purge water from monitoring wells, drill cuttings, decontamination fluids, reusable equipment, and disposable equipment associated with sample collection during the EE/CA investigation.

8.2 DECONTAMINATION AND WASTE STAGING AREAS

Following is a discussion of estimated waste volumes, decontamination and staging areas, and security requirements.

8.2.1 Waste Volumes

The following are waste estimates for Phase 1; waste volumes for Phase 2 will most likely be less and will be handled in a similar manner. The estimated volume of soil waste is 5 to 10 cubic yards, water (decontamination water plus purge water) is 5000 gallons, and disposable equipment is 10 cubic yards. Following is the basis for these values:

Soil Volume

- 50 borings with 6 inch diameter and 10 foot depth
- expansion coefficient of 1.4

Water Volume

(a) purge water

- 40 wells with 4 inch diameter and 20 foot depth (slight over-estimation since some wells will have 2 inch diameters)
- three water columns of purge water before taking sample

- (b) decontamination water
 - one gallon of water per foot of boring

Disposable Equipment

- Tyvek suits will be the majority of disposable equipment waste
- workers will change suits twice per day
- four workers will be working for two months

8.2.2 Decontamination Area

Prior to and between each drilling location, down-hole tools and equipment will be decontaminated by steam cleaning with potable water. At the end of each work-day, personal protection equipment will either be decontaminated or disposed in the waste staging area. A temporary decontamination area will be constructed to collect potentially contaminated water.

The decontamination area will be located south of the former employee parking lot on a nearby rise (Figure 3-1). The location is elevated approximately 10 feet above the staging area. This location allows for gravity flow of decontamination fluids to the staging area on the paved parking lot and minimal piping between the decontamination and staging areas.

The decontamination area will consist of an excavated pit area at least 1 foot deep and approximately 20 feet by 20 feet. The pit will be double-lined with impermeable, puncture resistant liners and will be graded to drain toward the drainage pipe leading to the staging area. A secure seal will be maintained between the drainage pipe and pit liners to ensure containment of decontamination fluids.

8.2.3 Waste Staging Area

Wastes generated during this investigation will be containerized and stored at the waste staging area. This area will consist of three waste storage zones: soil waste, liquid waste, and disposable equipment waste. The waste staging area will be located in a former employee parking lot as shown on Figure 3-1.

The soil waste zone will consist of a single roll off box in which soil generated by boring and soil sampling procedures will be stored. The roll off box will be lined with polyethylene sheeting and covered to prevent soil waste migration and the infiltration of rain water. Allowable fill volume of the roll off box will be approximately 10 cubic yards so as not to exceed the legal hauling capacity.

The liquid waste zone will consist of a single tanker trailer or equivalent container in which purge water and decontamination fluids will be stored. Allowable fill capacity of the container will be at least 5000 gallons.

The disposable equipment waste zone will be comprised of a single roll off box in which primarily disposable personal protection equipment (PPE) used during sampling activities will be stored. The roll off box will be covered to prevent the infiltration of rain water. Other disposable wastes may include used sample containers, decontamination area liners, or other disposable field supplies that

come in contact with contaminated soil or water. Free liquids will be drained off of disposable waste before being placed into the roll off box. Collected liquids will be transferred to the liquid waste tank.

8.2.4 Storage Requirements

Soil and liquid waste material will be managed as hazardous waste until such time as it is determined to be non-hazardous. Prior to receiving analytical results necessary for hazard determination, the following waste storage requirements will be followed:

- Waste storage containers will be labeled or marked with the words "Hazardous Waste" and the accumulation start date (Figure 8-1). This information will be protected against loss due to inclement weather or damage during storage.
- Storage containers will remain closed or covered except when it is necessary to add or remove waste.
- The waste staging area will be inspected at least weekly, looking for leaks and deterioration. Inspections will be documented.
- Upon completion of the field investigation (or if necessary, during the investigations) contaminated equipment, structures, soil, and water will be properly disposed.

8.2.5 Security

Two locked security gates will minimize unauthorized access to the waste staging area. Olin's daily security checks will continue throughout the EE/CA investigation.

8.3 HANDLING OF CONTAMINATED MEDIA

Various waste streams will be generated throughout drilling activities, sample collection, and equipment decontamination. Each of these wastes (drill cuttings, purge water, decontamination water), along with potentially contaminated disposable equipment, will be containerized, sampled, and analyzed to determine appropriate disposal options.

8.3.1 Soil, Water, and Decontamination Fluids

At drilling locations, field containers (e.g., 55 gallon drums) will be half filled with soil or completely filled with purge water. Soil and purge water wastes will be transported back to the waste staging area by truck or equivalent means. Field containers will then be emptied into bulk storage containers using conventional means so that minimal residue remains. Field containers will not be cleaned between drilling locations.

As mentioned, decontamination fluids will be collected in an excavated pit double-lined with impermeable, puncture resistant liners. The pit will be graded to drain toward a drainage pipe leading to the staging area. Decontamination fluids will gravity drain to the tanker trailer container located in the liquid waste zone. A pump will be incorporated in the pipeline, if needed.

8.3.2 Disposable Equipment

Disposable equipment will consist primarily of disposable personal protection equipment (PPE), but may include other disposable field supplies that come in contact with contaminated soil or water. Examples of disposable PPE are Tyvek suits, respirator canisters, plastic eye shields, tape used to seal suits, and chemical resistant gloves and boots. Other disposables may include used field sample or waste containers or decontamination area liners. As mentioned, disposable equipment will be containerized in a single roll off box located in the disposable equipment waste zone.

8.3.3 Reusable Equipment

In general, reusable equipment is defined as any contaminated equipment or instrumentation used in the investigation that can be decontaminated and reused. Examples of reusable equipment include augers, tools, and respirators. Reusable equipment will be decontaminated prior to and between each drilling location to prevent cross contamination of samples.

8.4 WASTE DISPOSAL

Once investigation-derived wastes have been properly containerized and labeled, each of the three bulk storage containers (soil, liquid, disposable equipment) will be sampled to determine if the waste is considered hazardous. After wastes have been properly analyzed and designated as hazardous or non-hazardous, each waste will be properly disposed. A decision matrix for managing investigation-derived wastes is presented in Figure 8-2.

8.4.1 Soil, Water, Decontamination Fluids, and Disposable Equipment

As discussed, investigation-derived soil will be stored in a roll off box, investigation-derived purge water and decontamination fluids will be stored in a tanker trailer, and contaminated disposable equipment will be stored in a roll off box. One representative composite sample will be taken from each bulk storage container at the end of the EE/CA investigation (or if necessary, during the EE/CA investigation) and analyzed to determine the regulatory status of each waste. The composite sample of disposable waste will consist of representative sections cut from the unsorted disposable wastes.

8.4.1.1 Chemical Analysis

Slightly different chemical and physical analyses will be conducted on soil, liquid, and disposable equipment media to determine if the media is hazardous according to 40 CFR Part 261 Subpart C of the Resource Conservation and Recovery Act (RCRA). Table 8-1 details the specific chemical analyses to be conducted on the soil, liquid, and disposable equipment waste samples; all analyses listed in Table 8-1 will be conducted on the three waste samples. This list of analyses was generated based on the history of known chemicals used at the site. Based on the history of operations, investigation-derived wastes are not expected to be reactive, ignitable, or contain pesticides; therefore, samples will not be tested for reactivity or ignitability and Toxicity Characteristic Leaching Process (TCLP) analyses will exclude pesticides.

8.4.1.2 Disposal Options and Decisions

Investigation-derived wastes will be considered hazardous and subject to 40 CFR Part 261 Subtitle C regulation if the waste is determined to be characteristically hazardous as determined by the TCLP or corrosivity (pH) analyses (40 CFR Part 261.2 and 40 CFR Part 261.4, respectively). Before landfilling is considered as a disposal option, wastes will be tested to determine if the waste exceeds extract concentration limits for any Land Disposal Restriction (LDR). If LDR extract concentration limits are exceeded, the waste will be subject to additional treatment standards before landfilling.

8.4.1.2.1 Hazardous Waste Disposal Options

OHM (or another Olin-approved company/facility) will be responsible for handling wastes, although waste disposal may be to another company. Hazardous soil media can be disposed of at a RCRA Subtitle C approved landfill, provided that LDR limits are not exceeded. Possible disposal sites include Chemical Waste Management Landfill Sites located in Niagara Falls, New York and Emelle, Alabama or Michigan Disposal Landfill located in Wayne, Michigan. If LDR limits are exceeded, treatment options include incineration and chemical processing. After proper treatment, these wastes can then be disposed of at a RCRA Subtitle C approved landfill. Hazardous liquid wastes can be disposed of at a hazardous wastewater treatment site.

8.4.1.2.2 Management of Wastes in Accordance with Best Management Practices

Best management practices will be followed when the analytical results indicate that the soil waste, liquid waste, or disposable equipment is not characteristically hazardous. Liquid waste will be disposed of through NPDES permitted Outfall 004 if the liquid waste is determined to be non-hazardous and meets NPDES permit requirements. Non-hazardous soils will be disposed of on-site at a former process area. Disposable equipment will be disposed of in a unit which is operated in accordance with an environmental permit (e.g., RCRA Subtitle D, solid waste).

8.4.2 Pre-transport Requirements

As stated previously, storage containers will be labeled as hazardous until further analysis determines otherwise. Storage containers containing hazardous wastes will be labeled with the following information (in addition to that previously discussed):

- Generator information,
- EPA waste number,
- Proper Department of Transportation (DOT) shipping name with UN or NA number,
- "Federal law prohibits improper disposal. If found, contact the nearest police, public safety authority, or the USEPA".

An approved hazardous waste label is shown in Figure 8-1. Additional labeling and marking requirements for shipping of hazardous wastes are found in 40 CFR 262 Subpart C, and 49 CFR 172.101. These regulations specify that the containers will be marked with appropriate hazard class

labels in addition to those already discussed. Containers to be shipped will be labeled with the appropriate placards.

After analyses have been completed, non-hazardous wastes will be labeled with generator information and a description of the container contents. Figure 8-3 is a copy of an approved non-hazardous waste label.

Containers of waste will be examined for leaks and damage prior to off-site transport. This inspection should include verifying that the container is properly sealed and in good condition. Appropriate corrective action will be taken if leakage is identified.

8.5 RECORDKEEPING

The type of manifest used when shipping wastes off site will depend on the characteristics of the waste and the disposal destination. As stated previously, wastes will be contained in three bulk storage containers (soil, liquid, disposable equipment). If waste is shipped off site for treatment or disposal, it will be accompanied by a properly completed and signed waste manifest will accompany each bulk transport container. A manifest specific to the state to which the waste is being transported for treatment or disposal should be used. If the state to which the waste is being transported does not have a specific manifest, the manifest for the state in which the generator is located (West Virginia) should be used. General hazardous waste manifest requirements are discussed in 40 CFR Part 262 Subpart B. Each container shipped off-site will also contain records specifying the Generator Identification Number (for Olin Corporation). A copy of supporting analytical results, waste manifests, and other information pertinent to the Disposal Plan implementation will be maintained in the project file.

TABLE 8-1 CHEMICAL ANALYSES FOR DISPOSAL OF INVESTIGATION DERIVED WASTES Hanlin-Allied-Olin Site Moundsville, West Virginia			
PURPOSE	ANALYSES	WASTE STREAM	EPA METHOD NO.
Toxicity	TCLP Constituents (excluding pesticides)	All	SW 846-1311
Corrosivity	pH	All	Field Instrument; SW 846-9045
LDR	VOC's	All	SW 846-8240 SW 846-8260
LDR	PCB's	Soil, Disposable Equipment	SW 846-8080
LDR	SVOC's	All	SW 846-8270
LDR	RCRA Metals	All	SW 846-6010 SW 846-7470 SW 846-7471 SW 846-7060 SW 846-7740

LDR - Land Disposal Restrictions
TCLP - Toxicity Characteristic Leaching Process
RCRA - Resource Conservation and Recovery Act

CAD FILE NAME: C:\DWG\89494\9494ND20

HAZARDOUS WASTE

FEDERAL LAW PROHIBITS IMPROPER DISPOSAL.

IF FOUND CONTACT THE NEAREST POLICE
PUBLIC SAFETY AUTHORITY OR THE
U.S. ENVIRONMENTAL PROTECTION AGENCY.

GENERATOR INFORMATION:

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

EPA ID NO. _____ EPA WASTE NO. _____

ACCUMULATION START DATE _____ MANIFEST DOCUMENT NO. _____

[_____]
[_____]
[_____]
D.O.T. PROPER SHIPPING NAME AND UN OR NA NO. WITH PREFIX

HANDLE WITH CARE!

AR300204

RUST ENVIRONMENT &
INFRASTRUCTURE

PROJ. NO.: 32329.000 DATE: 11/94

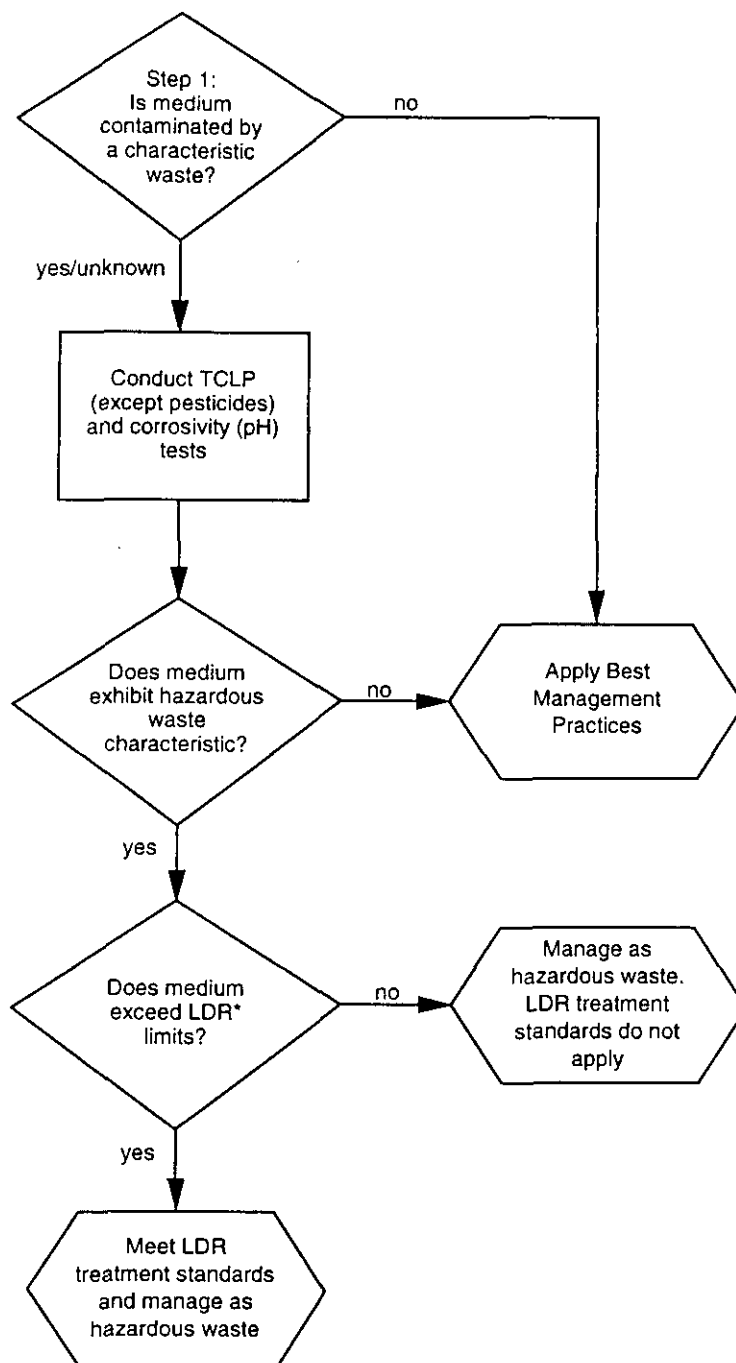
RUST DWG. NUMBER: **FIGURE 8-1**

HAZARDOUS WASTE LABEL

MOUNDSVILLE

HANLIN-ALLIED-OLIN SITE

WEST VIRGINIA



*Refer to Table 8-1 for specific chemical analyses to be conducted on samples

CAD FILE NAME: C:\DWG\89494\9494ND20

NON- HAZARDOUS	WASTE
	OPTIONAL INFORMATION
	SHIPPER _____
	ADDRESS _____
	CITY, STATE, ZIP _____
	CONTENTS _____
NON-HAZARDOUS WASTE	

AR300206

RUST ENVIRONMENT &
INFRASTRUCTURE

NON-HAZARDOUS WASTE LABEL

PROJ. NO.: 32329.000 DATE: 11/94

RUST DWG. NUMBER: **FIGURE 8-3**

HANLIN-ALLIED-OLIN SITE

MOUNDSVILLE

WEST VIRGINIA

Section 9.0

AR300207

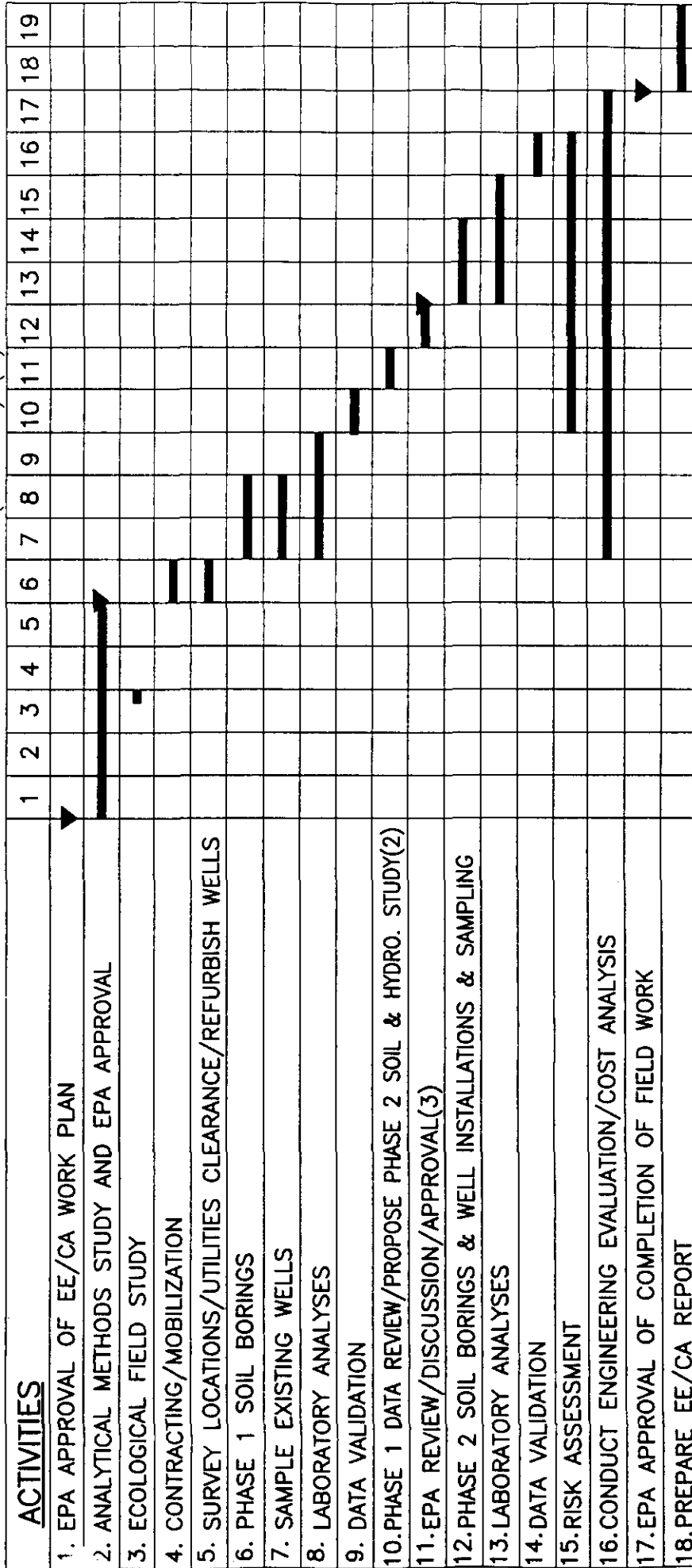
9.0 SCHEDULE

Implementation of the EE/CA Work Plan will begin within 30 calendar days of receipt of written approval of the EE/CA Work Plan by EPA. The estimated schedule for the EE/CA is:

- (1) Six months to perform analytical methods study and obtain EPA approval.
(Assumes standards are available in a timely manner.)
- (2) One week to conduct the ecological field study (concurrent with methods study).
- (3) Within 30 days of EPA approval of the methods study findings, begin to hire, coordinate, and/or mobilize a driller, surveyor, utilities locator, and laboratory (one month to complete).
- (4) Two months to conduct the Phase 1 soil borings and Phase 1 groundwater sampling.
- (5) One month after completion of the Phase 1 soil and groundwater field work to receive laboratory data.
- (6) One month after receipt of Phase 1 analytical data to complete data validation.
- (7) Two months to propose (in a Work Plan addendum), discuss, and get approval from EPA for the Phase 2 soil and hydrogeological studies.
- (8) Two months to conduct Phase 2 soil borings and hydrogeological study (including new well installation and sampling of existing and new wells).
- (9) One month after completion of the Phase 2 soil and hydrogeological field work to receive laboratory data.
- (10) One month after receipt of Phase 2 soil analytical data to complete data validation.
- (11) Risk assessment activities will be initiated following receipt of Phase 1 analytical results.
- (12) Engineering evaluation/cost analysis will begin with Phase 1 field work and continue as data are gathered throughout the project.
- (13) Two months after completion of the activities required by the EE/CA Work Plan (including data validation), submit the EE/CA Report to the EPA.

The proposed schedule is shown on Figure 9-1. Concurrent with field work will be analysis and disposal of the investigation derived wastes. These procedures were specified in the Disposal Plan presented in Section 8.0 of this EE/CA Work Plan.

ESTIMATED TIME FRAME (MONTHS) (1)



1. SCHEDULE IS DEPENDENT ON WEATHER, CONTRACTOR AVAILABILITY, ACCESS, AND ANY DELAYS CAUSED BY FORCE MAJEURE

2. PHASE 2 SOIL AND HYDROGEOLOGICAL STUDY PLAN WILL BE SUBMITTED AS AN EE/CA WORK PLAN ADDENDUM

3. SCHEDULE IS BASED ON EXPEDITIOUS EPA REVIEW AND APPROVAL; DELAYS IN APPROVALS, WHERE REQUIRED, WILL ALTER THE SCHEDULE BY CORRESPONDING AMOUNT OF TIME; EPA APPROVALS ARE INDICATED BY TRIANGLES

RUST ENVIRONMENT & INFRASTRUCTURE

PROJ. NO.: 32329/200 DATE: 12/94

RUST DWG. NUMBER: **FIGURE 9-1**

EE/CA SCHEDULE

HANLIN-ALLIED-OLIN SITE

MOUNDSVILLE

WEST VIRGINIA

AR300209

References

AR300210

REFERENCES

"Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA," EPA/540-R-93-057, August 1993, Washington, D.C.

"Region III Interim Ecological Risk Assessment Guidelines (Draft)," Robert S. Davis, Technical Support Section, Superfund Program Branch, Hazardous Waste Management Division, July 27, 1994, Philadelphia, PA.

"Risk Assessment Guidance for Superfund, Volume II, Environmental Evaluation Manual, Interim Final," EPA/540/1-89-001, March 1989, EPA, Washington, D.C.

"ECO Update," EPA Office of Solid Waste and Emergency Response, Publication 9345.0-051, September 1991, December 1991, March 1992, May 1992, and August 1992, Washington, D.C.

"Natural Resources Law Section, Monograph Series No. 5, Checklists for Preparing National Environmental Policy Act Documents," Owen L. Schmidt, Section of Natural Resources Law, American Bar Association and The National Energy Law & Policy Institute, University of Tulsa College of Law (no date).

"Federal Manual for Identifying and Delineating Jurisdictional Wetlands," Fish and Wildlife Service, EPA, Department of the Army, and Soil Conservation Service, U.S. GPO: 1989-236-985/00336, January 10, 1989, Washington, D.C.

APPENDIX A
ECONOMICALLY AND ENVIRONMENTALLY SENSITIVE AREAS CHECKLIST

AR300213

ENVIRONMENTALLY SENSITIVE AREAS

HABITAT	WINTER	SPRING	SUMMER	FALL
	J F M	A M J	J A S	O N D
Marshes, tidal or fresh				
Swamps, tidal or fresh				
Riverine, tidal or fresh				
Intertidal flats, exposed and/or sheltered				
Sheltered sand/mud flats				
Sheltered vegetated low banks				
Muddy unvegetated substrate, vegetated low bank				
Seagrass area				
Sheltered manmade structure, sheltered rocky shore				
Sheltered scarp in bedrock				
Vegetated steeply sloping bluff				
Reefs, riprap structure, gravel beach				
Mixed sand and gravel beach				
Soft bottom subtidal area				
Fine grained sand beach				
Eroding scarp in unconsolidated sediment				
Exposed eroding bank in unconsolidated sediment				
Wave cut platform in bedrock				
Shelving bedrock shore				
Exposed rocky cliff				
Exposed rocky bank				

A = MOST SENSITIVE; B = SENSITIVE; C = LEAST SENSITIVE

AR300214

ENVIRONMENTALLY SENSITIVE AREAS

MANAGEMENT AREAS	WINTER	SPRING	SUMMER	FALL
	J F M	A M J	J A S	O N D
National/State forest				
National/State conservation area				
Federal/State/Local preserve				
Wildlife refuge				
Federal/State land designated for protection of natural ecosystem				
Proposed wildlife area				
Federal/State sanctuary				
Federal/State wilderness area				
National estuary program area				
Federal/State management act designated area				
Near coastal waters program area				
Clean lakes program critical area				
Federal/State designated scenic or wild river				
Federal/State waterfowl and game management area				
State land				
Private conservation area				

A = MOST SENSITIVE; B = SENSITIVE; C = LEAST SENSITIVE

AR300215

ECONOMICALLY SENSITIVE AREAS

WATER DEPENDENT COMMERCIAL AREAS	WINTER	SPRING	SUMMER	FALL
	J F M	A M J	J A S	O N D
Drinking water intake				
Industrial intake				
Aquaculture				
Marina				
Commercial fishing area				
Shellfish				
Federal/State/Private fish hatchery				
Federal/State irrigation agricultural channel and water project				
Specially designated residential, commercial and industrial area				
Cooling water intake				
Agricultural area				
Locks and dams				
WATER DEPENDENT RECREATIONAL AREAS				
Boating				
Public recreational area				
Sport fishing				
National/State/Local park and beach				
National seashore recreational area				
National lakeshore recreational area				
National river reach designated as recreational				
ANTHROPOLOGICAL AREAS				
Native lands				
Historic landmark				
Archaeological site				
Heritage program site				
Historical site				
Land trust area				
Human use area				

A = MOST SENSITIVE; B = SENSITIVE; C = LEAST SENSITIVE

AR300216

APPENDIX B
EXAMPLE FIELD FORMS

AR300217

Date: 1/1

Circle: Sun Mon Tue Wed Thu Fri Sat

Site: _____ Project No.: _____

Weather: _____

Task/Equipment: _____

Firm/Contractor's Personnel: _____ Hrs On-Site: _____

RUST's Personnel: _____ Hrs On-Site: _____

Site Visitors: _____

Time Log indicating work in progress, remarks:

0600 - 0630 _____

0630 ~ 0700

0700 - 0730

0730 - 0800

0800 - 0830

0830 - 0900

0900 - 0930

0930 - 1000

1000 – 1030 _____

1030 - 1100

1100 - 1130 _____

1130 - 1200

1200 - 1230

1230 – 1300

1300 - 1330 _____

1330 - 1400

1400 - 1430

1430 - 1500

1500 – 1530

1530 - 1600

1600 - 1630

1630 – 1700

1700 - 1730

1730 - 1800

Items requiring follow-up: _____

AR300218

FIELD BORING LOG

WATER LEVEL READINGS

DATE/TIME

WATER
DEPTH

HOLE
DEPTH

CASING
DEPTH

GROUND SURFACE ELEV.:

COORDINATE TYPE:

NORTH:

EAST:

DATE/TIME START:

ABANDONMENT DATE:

DATE/TIME COMPLETE:

ABANDONMENT METHOD:

WELL INSTALLATION DATE:

AR300219

GROUT BATCH RECORD

Site name: _____ Boring LD.: _____ Date: _____
 Inspected by: _____ Contractor: _____
 Equipment (grout mixer, pump, marsh funnel, mud scale, tremie, measuring devices for water, grout, bentonite, etc.) _____

Volume Calculations: $\text{Volume of borehole} = h \times \pi \times r^2_{\text{borehole}}$
 $\text{Volume of annular space} = (h \times \pi \times r^2_{\text{borehole}}) - (h \times \pi \times r^2_{\text{OD of well casing}})$
 h = length of borehole of same diameter; for well casing, this would be the length of the interval to be grouted in feet.
 r = radius of borehole or well casing in feet.
 If borehole has various diameters, volumes for each section should be calculated separately, then all sections should be added together to get a total volume of the borehole or annular space.

Manufacturers _____

Batch No. _____ Installation date/time _____
 _____ lbs. Cement: _____ lbs. Bentonite: _____ gal. water
 _____ gal./batch: _____ gal. cumulative volume.

Viscosity _____: Mud Weight _____

Depth of Bottom of Tremie _____

Batch No. _____ Installation date/time _____
 _____ lbs. Cement: _____ lbs. Bentonite: _____ gal. water
 _____ gal./batch: _____ gal. cumulative volume.

Viscosity _____: Mud Weight _____

Depth of Bottom of Tremie _____

Batch No. _____ Installation date/time _____
 _____ lbs. Cement: _____ lbs. Bentonite: _____ gal. water
 _____ gal./batch: _____ gal. cumulative volume.

Viscosity _____: Mud Weight _____

Depth of Bottom of Tremie _____

AR300220

Form 101

Site: _____ Date: _____
 Inspected By: _____ Project No. _____ Well No. _____
 Driller/Contractor _____

Concrete Diameter

PROTECTIVE CASING Type _____ Vented Yes/No Type _____
 Diameter _____ Locked _____
 Length _____ Key # _____

GUARD POSTS

PVC Stick Up

Protective Casing Length

CAP OR PLUG Vented Yes/No Type _____

Concrete Thickness

*Top of Seal _____ ft.

CONCRETE COLLAR

Seal Thickness

*Top of Filter Pack _____ ft.

SEAL

Filter Pack Thickness

Powder/Granular/Pellets Quantity _____ gal.
 Hydrated _____ gal., Time _____
 Manufacturer _____

Well Length

*Top of Screen _____ ft.

PIPE Type _____ Schedule _____
 O.D. _____" I.D. _____"
 Length/Sec. _____ No. of Sec. _____
 Manufacturer _____

JOINTS Flush Threaded Yes/No _____
 Teflon Taped Yes/No O-Ring Yes/No
 Manufacturer _____

Screen Length

*Bottom of Screen _____ ft.

FILTER PACK Type(s) _____
 Source _____
 Volume _____ gal.
 Manufacturer _____

SCREEN

Type _____ Schedule _____
 Length/Sec. _____ No. of Sec. _____
 O.D. _____" I.D. _____"
 Slot Size _____ No. Slots/ft. _____
 Manufacturers _____

CAP OR PLUG Type _____ Length _____

MATERIAL

*Boring Depth _____ ft.

Borehole Diameter

*Measured From Ground Surface

WATER SOURCE _____

Notes: _____

AR300221

Site: _____ Date: _____
 Inspected By: _____ Project No. _____ Well No. _____
 Driller/Contractor _____

The diagram illustrates a piezometer installation with the following components and measurement points:

- Concrete Diameter**: Indicated at the top of the casing.
- PROTECTIVE CASING**: Includes fields for Type, Diameter, Length, Vented Yes/No, and Key #.
- GUARD POSTS**: Located at the top of the casing.
- CAP OR PLUG**: Includes fields for Vented Yes/No and Type.
- CONCRETE COLLAR**: Includes fields for Cement (lbs. + Water gal.), Total Quantity gal., and Manufacturer.
- UPPER SEAL**: Includes fields for Powder/Granular/Pellets Quantity gal., Hydrated gal., Time, and Manufacturer.
- PIPE**: Includes fields for Type, Schedule, O.D., I.D., Length/Sec., No. of Sec., and Manufacturer.
- GROUT**: Includes fields for Type, Mix (lbs. of +), Water gals., Total Quant. gal., and Manufacturers.
- JOINTS**: Includes fields for Flush Threaded Yes/No, Teflon Taped Yes/No, O-Ring Yes/No, and Manufacturer.
- LOWER SEAL**: Includes fields for Powder/Pellets Quantity gal., Hydrated gal., Time, and Manufacturer.
- SCREEN**: Includes fields for Type, Schedule, Length/Sec., No. of Sec., O.D., I.D., Slot Size, No. Slots/ft., and Manufacturers.
- FILTER PACK**: Includes fields for Type(s), Source, Volume gal., and Manufacturer.
- PLUG OR CAP**: Includes fields for Type and Length.
- MATERIAL**: Located at the bottom of the well.
- Measurements**:
 - Concrete Thickness
 - Seal Thickness
 - Grout Thickness
 - Well Length
 - Seal Thickness
 - Effective Screen Length
 - Screen Length
 - Mater. Thickness
 - *Top of Seal ft.
 - *Top of Grout ft.
 - *Top of Seal ft.
 - *Top of Filter Pack ft.
 - *Top of Screen ft.
 - *Bottom of Screen ft.
 - *Boring Depth ft.
 - *Measured From Ground Surface
 - Borehole Diameter

WATER SOURCE _____

Notes: _____

PROJECT NO. _____ SITE _____

Description Of Site _____
Soil Conditions _____
Weather _____ Temperature _____
Entered On Computer _____ Signature _____ Date _____

Well No. _____

Date: / /

Mon. Tues. Weds. Thurs. Fri.

Site: _____

Weather:

Project No.: _____

Development Method: Pumped ☐ Bailed ☐

Other: _____

Pump Type:

Bailer Type:

Volume Calculation:

$$(D.T.B. - D.T.W. \times \text{vol./ft.} = \text{PVC/well volume}) + (N^* \times H^* \times \text{Annulus vol./ft.}) = \text{Total Well Volume}$$

* (Wells that cannot be purged dry, 10x's the Total Well Volume must be purged)

(Wells that can be purged dry, slowly removing water, without surging until dry)

[illegible]

Comments:

*N = porosity of filter pack

*H = length of filter pack or length of saturated filter pack (water level within screen length)

* = A 30-minute surge and purge before the 10x's the Total Well Volume

Signature: _____

Annulus	vol./ft.	Inside Diameter	vol./ft.
4"	0.42	1"	0.04
6"	1.24	1.25"	0.06
8"	2.38	2"	0.16
10"	3.85	4"	0.65

HNu/PPM	LEL/%	O ₂ /%	H ₂ S/PPM	CO/PPM	

Project No.: _____ Well No. Site: _____

Purging Method: Pumped ☐ Bailed ☐ Other: _____

Pump Type: _____ Bailer Type: _____

Weather Conditions: _____

Volume Calculation: _____

(D.T.B. - D.T.W. x vol./ft. = Gals./well vol.)
(Gals./well vol. x 5 = Total Volume to be removed)

Gals./well vol.: _____

Time	Depth to Water (D.T.W.)	Depth to Bottom (D.T.B.)	Volume Removed (gal.)	pH	Cond.	Temp.	Color	Odor Y/N	Turbidity
		Sample Readings							

Comments: _____

Inside Diameter	vol./ft.
1"	0.04
1.25"	0.06
2"	0.16
4"	0.65

Field Blank Taken ☐ Time: _____

Well Duplicate ☐ No.: _____

Signature: _____

Date: / /

AR300225

HNu/PPM	LEL/%	O2/%	H2S PPM	CO/PPM	

[illegible]

COMMENTS: _____

pH Meter: MFG _____ Model: _____ EPA ID No.: _____

Buffers: 4 Source _____ Date Opened _____

7 Source _____ Date Opened _____

10 Source _____ Date Opened _____

Project Number		Project Name/Client			Analysis Required										Custody Seal #		
Sample Manager: (Signature)															Matrix		
Item No.	Sample Description (Field ID Number)	Date	Time	Grab	Comp.	Lab Sample Number	Tag Number					X-Field Filtered	Preservative Type	X Supp. Hazard Matl.	Sample Type (water, soil, etc.)	Sample Container	
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	
18																	

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Disposed of by: (Signature)	Items:	Date/Time

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Disposed of by: (Signature)	Items:	Date/Time

Send Lab Results To:	Remarks:	Laboratory Receiving Notes:
		Check delivery method: ☐ Samples delivered in person ☐ SEC Donohue courier ☐ Common carrier ☐ Mail
		Custody Seal Intact?
		Temp. of Shipping Container:
		Sample Condition:

APPENDIX C
KATAHDIN ANALYTICAL SERVICES LABORATORY QAPP

AR300228

Quality Assurance Manual

AR300229

Katahdin Analytical Services, Inc.

340 Country Road No. 5
P.O. Box 720
Westbrook, ME 04098
(207) 874-2400

Analytical Laboratory Quality Assurance Manual

TITLE: Katahdin Analytical Services, Inc. Quality Assurance Manual

Prepared By/Date: Wendy Harris/Julie Ricardi February 1996

Approved By/Date:

Wendy Harris 2-27-96
Wendy Harris, QA Officer Date

Julie Ricardi 2/27/96
Julie Ricardi, QA Officer Date

John Burton 2/28/96
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1.0 INTRODUCTION

1.1 Purpose and Scope

This manual details the quality assurance program in effect in the Katahdin Analytical Services, Inc. Laboratory. It is meant to be a teaching tool and source of information for laboratory personnel and clients. The Manual is divided into logical sections, each dealing with a different phase of laboratory operation, yet all sections overlap and function together to form a complete quality assurance program. The Manual is based on Good Laboratory Practices, technical knowledge, industry-accepted standard analytical practices and common sense.

The Manual must be read and understood by all laboratory personnel as part of their training program. The Manual should also be referred to regularly as a source of information. A system of continuous updating is built into the Manual to allow it to change as laboratory conditions change or as new regulations are promulgated. This manual is a controlled document, which means that its identity, development, distribution, and status must be known and traceable at all times. All Katahdin permanent laboratory personnel are assigned a controlled copy. Temporary personnel are expected to read and understand the QA Manual.

Whenever a technician or analyst is in doubt as to proper procedures in a specific circumstance, the Manual should be consulted. Omissions or errors should be immediately reported to the Quality Assurance Officer for corrective action. **IT IS THE RESPONSIBILITY OF EACH LABORATORY WORKER TO ENSURE THAT THE PROVISIONS OF THIS MANUAL ARE FOLLOWED.** Disagreement with specific requirements or knowledge of changes causing deviation from the procedures should be discussed with the immediate supervisor before further work is completed. Laboratory personnel are encouraged to comment on the Manual and make recommendations for more efficient procedures.

The latest revision of each section of the Manual is the applicable rule. Therefore, revisions will be announced to all laboratory personnel. An uncontrolled copy of the Manual is offered to clients and regulatory agencies as the definitive quality assurance program used at Katahdin.

1.2 QA Policy and Objectives of the Program

Katahdin is committed to quality as priority number one. Katahdin's quality assurance policy is based on the definition of quality as conformance to requirements, and further, on the premise that the requirements are governed by Company policies, government regulations and standard operating procedures. This commitment recognizes the need for data to be representative of the environmental conditions under consideration, and for data to be generated within a system of functions that is designed to meet applicable regulatory compliance criteria. To this end, Katahdin has developed a Quality Assurance (QA) Manual and maintains an ongoing QA Program. Our Quality Assurance Program contains provisions for establishing, maintaining and executing protocols which lead to results of known, appropriate and acceptable quality;

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documentation of these activities is an integral part of the QA Program. No other concern will be permitted to interfere with the quality of data Katahdin provides to clients.

This manual describes the set of policies and principles which guide day-to-day operations. Specific protocols are included by reference and are contained in a series of volumes cited in Section 8.0 of this document.

1.3 Quality Assurance Documents

1.3.1 QA Manual

This document describes management policies related to operation of the analytical laboratories. It provides overall guidance regarding acceptable practices and discusses each element of the Quality Assurance Program. It functions as the Project QA Manual where no other Quality Assurance Project Plan, Statement of Work or other contractually mandated project plan has been specified. Adherence to the practices described in this manual is required of all employees. This manual may be revised and/or superseded only with the written authority of the Katahdin General Manager. Copies of this manual are controlled and distribution is administered by the QA Department.

1.3.2 Standard Operating Procedures Manuals

All procedures related to sample collection, storage, preparation, analysis, disposal, data validation, data reporting and employee training and safety shall be contained in written Standard Operating Procedures (SOPs) Manuals. Each SOP shall contain the elements outlined in the current revision of SOP QA-553, Preparation of SOPs. All sections shall be structured in a step-wise manner using numbered sections. All record-keeping requirements shall be described at each step in the SOP. Examples of forms used shall be included as tables or figures and referenced within the text. Preparation of SOPs shall be the responsibility of each department under the guidance of and review by the appropriate Supervisor. SOPs shall be assigned a number from the inventory list for SOPs maintained by the Quality Assurance Department. This number shall become part of the document control number when the SOP is accepted for implementation by Katahdin management. SOPs shall be reviewed and approved by the appropriate Supervisor, Manager (e.g., the Operations Manager for all SOPs related to analytical procedures) and the QA Officer(s), and submitted by the QA Department to the Operations Manager and the General Manager for approval prior to implementation.

1.3.3 Project QA Plans

Project QA Plans shall be implemented as required. These shall include such documents as Quality Assurance Project Plans (QAPPs). For those projects which

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require specific QA/QC criteria, a QAPP which has been approved by a regulatory agency, usually the EPA, is provided to Katahdin by the client. Often the analytical section of a QAPP is written by Katahdin for the client. In this instance the QAPP is reviewed and approved by the Katahdin Quality Assurance Officer, the Katahdin Operations Manager, and/or Field Services Manager as appropriate.

1.3.4 Document Control, Distribution and Revision

In order that this document achieve the goals outlined in Section 1.2, it is necessary that each Katahdin laboratory employee be familiar with the current provisions of this document. It is also necessary that this document represents agreement among Katahdin management and operational personnel as to the quality level desired and the means to that end.

Prior to its publication as a controlled document, this manual must be approved by the Katahdin Quality Assurance Officer(s), Laboratory Operations Manager, and the Katahdin General Manager. To obtain such approval, the document proceeds through an iterative process of review and revision, involving the affected managers and their designated representatives. The signature page at the beginning of the manual represents acceptance.

Each time a revision is made to this manual, it must also be approved. The Quality Assurance Officer(s) must approve each revision. If the revision constitutes a complete rewrite of the document, then review and approval by the Quality Assurance Officer(s), Laboratory Operation Manager, and the General Manager becomes necessary. The appropriate approval process will be decided in each case by the Quality Assurance Officer(s).

1.4 Terms and Definitions

<u>Accuracy:</u>	The closeness of agreement between an observed value and an accepted reference value. When applied to a set of observed values, accuracy will be a combination of a random component and of a common systematic error (or bias) component.
<u>Aliquot:</u>	A measured portion of a sample taken for analysis.
<u>Analyte:</u>	The specific component or constituent that the analytical measurement seeks to determine.
<u>Batch:</u>	A group of samples which are treated similarly with respect to the sampling or the testing procedures being employed and which are processed as a unit. For QC purposes, if the number of samples in a group [first] is greater than 20, then each group [successive] of 20 samples or less will all be handled as a separate batch.
<u>Blank:</u>	See Equipment Rinsate, Method Blank, Trip Blank, Field Blank, Calibration Blank.
<u>Blind Sample:</u>	A sample submitted for analysis whose composition is known to the submitter but unknown to the analyst.
<u>Calibration:</u>	The process of establishing the relationship between instrumental response and known traceable quantities of analytes of interest.
<u>Calibration Blank:</u>	A quality control sample prepared in the same manner as calibration standards with the exception of the addition of the analytes of interest. A calibration blank is used to establish solvent/reagent and system contributions to the analytical result.
<u>Comparability:</u>	Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. Comparable data are produced through the use of standardized procedures and techniques.
<u>Completeness:</u>	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
<u>Continuing Calibration:</u>	The process of analyzing standards periodically to verify the maintenance of calibration of the analytical system.

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<u>Control Chart:</u>	A graphical plot of test results with respect to time or sequence of measurement, together with limits within which they are expected to lie when the system is in a state of statistical control.
<u>Control Limit:</u>	A range within which specified measurement results must fall to signify statistical control. Data that fall within prescribed limits are judged to be generated while the laboratory was in control. Data that fall outside the established control limits are judged to be generated during an "out-of-control" situation. These data are considered suspect and require corrective action including, but not limited to, qualification of the data.
<u>Data Validation:</u>	The internal process of review by which data are shown to be valid as evidenced by the soundness of the analytical system and successful meeting of the DQOs. Refer to QAM-001, Section 8.4.
<u>Dry Weight:</u>	The weight of a sample based on percent solids. The weight after drying in an oven. Refer to Katahdin Analytical Services SOP, QA-5833, Total Solids.
<u>Duplicate Analysis:</u>	A second measurement made on the same sample, sample extract or sample digestate to assist in the evaluation of precision of analysis.
<u>Duplicate Sample:</u>	See Field Duplicate, Matrix Duplicate, and Matrix Spike Duplicate.
<u>Equipment Blank:</u>	A field blank used to verify the effectiveness of equipment decontamination procedures. Laboratory deionized water is passed over sampling equipment after decontamination.
<u>Field Blank:</u>	Samples of analyte-free media (generally water) taken from the laboratory to the field as: 1) distinct aliquots in the same containers used to collect samples with the appropriate preservative reagents added, or, 2) a single reserve to be aliquoted in the field into the appropriate containers with the appropriate preservatives for the parameters of interest. The intent of the field blank is to ascertain and document any contamination attributable to shipping, field handling procedures and potentially to ambient conditions.
<u>Field Duplicate:</u>	Independent samples which are collected as close as possible to the same point in space and time. They are two separate samples taken from the same source, stored in separate containers and analyzed independently. These duplicates are useful in documenting the precision of the sampling process.

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Field Sample: A portion of material received by the laboratory to be analyzed, that is contained in single or multiple containers and identified by a unique field ID number.

Holding Time: The elapsed time expressed in days (except for parameters requiring analysis in ≤ 48 hours) from the date of sample collection by the field personnel until the date of its processing/analysis. Holding time requirements are dictated by the EPA Federal Register 40CFR Part 136, Table II, or other appropriate method references, QAPPs, State regulation, or specific agency programs (i.e. AFCEE, NFESC, etc.).

Homogeneity: The degree to which a property or substance is evenly distributed throughout a material.

Instrument Detection Limit: The statistically derived minimum concentration at which a substance can be measured at the instrument with 99% confidence that the analyte concentration is greater than zero. The instrument detection limit is determined by a minimum of three replicate analyses of a standard solution prepared at the instrument as individually defined by the appropriate SOP.

Initial Calibration: The process of analyzing standards, prepared at specified concentrations, to define the quantitative response, linearity and dynamic range of the instrument to the analytes of interest. Initial calibration is performed whenever the results of a continuing calibration do not conform to the requirements of the method in use or at a frequency specified in the method.

Internal Standards: Analytes, selected as non-targets or in a deuterated state, that are added to all standards and samples at the time of instrumental analysis. Internal standard quantitation takes into account the variability of the instrumental components at the discrete time of standard or sample analysis. The quantitation of the internal standard provides the evaluation of the influence upon the analysis and provides for the application to final sample data.

Lab Control Sample: A control sample whose matrix is of known composition or analyte-free matrix spiked with a known concentration of analytes of interest. Laboratory control samples are handled using the same preparation, reagents, and analytical methods employed for field samples. Laboratory Control Samples are utilized as indicators of the accuracy of the analysis.

LIMS: Laboratory Information Management System

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Lot: A quantity of bulk material of similar composition processed or manufactured at the same time.

Matrix: The component or substrate (e.g. surface water, drinking water) which contains the analyte of interest.

Matrix Duplicate: An intralaboratory split sample which is used to document the precision of a method in a given sample matrix.

Matrix Spike: Aliquot of sample fortified (spiked) with known quantities of specified analytes and processed through the entire procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery.

Matrix Spike Duplicate: Intralaboratory split samples spiked with identical concentrations of target analyte (s). The spiking occurs prior to sample preparation and analysis. They are used to document the precision and bias of a method in a given sample matrix.

Method Blank: An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank should be carried through the complete sample preparation and analytical procedure. The method blank is used to document analyte contribution resulting from the analytical process. Acceptable levels of contamination are defined in individual SOPs and/or by project specific data quality objectives.

Method Detection Limit: The statistically derived minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. Method detection limits are determined using replicate spike samples prepared by the lab and taken through all preparation and analysis steps of the method. The method detection limit is calculated using the appropriate Student's t parameter times the standard deviation of a series of spiked samples.

Performance Audit: A process to evaluate the compliance of actual laboratory practices with relevant project requirements, regulations, contract specifications or internally stated standard operating procedures and practices.

Performance Evaluation: A process to evaluate the proficiency of an analyst or laboratory by evaluation of the results obtained on known test materials.

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- Precision: The agreement among a set of replicate measurements without assumption of knowledge of the true value. Precision is estimated by means of duplicate/replicate analyses. These samples should contain concentrations of analyte above the MDL, and may involve the use of matrix spikes. The most commonly used estimates of precision are the relative standard deviation (RSD) and the relative percent difference (RPD), when only two samples are available.
- Protocol: A stated plan that clearly defines the objectives, methods and procedures for accomplishing a task.
- PQL: Practical Quantitation Limit; a value three to five times the Method Detection Limit.
- QAPP: A Quality Assurance Project Plan or QAPP is a project specific document that describes the policies, organization, objectives, functional activities, and specific QA and QC activities designed to achieve the data quality goals of a specific project.
- Quality Assurance Program: A system of policies and procedures whose purpose is to ensure, confirm and document that the product or service rendered fulfills the requirements of Katahdin and its client. Quality Assurance includes quality planning, quality control, quality assessment (auditing), quality reporting and corrective action.
- Quality Control: A system of checks and corrective measures, integrated with the activities that directly generate the product or service, that serves to monitor and adjust the process to maintain conformance to predetermined requirements.
- Reporting Limit: The level at which method, permit, regulatory and client specific objectives are met. The reporting limit may never be lower than the statistically determined MDL, but may be higher based on any of the above considerations. Reporting limits are corrected for sample amounts, including the dry weight of solids, unless otherwise specified.
- Rounding Rules: If the figure following those to be retained is less than 5, the figure is dropped, and the retained figures are kept unchanged. If the figure following those to be retained is greater than 5, the figure is dropped, and the last retained figure is raised by 1. If the figure followir : figure 5 is

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dropped and the last-place figure retained is increased by one if it is an odd number or it is kept unchanged if an even number. If a series of multiple operations is to be performed (add, subtract, divide, multiply), all figures are carried through the calculations. Then the final answer is rounded to the proper number of significant figures.

Original #	Rounded To
11.443	11.44
11.446	11.45
11.435	11.44
11.425	11.42

Sensitivity: Capability of methodology or instrumentation to discriminate between samples having differing concentrations or containing differing amounts of an analyte.

Split Sample: Aliquots of sample taken from the same container and analyzed independently. In cases where aliquots of samples are impossible to obtain, field duplicate samples should be taken for the matrix duplicate analysis. These are usually taken after mixing or compositing and are used to document intra- or interlaboratory precision.

Standard: A substance or material the properties of which are known with sufficient accuracy to permit its use to evaluate the same property in a sample.

Standard Operating Procedure: A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps that outline expected limits of achievement and will produce consistent performance with repetitive use. This document must be officially approved as the method for performing certain routine or repetitive tasks.

Surrogates: A compound which is similar to the target analyte(s) in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples. When employed, these compounds are added to every field and quality control sample prior to processing or preparation. Surrogate compounds are used to evaluate analytical efficiency by measuring recovery. Surrogates are generally utilized for organic analyses.

Systems Audit: An on-site inspection or assessment of a laboratory's quality system or one of its components.

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- Traceability: The ability to trace the source and accuracy of a material (i.e., standard) to a recognized primary reference source such as the National Institute of Standards and Technology (NIST) or USEPA. Also, the ability to independently reconstruct and review all aspects of the measurement system through available documentation.
- Trip Blank: A sample of analyte-free media taken from the laboratory to the sampling site and returned to the laboratory unopened. A trip blank is used to document contamination attributable to shipping and field handling procedures. This type of blank is useful in documenting contamination of volatile organics samples.
- Verified Time of Sample Receipt: VTSR is the time that the laboratory accepts samples into its custody as documented by Sample Management signature and record of time of receipt on the chain-of-custody accompanying the samples. VTSR includes the inspection and resolution of any inconsistencies or issues regarding sample status, condition, or analytical request. VTSR begins at the time of final resolution
- Warning Limits: The limits (typically 2 standard deviations either side of the mean) within which most analytical results are expected to lie with a 95% probability while the system remains in a state of statistical control.

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TABLE 1-1

ACRONYMS

AA	Atomic Absorption
ACOE	Army Corps of Engineers
AFCEE	Air Force Center for Environmental Excellence
CCB	Continuing Calibration Blank
CCC	Calibration Check Compounds
CCV	Continuing Calibration Verification
CLP	Contract Laboratory Program
CRDL	Contract Required Detection Limit
DQO	Data Quality Objectives
GC	Gas Chromatograph
GCMS	Gas Chromatograph Mass Spectrometer
GFAA	Graphite Furnace Atomic Absorption
GLP	Good Laboratory Practices
ICP	Inductively Coupled Plasma (Spectrophotometer)
ICV	Initial Calibration Verification
IDL	Instrument Detection Limit
LCS	Laboratory Control Sample
LIMS	Laboratory Information Management System
LRS	Linear Range Standard
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NFESC	Naval Facilities Engineering Service Center
NJDEP	New Jersey Department of Environmental Protection
PE	Performance Evaluation
PQL	Practical Quantitation Limit
QA	Quality Assurance
QAM	Quality Assurance Manual
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SD	Sample Duplicate
SOP	Standard Operating Procedure
SPCC	System Performance Check Compound
VTSR	Verified Time of Sample Receipt

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2.0 QA ORGANIZATION AND PERSONNEL

Katahdin Analytical Services, Incorporated is a privately held, full service environmental testing firm. The company consists of analytical services, field sampling and measurement services, accounting, business development, financial management, human resources development, information systems, marketing and quality activities. The organizational structure of the company is provided in Figure 2-1.

It is important for efficient laboratory operation that all laboratory employees understand the operational structure, specific areas of responsibility and lines of authority within the organization. It is equally important for laboratory personnel to understand that the structures of the Quality Organization may be separate from other laboratory operations but that the quality function is totally integrated into every aspect of laboratory operation. All laboratory personnel are responsible for knowing and following proper methods and standard operating procedures; recording quality control information required by those procedures in the proper location; and suspending analyses when quality control criteria are not met.

The laboratory is managed by the General Manager. Customer Service, Laboratory Operations, Field Operations and Quality Assurance Groups report directly to the General Manager.

Under the direction of the laboratory Operations Manager, the technical staff is organized into the following functional laboratory groups:

- Wet Chemistry
- Metals Preparation and Analysis
- Organic Extractions (Sample Preparation)
- GC Analysis
- GC/MS Volatiles and Semivolatiles Analysis

The Customer Service/Sample Management Manager is responsible for the following functional groups:

- Sample Management
- Project Management
- Reporting/Data Management
- Management Information Systems

Each group is led by a Supervisor who is responsible for operations on a daily basis. Environmental chemists, analysts, laboratory technicians and laboratory assistants report to the Supervisors. All field personnel report directly to the Field Services Manager. See Appendix A for resumes of all key personnel employed at Katahdin Analytical Services, Inc.

2.1 Laboratory Organization

It is the individual responsibility of all analysts and technicians to perform their assigned tasks according to the this QA Manual, applicable SOPs, QA Project Plans, Study Protocols, Scope of Work, and Work Plans. This includes responsibility for performing quality control analyses as specified in the method SOP and for entering the QC data in the appropriate logbook, electronic database, or method control file system. The analyst shall report out-of-control results to the Supervisor and will initiate corrective action for out-of-control events.

Supervisors shall assure that analysts and technicians are instructed in the requirements of the Laboratory QA Manual, study-specific QA Project Plans, SOPs, Protocols, and Work Plans for the analytical method or other procedure. Supervisors shall review sample QC data at frequent intervals designed to assure that QC analyses are being performed at the required frequency, that data are documented in the appropriate logbook, electronic database, or method control file system, and that established corrective action procedures for out-of-control situations are followed and the results documented. It is the responsibility of the Supervisor to assure that data have been validated and reported to the Reporting/Data Management Group or Operations Manager as appropriate. Supervisors shall report to the laboratory Operations Manager.

In the absence of the Supervisor, it shall be the responsibility of a designated senior analyst, other department supervisor, or the Operations Manager to carry on his/her duties.

The Operations Manager shall take overall responsibility for technical conduct, evaluation and reporting of all tasks associated with analytical work performed by the laboratory. The Operations Manager assures that approved procedures are documented and followed, that all data are recorded and verified and that all deviations from approved procedures are documented. The Operations Manager shall assure that Supervisors are instructed in the requirements of the Laboratory QA Manual, study-specific QA Project Plans, SOPs, Protocols, and Work Plans. The Operations Manager provides guidance and assistance in the development of laboratory quality control procedures, approves quality control limits for methods, works with Supervisors to bring out-of-control methods back to within established acceptance limits, and assists Supervisors in correcting analytical problems revealed by QA audits. The Operations Manager shall report to the General Manager.

In the absence of the Operations Manager, it shall be the responsibility of his/her designee, who may be a senior technical person, supervisor, Client Services Manager or the General Manager, to carry on his/her duties.

The Quality Assurance Department shall be responsible for conducting systems audits and inspections for compliance with this manual, SOPs and QA Project Plans or other project-specific protocols, maintaining historical files of all QA documents, reviewing QC charts, documenting findings and corrective actions, managing PEs,

maintaining conformance with certification requirements and reporting findings related to all of the above to management. The Quality Assurance Officers shall report directly to the General Manager.

In the absence of the Quality Assurance Officer, it shall be the responsibility of his/her designee, who shall not be involved in the direct production of the work in the area of concern, to carry out his/her duties.

The General Manager shall designate the Operations Manager and is responsible for managing all activities related to laboratory services, including the Quality Assurance Program. The General Manager shall assure that there is a Quality Assurance Department, that personnel and other resources are adequate, that personnel have been informed of their responsibilities, that deficiencies are reported to the appropriate Operations Manager, that corrective actions are taken and documented and that the quality assurance program is effective in accomplishing the underlying goals. Any significant changes to written SOPs shall be authorized in writing by the General Manager.

In the absence of the General Manager, it shall be the responsibility of his/her designee, who shall not be responsible for the direct production of the work in the area of concern, to carry on his/her duties. Such designees may include the Client Services Manager, senior data management personnel, or the Vice President.

2.2 Training and Orientation

Each new permanent employee receives a four part orientation: a human resources orientation, a safety department orientation, a quality assurance department orientation, and a supervisory orientation. The human resources orientation involves matters of immediate personal concern such as benefits, salary, and company policies. The safety department orientation is an in-depth examination of the laboratory Chemical Hygiene Plan and safety program, which are consistent with the requirements of OSHA's Hazard Communication Program (29 CFR 1910.1200). The quality assurance orientation provides the new employee with information on the Katahdin Analytical Services QA program through a brief introduction to the QA manual and SOPs, acceptable recordkeeping practices, and the individual's responsibility with respect to the quality assurance program. The new employee's Supervisor provides the employee with a basic understanding of the role of the laboratory and the basic elements of that individual's position within the laboratory. Temporary employees receive the same orientation as permanent staff with the exception of the human resources orientation. A form documenting the completion of the new employee orientation and date is maintained in the employee's individual training documentation file.

The training of a new employee concentrates on his/her scientific background and work experience to provide the employee with a level of competence so that the individual will be

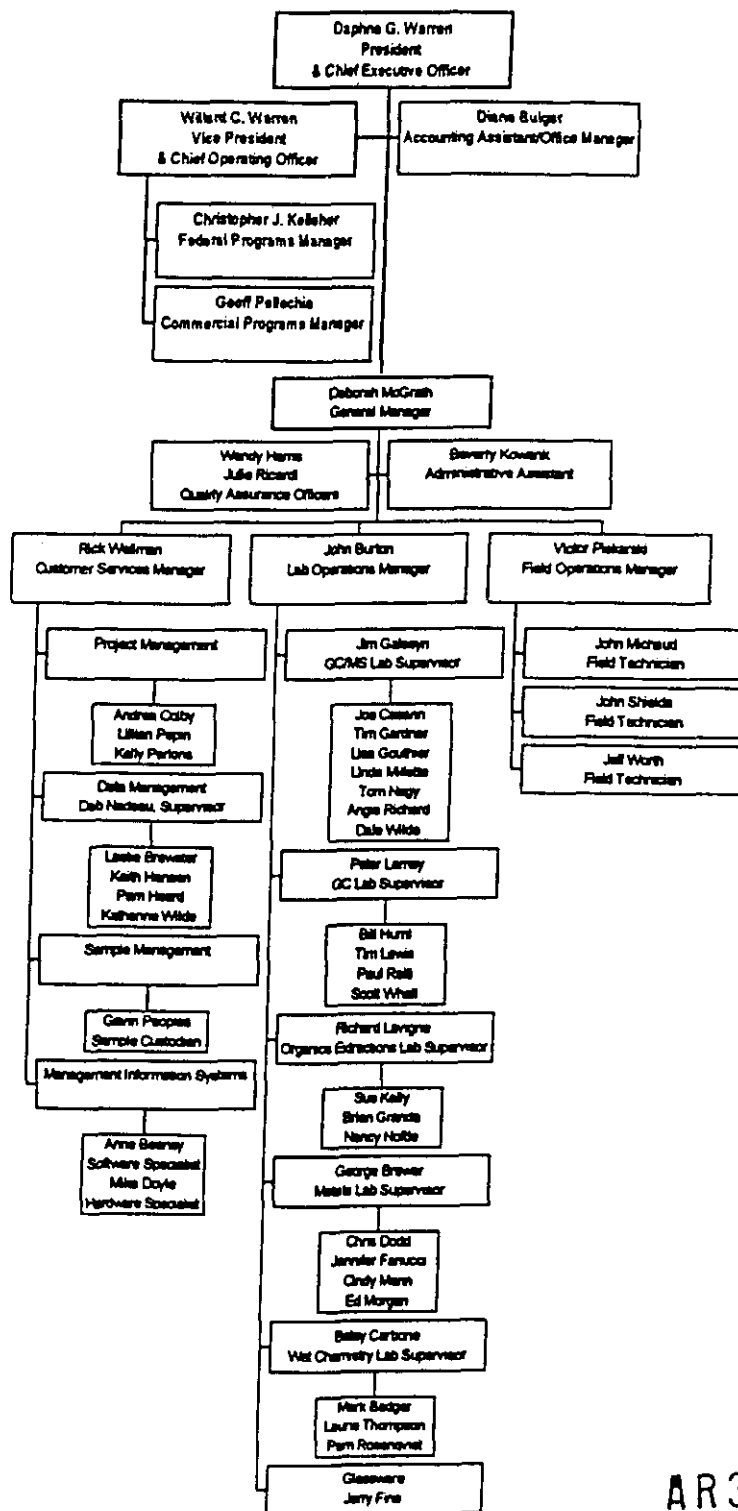
able to function within the defined responsibilities of his/her position as soon as possible. Training techniques utilized may include any of the following:

- on-the-job training
- lectures
- programmed learning
- conferences and seminars
- short courses
- specialized training by instrument manufacturers
- participation in check-sample or proficiency sample programs.

Supervisors shall be responsible for providing documentation of training and proficiency in accordance with Katahdin Analytical Services SOP AD-002, Personnel Training, for each employee under their supervision. The training documentation file indicates what procedures (SOPs) an analyst or technician is capable of performing either independently or with supervision. The files shall also include demonstrated performance of passing QC samples. The Supervisor is responsible for maintaining a training documentation file for each person under their supervision which is updated and current.

Figure 2-1

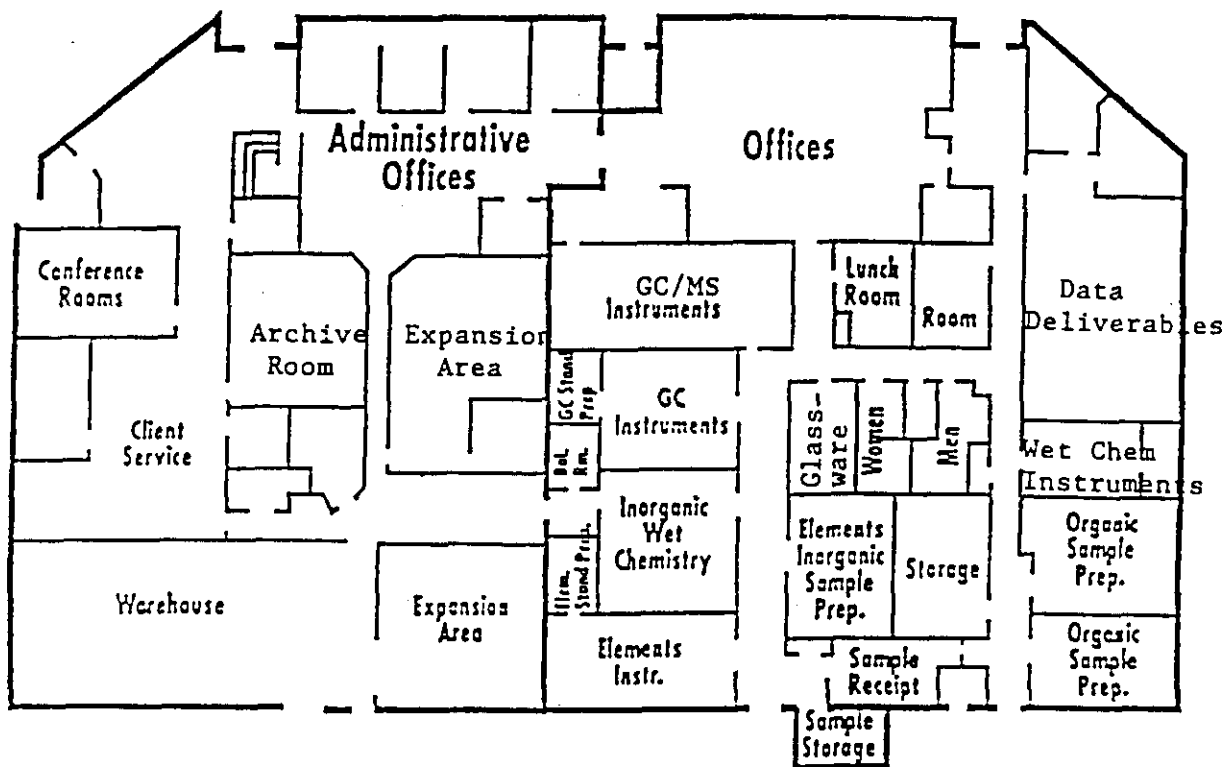
Katahdin Analytical Services, Incorporated
 Organizational Structure



AR300251

Figure 2-2

Katahdin Analytical Services, Incorporated
 Facilities Floor Plan



OFFICE SPACE	3500 square feet	LABORATORY ROOM #4	300 sf
RECORD SPACE	700 sf	Metals Sample Prep	
RECEPTION AREA	300 sf	LABORATORY ROOM #5	450 sf
CONFERENCE ROOM	350 sf	Metals Instrumentation	
LABORATORY ROOM #1	200 sf	LABORATORY ROOM #6	550 sf
Wet Chemistry Instruments		Wet Chemistry	
LABORATORY ROOM #2	350 sf	LABORATORY ROOM #7	480 sf
Organic Extractions		GC Instruments	
LABORATORY ROOM #3	400 sf	LABORATORY ROOM #8	780 sf
Organic Extractions		GC/MS Instruments	
		STORAGE AREA	2000 sf

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APPENDIX A

Katahdin Analytical Services, Incorporated
Resumes For Key Personnel

AR300253

DAPHNE G. WARREN, President and Chief Executive Officer

PRESENT QUALIFICATIONS SUMMARY

As President and Chief Executive Officer of Katahdin Analytical Services, Ms. Warren brings over 18 years of financial and managerial experience to Katahdin, having worked for Maine's largest banks. This expertise allows Ms. Warren to place the emphasis on the analytical processes of the company while maintaining administrative overhead at a minimum. Ms. Warren is responsible for the administrative and financial aspects of the Company which include vendor and client negotiation, cost accounting and payroll, and administrative supervision.

EDUCATION

Liberal Arts, University of Southern Maine, 1975

PROFESSIONAL EXPERIENCE

11/95-Present - President and Chief Executive Officer, Katahdin Analytical Services, Inc., Westbrook, ME

9/94-11/95 - Bank Manager, Atlantic Bank, So. Portland, ME -- Ms. Warren was responsible for the administration of one of Maine's largest bank branches. With a deposit base of over \$ 30 million, Ms. Warren interacted with the institution's largest clients which included both locally-based and international corporate accounts. Ms. Warren also was responsible for the training in the operation of banking sales, client service, and staff.

4/90-9/94 - Branch Manager, Citibank, Falmouth, ME -- Ms. Warren was responsible for the operations of this branch office. Ms. Warren conducted business primarily with small business clients of this \$ 34 million deposit base office. In addition to directing a staff, Ms. Warren also was in charge of consumer lending and sales.

9/89-4/90 - Assistant Bank Manager, Citibank, Falmouth, ME -- Ms. Warren was responsible for sales of deposits with emphasis on lending. She also directed teller activities, both operations and audit.

6/78-8/89 - Consumer Loan Administrator, Sun Savings & Loan Assoc., Portland, ME -- Ms. Warren was responsible for processing and approval of consumer loans, introduction of customer accounts, and client service.

PROFESSIONAL MEMBERSHIPS / COMMUNITY ACTIVITIES

1988-Present -- Board Member, Falmouth-Cumberland, ME Chamber of Commerce
1985-1988 -- Board Member, Greater Portland Council of Governments, Portland, ME
1987-1988 -- Chairperson of Town Council, Cumberland, ME
1983-1988 -- Member of Town Council, Cumberland, ME

updated: 1/96

AR300254

WILLARD C. WARREN, Vice President and Chief Operating Officer

QUALIFICATIONS SUMMARY

As Vice President and Chief Operating Officer, Mr. Warren is primarily responsible for sales & marketing, and technical operations. In this function, Mr. Warren directs the sales force in targeting opportunities, writing technical proposals, and negotiating contracts. Mr. Warren also works with operational personnel to ensure project requirements are understood and expectations are met. Mr. Warren has operated the present day Katahdin laboratory for prior owners for over ten years.

EDUCATION

B.S./Civil Engineering, 1971, Northeastern University, Boston, MA

PROFESSIONAL EXPERIENCE

11/95-Present - Vice President and Chief Operating Officer

11/92-11/95 - Group Vice President, PACE, Incorporated, Minneapolis, MN -- Mr. Warren was responsible for eight laboratory operations of the eighteen PACE Incorporated Divisions. Mr. Warren had overall financial accounting and operational development of his group which generated over \$ 25 million annually. As a Group Vice President, Mr. Warren worked with laboratory General Managers in developing sales and marketing programs, evaluating costs, and implementation of quality assurance standards at each of the laboratories.

1/92-8/94 - President, Northern Division, Coast-to-Coast Analytical Services, Inc., Westbrook, ME -- Mr. Warren was responsible for the management of CCAS's Northern Division with overall responsibility for its laboratory operations, including sales & marketing, quality assurance, and financial performance. Mr. Warren also served as project manager for several large scale Federal Program analytical projects within AFCEE and COE. Through his experience, he developed a working knowledge of Federal and State regulations including those promulgated under the Clean Water Act, SARA, CERCLA and RCRA.

1988-1/92 - Director of Laboratory Services, ABB Environmental Services, Inc., Westbrook, ME -- Mr. Warren had overall responsibility for ABB-ES's Westbrook, ME environmental laboratory. Under his direction, Mr. Warren designed ABB's new laboratory which led to the successful move of ABB's laboratory operations to Westbrook. The new lab layout and emphasis on TQM led to an increase in operational efficiency by over 40% within six months.

1971-1988 - Assistant Division Manager/Project Manager, ABB Environmental Services, Inc., Portland, ME -- Mr. Warren was responsible for several ABB-ES technical departments including the environmental laboratory, civil engineering, wastewater engineering, and special studies. Mr. Warren also managed ABB's technical assistance contract with EPA.

AR300255

WILLARD C. WARREN, Vice President and Chief Operating Officer - Continued

PROFESSIONAL LICENSES

Professional Engineer - Maine

PROFESSIONAL AFFILIATIONS

TAPPI, Chairman, Environmental Division

COMMUNITY ACTIVITIES

Cumberland - North Yarmouth Lions Club - Past Treasurer

updated: 1/96

AR300256

DEBORAH F. MCGRATH, General Manager

PRESENT QUALIFICATIONS SUMMARY

As General Manager, Ms. McGrath is responsible for the overall management of the Laboratory, which includes the oversight and coordination of the Laboratory and Field Operations, Quality Assurance, Administrative and Customer Service departments.

EDUCATION

B.S. Chemistry, Simmons College, Boston, MA 1971

PROFESSIONAL EXPERIENCE

11/95-Present - General Manager, Katahdin Analytical Services, Inc., Westbrook, ME

3/93-11/95 - General Manager, PACE - Maine Laboratory, Westbrook, ME - Ms. McGrath was responsible for the overall management of PACE New England's Westbrook, ME and Hampton, NH locations, which included the oversight and coordination of Laboratory and Field Operations, Quality Assurance, Support Systems, Administrative, and Sales/Marketing departments.

1989-3/93 - Vice President and Division Manager, NET Inc., Cambridge Division, in Bedford, MA (formerly Cambridge Analytical Associates, Inc.) -- from 1989-1993 where her responsibilities included oversight of the technical operations and business development of the division. She was Vice President of Environmental Services for one year and Director of Analytical Services for two while employed by Cambridge Analytical Associates, Inc. from 1986-1989.

1981-1986 - Manager of the Laboratory Analysis Department and Inorganics Section, GCA Technology Division, Bedford, MA

1971-1981 - Analytical Chemist, Kennecott Copper Ledgemont Laboratory, Lexington, MA

PUBLICATIONS

Ms. McGrath is the author/co-author of over 15 publications on methods development and comparison studies, waste oil and biota analysis, combustion assessments and waste minimization.

updated: 1/96

AR300257

JULIE A. RICARDI, Quality Assurance Officer

PRESENT QUALIFICATIONS SUMMARY

As Quality Assurance Officer, Ms. Ricardi is responsible for direction of the laboratory quality assurance program. Primary responsibilities include development and ongoing evaluation of the laboratory quality assurance/quality control (QA/QC) procedures, review of quality control data, and performing internal audits to assess conformance to the laboratory quality assurance program. Additional responsibilities include development and improvement of chemical analytical methods, review and implementation of standard operating procedures (SOPs), maintaining laboratory certification programs, overseeing laboratory performance evaluation analyses, and reviewing and revising as necessary the Laboratory Quality Assurance Manual.

Ms. Ricardi is responsible for maintenance of certifications, accreditations and participation in laboratory approval programs. Katahdin Analytical Services, Inc., currently maintains laboratory certifications in Maine, New Hampshire, Massachusetts, New York, Connecticut, Maryland, New Jersey and Rhode Island and is accredited by the American Association For Laboratory Accreditation. Katahdin Analytical Services also maintains approvals by a number of Federal agencies to perform analytical services in support of government installation site assessments and cleanup activities. Present approvals include the U.S. Air Force Center for Environmental Excellence, U.S. Army Corps of Engineers, and U.S. Department of Energy's Hazardous Waste Remedial Actions Program (HAZWRAP).

EDUCATION

B.S./Chemical Engineering, 1983, Louisiana State University, Baton Rouge, LA

PROFESSIONAL EXPERIENCE

11/95-Present - Quality Assurance Officer, Katahdin Analytical Services, Inc., Westbrook, ME

8/94-11/95 - Quality Assurance Coordinator, PACE - Maine Laboratory, Westbrook, ME -- Ms. Ricardi was responsible for the direction of the laboratory quality assurance program. Additional responsibilities included review and implementation of standard operating procedures, maintaining laboratory certifications and overseeing performance evaluation analyses.

2/89-8/94 - Quality Assurance Coordinator, Coast-to-Coast Analytical Services, Inc., Westbrook, ME -- Ms. Ricardi was responsible for the direction of the laboratory quality assurance program. Additional responsibilities included review and implementation of standard operating procedures, maintaining laboratory certifications and overseeing performance evaluation analyses.

8/87-2/89 - Consultant, Enseco, Inc., Arvada, CO -- Ms. Ricardi was contracted for two months to develop and write a training manual for gas chromatography/mass spectrometry (GC/MS) chemists. A "hands-on" training program was developed which utilized computer interaction to simulate actual sample analysis, data reduction and interpretation, and quality control requirements for a variety of standard environmental GC/MS analyses. She also wrote the Standard Operating Procedure (SOP) for semivolatiles sample preparation and analysis by GC/MS.

AR300258

JULIE A. RICARDI, Quality Assurance Officer – Continued

9/85-8/87 - GC/MS Chemist, Enseco, Inc., Arvada, CO – Ms. Ricardi was responsible for daily operation and maintenance of Finnigan GC/MS systems to perform chemical analysis for volatile and semivolatile organic compounds. She also provided training support for less experienced analysts and was responsible for scheduling analyses for all semivolatiles work. She worked in this capacity for three years.

2/85-9/85 - Laboratory Technician, Enseco, Inc., Arvada, CO – Prior to GC/MS analysis, Ms. Ricardi worked for six months as a laboratory technician in the area of sample preparation for GC and GC/MS analyses. She was responsible for water, soil, and sludge sample preparation utilizing a variety of extraction, concentration and clean-up techniques to recover organic compounds for analysis by GC and GC/MS.

7/83-12/84 - Technical Representative, E. I. DuPont de Nemours, Denver, CO – Ms. Ricardi was responsible for customer relations, technical support, and sales and marketing of medical x-ray film, chemicals and equipment. Daily duties included process and equipment troubleshooting, establishing and monitoring quality control programs, and time and budget management. Ms. Ricardi held this position from September 1983 through November 1984.

updated: 1/96

AR300259

WENDY ELCOME HARRIS, Quality Assurance Officer

PRESENT QUALIFICATIONS SUMMARY

As Quality Assurance Officer, Ms. Harris is responsible for direction of the laboratory quality assurance program. Primary responsibilities include development and ongoing evaluation of the laboratory quality assurance/quality control (QA/QC) procedures, review of quality control data, and performing internal audits to assess conformance to the laboratory quality assurance program. Additional responsibilities include development and improvement of chemical analytical methods, review and implementation of standard operating procedures (SOPs), maintaining laboratory certification programs, overseeing laboratory performance evaluation analyses, and reviewing and revising as necessary the Laboratory Quality Assurance Manual.

She is also responsible for maintaining laboratory certifications and related activities and for administrative tasks such as maintenance of permanent record storage, report archiving and retrieval. She performs other duties such as QAP preparation.

EDUCATION

B.A. cum laude, Zoology, University of New Hampshire, 1974

PROFESSIONAL EXPERIENCE

11/95-Present - Quality Assurance Officer, Katahdin Analytical Services, Inc. , Westbrook, ME

3/95-11/95 - Quality Assurance Officer, PACE - New Hampshire Laboratory, Hampton, NH -- Ms. Harris was responsible for the direction of the laboratory quality assurance program. Primary responsibilities included development and ongoing evaluation of the laboratory quality assurance/quality control (QA/QC) procedures, review of quality control data, and performing internal audits to assess conformance to the laboratory quality assurance program. Additional responsibilities included development and improvement of chemical analytical methods, review and implementation of standard operating procedures (SOPs), maintaining laboratory certification programs, overseeing laboratory performance evaluation analyses, and reviewing and revising as necessary the Laboratory Quality Assurance Manual.

6/92-3/95 - Quality Assurance Auditor, PACE - New Hampshire Laboratory, Hampton, NH -- Ms. Harris was responsible for performing systems, SOP, and data audits; and preparing and distributing the resulting reports to management and laboratory personnel. She was responsible for helping to maintain laboratory certifications and related activities and also for administrative tasks such as SOP preparation, maintenance of permanent record storage, report archiving and retrieval. She performed other duties such as QAP preparation as assigned by the QA officer.

4/90-6/92 - Quality Assurance Auditor, Resource Analysts, Inc., Hampton, NH -- Ms. Harris was responsible for performing systems, SOP, and data audits; and preparing and distributing the resulting reports to management and laboratory personnel. She was responsible for helping to maintain laboratory certifications and related activities and also for administrative tasks such as SOP preparation, maintenance of permanent record storage, report archiving and retrieval. She performed other duties such as QAP preparation as assigned by the QA officer.

AR300260

WENDY ELCOME HARRIS, Quality Assurance Officer - Continued

9/74-11/86 - Normandeau Associates, Inc., Bedford, NH – During a 12 year tenure at Normandeau Associates, her responsibilities included those of a biological field and laboratory technician, toxicologist and project coordinator for a range of environmental impact assessment studies.

CONTINUING EDUCATION

LOTUS 1,2,3 - Intro. and Intermediate, Millipore Corp., Bedford, MA, 1991

Word Perfect 5.0 - Intro. and Intermediate, OMC, Portsmouth NH, 1992

updated: 1/96

AR300261

RICHARD L. WELLMAN, Customer Services Manager

PRESENT QUALIFICATIONS SUMMARY

As Customer Services Manager, Mr. Wellman is responsible for overseeing the management of Project Management, Reporting Department, Sample Management and Management Information Systems.

EDUCATION

M.B.A., Business Administration, Boston University, Boston, MA, 1987

B.S., Chemistry, Union College, 1975

PROFESSIONAL EXPERIENCE

11/95-Present - Customer Services Manager, Katahdin Analytical Services, Inc., Hampton, NH

6/92-11/95 - Laboratory Operations Manager, PACE - New Hampshire Laboratory, Hampton, NH – Mr. Wellman was responsible for the management of both inorganics and organics laboratory groups providing wet chemistry, metals prep, metals, pesticide/PCB, volatiles and semivolatiles analysis. He reported to Deborah McGrath, General Manager.

1991-6/92 - Manager, Metals Labs, Reporting/Data Review and Data Services Departments, Resource Analysts, Inc., Hampton, NH

1988-1991 - GC Lab Director, Resource Analysts, Inc., Hampton, NH

Mr. Wellman has extensive experience in the analytical chemistry field as a Consultant and Chemist. Mr. Wellman has over thirteen years of experience in Gas Chromatography, High Pressure Liquid Chromatography, Infrared Spectrophotometry, UV-VIS Spectrophotometry, GPC, and NMR.

Summer 1986 - Consultant, Medical & Scientific Enterprises, Sudbury, MA

Summer 1986 - Consultant, Acadia Management, Boston, MA

1984-1985 - Systems Specialist, DuPont/NEN Products, Boston, MA

1978-1984 - Group Leader Analytical Chemistry, DuPont/NEN Products, Boston, MA

CONTINUING EDUCATION

"Environmental Data Requirements," conference, April 25, 1989

"HP RTE System Managers Course," May 22-26, 1989

"Newest Analytical Methods and Techniques," Hewlett Packard Video Teleconference, April 19, 1990

updated: 1/96

AR300262

ANDREA COLBY, Project Manager

PRESENT QUALIFICATIONS SUMMARY

As Project Manager, Ms. Colby is responsible for managing analytical projects from initiation to completion. Ms. Colby is the point of contact for client projects, priorities, preliminary data, bottle orders and price quotes for commercial work and work by special protocol such as CLP. Negotiates project specifications with clients, insures specifications are met by the lab and delivered to the client in the required time frame. Maintains communications channels with the Sales Department and the Laboratory Staff.

EDUCATION

B.A. Biology, 1987, University of California, Santa Cruz

PROFESSIONAL EXPERIENCE

11/95-Present - Project Manager, Katahdin Analytical Services, Inc. , Westbrook, ME

8/94-11/95 - GC/MS Chemist, PACE - Maine Laboratory, Westbrook, ME

1/92-8/94 - Elements Group Chemist, Coast-to-Coast Analytical Services, Inc., Westbrook, ME

1991-1/92 - Elements Group Chemist, ABB, Westbrook, ME

1988-1991 - Wet Chemistry Laboratory Associate Chemist, ABB, Westbrook, ME

1987-1988 - Extractions Laboratory Assistant, E.C. Jordan, Westbrook, ME

EXPERIENCE

Analysis of Landfill, Confidential Client, Winthrop, ME - Ms. Colby was involved in the digestion and elemental analyses of soils, groundwater, lake water and lake sediments sampled on a quarterly and annual basis from this unremediated waste site.

Ash and Sludge Testing - Ms. Colby performed elemental analyses for routine monitoring at municipal and industrial landfills in Maine.

Baseline Study, Proposed Mining Site, ME - Ms. Colby performed two level elemental analyses using furnace atomic absorption for samples from a pristine watershed.

Hazardous Waste Remedial Action Program (HAZWRAP), Confidential Client - Ms. Colby performed elemental analyses following CLP protocol for two out-of-state projects.

Surface, Groundwater and Ash Monitoring, Pulp and Paper Client, ME - Ms. Colby performed elemental analyses by graphite furnace and ICP techniques.

AR300263

ANDREA COLBY, Project Manager – Continued

State Priorities List Site, Rhode Island, MA - In support of a remedial investigation, Ms. Colby performed elemental analyses in compliance with client and MADEP reporting requirements.

Remediation Project, Maine Engineering Firm - Ms. Colby performed elemental analyses on samples from an ongoing remediation project.

CLP Deliverable Projects, Maine Engineering Firm - Ms. Colby performed elemental analyses following CLP protocol. One of these projects was a phase II site investigation.

updated: 1/96

AR300264

LILLIAN PEPIN, Project Manager

PRESENT QUALIFICATIONS SUMMARY

As Project Manager, Ms. Pepin is responsible for managing analytical projects from initiation to completion. Ms. Pepin is the point of contact for client projects, priorities, preliminary data, bottle orders and price quotes for commercial work and work by special protocol such as CLP. Negotiates project specifications with clients, insures specifications are met by the lab and delivered to the client in the required time frame. Maintains communications channels with the Sales Department and the Laboratory Staff.

EDUCATION

Data Processing Certificate, Hesser College, Portsmouth, NH, 1989
Nursing Assistant Certificate, State of NH 1985

PROFESSIONAL EXPERIENCE

11/95-Present - Project Manager, Katahdin Analytical Services, Inc. , Westbrook, ME

6/92-11/95 - Project Manager, PACE - New Hampshire Laboratory, Hampton, NH – Ms. Pepin was responsible for project management from initiation to completion. Ms. Pepin was the point of client contact for projects, priorities, preliminary data, bottle orders and price quotes for commercial work and work by special protocol such as CLP. Ms. Pepin also served as liaison for PACE Network projects in which PACE, Inc. New England - New Hampshire Lab was involved.

8/90-6/92 - Sample Management Custodian, Resource Analysts, Inc., Hampton, NH – Ms. Pepin worked in Sample Management where she was responsible for the receiving, handling, storage, and distribution of incoming samples. Her duties also included client contact, data entry, maintenance of sample storage area security, and sample separation for proper disposal.

Ms. Pepin has significant previous experience in the health care industry and has pursued an education in data processing.

CONTINUING EDUCATION

"Exceptional Customer Service," Seminar, Dun & Bradstreet, Portland, ME, May 1991

updated: 1/96

AR300265

KELLY A. PERKINS, Project Manager

PRESENT QUALIFICATIONS SUMMARY

As Project Manager, Ms. Perkins is responsible for managing analytical projects from initiation to completion. Point of contact for client projects, priorities, preliminary data, bottle orders and price quotes for commercial work and work by special protocol such as CLP. Negotiates project specifications with clients, insures specifications are met by the lab and delivered to the client in the required time frame. Maintains communications channels with the Sales Department and the Laboratory Staff.

EDUCATION

B.S./Chemistry, 1984, Muhlenberg College, Allentown, PA

PROFESSIONAL EXPERIENCE

11/95-Present - Project Manager, Katahdin Analytical Services, Inc., Westbrook, ME

8/94-11/95 - GC Section Supervisor, PACE - Maine Laboratory, Westbrook, ME -- Ms. Perkins performed Gas Chromatographic analysis for pesticides and Polychlorinated Biphenyls by SW846 and CLP methods. She was responsible for the daily supervision of section chemists. She interpreted and reviewed technical data to ensure compliance with established procedures and laboratory QA program. She scheduled the completion of analyses to meet contractual agreements and analyzed environmental samples for routine and non-routine analyses. She was responsible for meeting acceptable performance criteria, for performance evaluations, and laboratory audits. She was responsible for the Pesticides/PCB fraction for EPA CLP program work.

9/91-8/94 - GC Section Supervisor, Coast-to-Coast Analytical Services, Inc., Westbrook, ME -- Ms. Perkins performed Gas Chromatographic analysis for pesticides and Polychlorinated Biphenyls by SW846 and CLP methods. She was responsible for the daily supervision of section chemists. She interpreted and reviewed technical data to ensure compliance with established procedures and laboratory QA program. She scheduled the completion of analyses to meet contractual agreements and analyzed environmental samples for routine and non-routine analyses. She was responsible for meeting acceptable performance criteria, for performance evaluations, and laboratory audits. She was responsible for the Pesticides/PCB fraction for EPA CLP program work.

8/89-9/91 - Chemist/Bench Supervisor Chemist, State of Maine Public Health Laboratory, Augusta, ME -- Ms. Perkins worked in the Pesticide Department. Her duties included sample preparation and extraction, standard preparation, Gas Chromatographic and High Performance Liquid Chromatographic analysis, data reduction and review, client consultation, and scheduling the completion of analyses to meet client and method criteria. Analytical methods used ranged from EPA drinking water methods to FDA Pesticide Analytical Methods for pesticide residue analysis in soils, tissues and vegetative material. She participated in AOAC Method Evaluation Studies and EPA, FDA and NEIC Performance Evaluation Studies. She also researched and validated new methods for use by the Public Health Laboratory.

AR300266

KELLY A. PERKINS, Project Manager -- Continued

Ms. Perkins also supervised a program for the State of Maine Department of Agriculture that analyzed feed and fertilizer samples for micro and macro nutrients. She scheduled completion of analyses, performed data review and formatted the yearly summary of results that is published by the Maine Department of Agriculture.

8/88-8/89 - Pesticide Residue Analysis, State of Maine Public Health Laboratory, Augusta, ME -- Ms. Perkins supervised the analysis of Pesticide/PCB residues in a variety of matrices including water, soil, vegetation and tissues. She trained other chemists to perform these analyses.

8/87-8/88 - Fyrol FR-2 Analysis, State of Maine Public Health Laboratory, Augusta, ME -- Ms. Perkins performed method development for Gas Chromatographic Analysis for residues of Fyrol-FR2 in drinking waters, river and mill effluents.

CONTINUING EDUCATION

High Performance Liquid Chromatographic Analysis, Waters, Milford, MA, 1989

updated: 1/96

AR300267

DEBORAH J. NADEAU, Data Management Supervisor

PRESENT QUALIFICATIONS SUMMARY

As Data Management Supervisor, Ms. Nadeau is responsible for coordinating tasks for the Data Management Group and overseeing such daily functions as data entry for organics and inorganics results, working with Ward and Telecations software as well as data package compilation for EPA CLP SOW protocols. Ms. Nadeau also coordinates day to day client reports, does final review of all inorganics data and communicates with Project Managers on daily status of projects.

Ms. Nadeau's background includes five years experience in inorganic analyses by ICP, graphite furnace, flame AA and cold vapor AA.

EDUCATION

B.S./Chemistry, 1989, Brandeis University, Waltham, MA

PROFESSIONAL EXPERIENCE

11/95-Present - Data Management Supervisor, Katahdin Analytical Services, Inc., Westbrook, ME

5/95-11/95 - Data Management Coordinator, PACE - Maine Laboratory, Westbrook, ME -- Ms. Nadeau was responsible for coordinating tasks for the Data Management Group. Additional responsibilities included data review and data entry for data packages compilation for EPA.

8/92-4/95 - Lab Analyst, PACE - Maine Laboratory, Westbrook, ME -- Ms. Nadeau was responsible for inorganic analysis using ICP, graphite furnace, flame AA and cold vapor AA, data review of metals and wet lab data, the compilation of CLP protocol data packages through Ward software, training of new personnel in laboratory skills, and maintenance of elemental instrumentation.

12/89-8/92 - Lab Analyst, Coast-to-Coast Analytical Services, Inc., Westbrook, ME -- Ms. Nadeau was responsible for inorganic analysis using ICP, graphite furnace, flame AA and cold vapor AA, data review of metals and wet lab data, the compilation of CLP protocol data packages through Ward software, training of new personnel in laboratory skills, and maintenance of elemental instrumentation.

5/89-12/89 - Inorganic Analyst, Northeast Laboratory, Winslow, Maine -- Ms. Nadeau's responsibilities included elemental analyses by flame AA and maintenance of the instrument.

CONTINUING EDUCATION

Thermo Jarrell Ash Corporation: Flameless Atomic Absorption Emission Spectroscopy course

updated: 1/96

AR300268

GAVIN PEOPLES, Sample Custodian/Chain-of-Custody Clerk

PRESENT QUALIFICATIONS SUMMARY

As Sample Custodian/Chain-of-Custody Clerk, Mr. Peoples is responsible for processing all the samples which come into the laboratory for analysis using the Laboratory Information Management System (LIMS). Using the LIMS, he has an overall knowledge of the various analytical groups and their log-in requirements. He coordinates with the Client Services Department to assure clients' requests are accurate and complete. He checks samples, completes and distributes sample log-in forms for analysis and QC criteria. Mr. Peoples is also responsible for sample disposal, the staging area, and shipping and receiving orders. As part of the staging area job task, Mr. Peoples maintains a supply of containers for clients and sampling needs.

EDUCATION

B.A., University of Maine, Orono, ME, 1988-1990

B.S./Sciences, attending University of Southern Maine, 1991-present (ongoing)

PROFESSIONAL EXPERIENCE

11/95-Present - Sample Custodian/Chain-of-Custody Clerk, Katahdin Analytical Services, Inc., Westbrook, ME

8/94-11/95 - Sample Custodian/Chain-of-Custody Clerk, PACE - Maine Laboratory, Westbrook, ME -- Mr. Peoples was responsible for processing all the samples which came into the laboratory for analysis using the Laboratory Information Management System (LIMS). He coordinated with the Client Services Department to assure clients' requests were accurate and complete. He checked samples, completed and distributed sample log-in forms for analysis and QC criteria. Mr. Peoples was also responsible for sample disposal, the staging area, and shipping and receiving orders.

9/93-8/94 - Sample Custodian/Chain-of-Custody Clerk, Coast-to-Coast Analytical Services, Inc., Westbrook, ME -- Mr. Peoples was responsible for processing all the samples which came into the laboratory for analysis using the Laboratory Information Management System (LIMS). He coordinated with the Client Services Department to assure clients' requests were accurate and complete. He checked samples, completed and distributed sample log-in forms for analysis and QC criteria. Mr. Peoples was also responsible for sample disposal, the staging area, and shipping and receiving orders.

Special projects listed below:

HAZWRAP Projects, Maine and Massachusetts -- Mr. Peoples is the primary Sample Custodian for samples received under the HAZWRAP Program. Thus far, he has logged or assisted in the log-in of samples in compliance with "Requirements for Quality Control of Analytical Data," DOE/HWP-65/R1, July 1990. These programs totaled over \$0.5 million.

AR300269

GAVIN PEOPLES, Sample Custodian/Chain-of-Custody Clerk – Continued

Confidential Client, New Jersey ISRA Investigation -- Mr. Peoples was responsible for checking, organizing and logging in samples for ISRA Investigation in New Jersey. This program consisted of over 100 samples received on weekdays and weekends. Samples were logged in to comply with "New Jersey Technical Requirements for Site Redemption," Chapter 26E et seq.

Contract Laboratory Program, U.S. EPA -- Mr. Peoples is the primary Sample Custodian for the Contract Laboratory Program (CLP). Samples are logged according to CLP requirements including generation from computer spreadsheets of the appropriate log-in form.

updated: 1/96

AR300270

ANNE BEANEY, Systems Manager

PRESENT QUALIFICATIONS SUMMARY

As Systems Manager, Ms. Beaney is responsible for the management and quality control of all computing systems (hardware, software, documentation and procedures), generating, updating, and quality controlling automated deliverables to meet all terms and conditions of the EPA contract. Ms. Beaney is also responsible for maintaining archives of electronic data including software. Ms. Beaney is responsible for the operations and maintenance of all PC based computer systems, and is experienced in CLP deliverables and Telecations software. Ms. Beaney is responsible for integration with the LIMS system and CLP software. She is responsible for managing databases, developing macros and required programs as well as providing electronic data in various formats such as ASCII, dBase, EXCEL, Lotus, etc.

EDUCATION

BA Administrative Science/Chemistry, Colby College, Waterville, ME, 1985

Graduate Studies: Computer Science, University of Southern Maine, 1988-Present

Graduate courses: Structural Problem Solving-Pascal, Algorithms in Programming, Discrete Structures, Theory of Computation, Data Structures, Computer Architecture

PROFESSIONAL EXPERIENCE

11/95-Present - Systems Manager, Katahdin Analytical Services, Inc., Westbrook, ME

8/94-11/95 - Systems Manager, PACE - Maine Laboratory, Westbrook, ME -- Ms. Beaney was responsible for the operations and maintenance of all PC based computer systems, and is experienced in CLP deliverables and Telecations software. Ms. Beaney was responsible for integration with the LIMS system and CLP software. She was responsible for managing databases, developing macros and required programs as well as providing electronic data in various formats.

11/89-8/94 - Systems Manager, Coast-to-Coast Analytical Services, Inc., Westbrook, ME -- Ms. Beaney was responsible for the operations and maintenance of all PC based computer systems. She was responsible for integration with the LIMS system and CLP software and for managing databases, developing macros and required programs as well as providing electronic data in various formats.

6/87-11/89 - GC Chemist, Coast-To-Coast Analytical Services, Inc., Westbrook, ME -- Responsible for GC/EC operations and pesticide residue analysis, programming languages, operating systems and software systems.

CONTINUING EDUCATION

Pick/UNIX Administration, 1/93

updated: 1/96

AR300271

MICHAEL J. DOYLE, Systems Administrator

PRESENT QUALIFICATIONS SUMMARY

As Systems Administrator, Mr. Doyle is responsible for the management and quality control of all computing systems (hardware, software, documentation and procedures), generating, updating, and quality controlling automated deliverables to meet all terms and conditions of our clients' needs. The Systems Administrator is also responsible for maintaining archives of electronic data including software. Mr. Doyle is responsible for the operations and maintenance of all PC based computer systems, and is experienced in CLP deliverables and Telecations software. Mr. Doyle is also responsible for maintaining the LIMS computer, managing databases, developing macros and required programs as well as providing electronic data in various formats such as ASCII, dBase, EXCEL, Lotus, etc.

EDUCATION

BA Mathematics, University of Maine, 1982

Graduate Studies: Number Theory, University of Maine, 1982

Graduate courses: Masters Thesis work on Goldbach's Conjecture

PROFESSIONAL EXPERIENCE

11/95-Present - Systems Administrator, Katahdin Analytical Services, Inc., Westbrook, ME

8/94-11/95 - Systems Administrator, PACE - Maine Laboratory, Westbrook, ME -- Mr. Doyle was responsible for the operations and maintenance of all PC based computer systems, and is experienced in CLP deliverables and Telecations software. Mr. Doyle was also responsible for maintaining the LIMS computer, managing databases, developing macros and required programs as well as providing electronic data in various formats.

6/94-8/94 - Systems Administrator, Coast-to-Coast Analytical Services, Inc., Westbrook, ME -- Mr. Doyle was responsible for the operations and maintenance of all PC based computer systems, and is experienced in CLP deliverables and Telecations software. Mr. Doyle was also responsible for maintaining the LIMS computer, managing databases, developing macros and required programs as well as providing electronic data in various formats.

9/93-6/94 - Data Deliverables Technician, Coast-to-Coast Analytical, Westbrook, ME -- Responsible for generating, updating, and quality controlling automated deliverables to meet all terms and conditions of the EPA Contract.

CONTINUING EDUCATION

Novell Netware, 3/95

updated: 1/96

AR300272

JOHN C. BURTON, Laboratory Operations Manager

PRESENT QUALIFICATIONS SUMMARY

As Laboratory Operations Manager, Mr. Burton oversees management of both inorganics and organics laboratory sections providing pesticides/PCB, volatiles, semivolatiles, wet chemistry, metals preparation, and metals analysis. He reports to Ms. McGrath, General Manager.

Mr. Burton has extensive experience in the environmental analytical chemistry field. Mr. Burton has over nine years of experience in Gas Chromatography, Mass Spectrometry, HPLC, and IR. Mr. Burton also has experience using GC/MS-SIM for various special projects including Love Canal.

EDUCATION

M.S. Forensic Chemistry, Northeastern University, Boston, MA, 1987

B.A. Chemistry, Virginia Polytechnic Institute and State University, Blacksburg, VA, 1982

PROFESSIONAL EXPERIENCE

11/95-Present - Laboratory Operations Manager, Katahdin Analytical Services, Inc., Westbrook, ME

10/94-11/95 - Laboratory Operations Manager, PACE - Maine Laboratory, Westbrook, ME -- Mr. Burton managed both the inorganics and organics laboratory sections providing pesticides/PCB, volatiles, semivolatiles, wet chemistry, metals preparation, and metals analysis.

1/93-10/94 - Laboratory Operations Manager, NET - Thorofare, Thorofare, NJ -- Mr. Burton, was responsible for oversight management of both the inorganics and organics laboratory sections providing pesticides/PCB, volatiles, semivolatiles, wet chemistry, metals preparation, and metals analysis.

3/91-12/92 - Organic Section Manager, NET-Thorofare, Thorofare, NJ

6/89-3/91 - GC/MS Supervisor, Cambridge Analytical Assoc./NET Cambridge, Cambridge, MA

6/87-6/89 - GC/MS Chemist, Cambridge Analytical Associates, Boston, MA

5/86-6/87 - Analytical Toxicologist, New England Pathology Services, Woburn, MA

Summer 1985 - Chemist, Bureau of Alcohol Tobacco & Firearms, Rockville, MD

CONTINUING EDUCATION

NET Professional Development Series TQM, 1991

NET Professional Development Series, 1990

Hewlett Packard System Manager Course, 1989

Hewlett Packard Aquarius User Course, 1988

updated: 1/96

AR300273

JAMES F. GALASYN, Senior Chemist, GC/MS Laboratory Supervisor

PRESENT QUALIFICATIONS SUMMARY

Dr. Galasyn is supervisor of the GC/MS laboratory and as such is responsible for all GC/MS activities, including scheduling and tracking of samples, supervision of chemists within the group, and operation and maintenance of the GC/MS equipment. Dr. Galasyn authors all of the organic standard operating procedures.

EDUCATION

NSF Post-doctoral Fellowship in Analytical/Atmospheric Chemistry, 1984-1986, Colorado College,
Colorado Springs, CO
Ph.D./Analytical/Environmental Chemistry, 1984, Dartmouth College, Hanover, NH
B.S./Chemistry, 1980, University of Connecticut, Storrs, CT

PROFESSIONAL EXPERIENCE

11/95-Present - GC/MS Supervisor, Katahdin Analytical Services, Inc., Westbrook, ME

8/94-11/95 - GC/MS Supervisor PACE - Maine Laboratory, Westbrook, ME -- Dr. Galasyn was responsible for the supervision of the GC/MS laboratory and as such was responsible for all GC/MS activities, including scheduling and tracking of samples, supervision of chemists within the group, and operation and maintenance of the GC/MS equipment. Dr. Galasyn authored all of the organic standard operating procedures.

6/87-8/94 - GC/MS Supervisor - Coast-to-Coast Analytical Services, Inc., Westbrook, ME -- Dr. Galasyn was responsible for the supervision of the GC/MS laboratory and as such was responsible for all GC/MS activities, including scheduling and tracking of samples, supervision of chemists within the group, and operation and maintenance of the GC/MS equipment. Dr. Galasyn authored all of the organic standard operating procedures.

2/86-6/87 - GC/MS Supervisor and Chemist, Confidential Laboratory, CT -- Served as GC/MS Supervisor and was responsible for the analysis of CLP and non-CLP extractable, base/neutral, and acid semivolatile target compound list and priority pollutant compounds. Instrumental responsibilities included the operation and maintenance of Hewlett-Packard GC/MS equipment.

9/82-6/84 - Graduate Student, Dartmouth College, Hanover, NH -- As a graduate student, Dr. Galasyn operated and maintained Finnigan GC/MS equipment for the environmental laboratory, which included analysis and interpretation of all organic intermediates for the chemistry department.

AR300274

JAMES F. GALASYN, Senior Chemist, GC/MS Laboratory Supervisor – Continued

ADDITIONAL EXPERIENCE

Dr. Galasyn's Post-doctoral Fellowship research was in the field of atmospheric chemistry and was an investigation of the contribution that dry deposition made to the wet deposition normally associated with acid rain. Various locales were studied, including the remote free troposphere at the Mauna Loa Observatory in Hawaii. Ionic species monitored included nitric acid vapor, aerosol nitrate, sulfate, and various anions. Instrumental responsibilities included operation and maintenance of ion chromatographs, an atomic absorption (AA) spectrometer, and field equipment.

For his Doctoral thesis, entitled "Residential Indoor and Outdoor Air Pollution," Dr. Galasyn examined the ambient air at various indoor and outdoor locations, and especially focused upon indoor air quality in the vicinity of woodstoves, fireplaces, and kerosene heaters. Pollutants monitored included polycyclic aromatic hydrocarbons, carbon monoxide, nitrogen dioxide, and total and respirable suspended particulates. Instrumentation employed included Finnigan GC/MS, various GC's, and HPLC.

PUBLICATIONS AND PRESENTATIONS

J.F. Galasyn, K.L. Tschudy, and B.J. Huebert, "Daily and Seasonal Variability of Nitric Acid Concentrations in the Remote Free Troposphere at Mauna Loa, Hawaii," Journal of Geophysical Research, Vol. 92, No. 03, Pg. 3105-3113, March 20, 1987.

J.F. Galasyn and B.J. Huebert, "Daily and Seasonal Variability of Nitric Acid Concentrations in the Remote Free Troposphere at Mauna Loa," presented at the IAMAP/IAPSO Joint Assembly, Honolulu, Hawaii, August 5-16, 1985.

B.J. Huebert and J.F. Galasyn, "Measurements of the Dry Deposition of Nitric Acid to a Developing Winter Wheat Crop," presented at the Rocky Mountain conference - First Symposium on Atmospheric Chemistry, Denver, CO, July 14-18, 1985.

B.J. Huebert, J.F. Galasyn, and K.L. Tschudy, "Measurements of the Seasonal and Diurnal Variations of Nitric Acid Vapor at the Mauna Loa Observatory," presented at the Rocky Mountain Conference - First Symposium on Atmospheric Chemistry, July 14-18, 1985.

J.F. Galasyn, J.F. Hornig, and R.H. Soderberg, "The Loss of PAH from Quartz Fiber High Volume Filters," J. Air Pollute. Control Assoc., 34, 57 (1984).

J.F. Hornig, R.H. Soderberg, A.C. Barefoot, and J.F. Galasyn, "Woodsmoke Analysis: Vaporization Losses of PAH from Filters and Levoglucosan as a Distinctive Marker for Woodsmoke," in Polynuclear Aromatic Hydrocarbons, ed. by Cooke, Battelle Press, Columbus, Ohio (1984).

AR300275

JAMES F. GALASYN, Senior Chemist, GC/MS Laboratory Supervisor – Continued

CONTINUING EDUCATION

Member, EPA Air Toxics Workgroup, 1990 - 1991

Hewlett-Packard 5988/96 RTE System Manager Course; Paramus, New Jersey, December 1986

American Chemical Society Short Course, "Effective Management of Chemical Analysis Laboratories," June 1986

PROFESSIONAL AFFILIATIONS

American Chemical Society

Air and Waste Management Association

American Society for Mass Spectrometry

Phi Beta Kappa

updated: 1/96

AR300276

PETER LEMAY, GC Group Supervisor/GC Operator

PRESENT QUALIFICATIONS SUMMARY

As GC Group Supervisor/GC Operator, Mr. Lemay is responsible for coordinating daily operations of the GC laboratory section. His activities include training of personnel, scheduling equipment and staff, prioritizing analytical work to meet holdtime requirements, ensuring that quality control criteria are met and performing data review. Mr. Lemay's responsibilities include oversight of analysis of samples for GC volatiles, pesticides, PCBs, PNAs, and PHCs, DROs/GROs by methods 601/602, 8010/8020, 608/8080A, 8015 mod. He has experience in the performance of herbicide analysis as well as the above methods and is trained in the operation of the following GCs and detectors: HP 5890, HP5880, HP 5840, Tracon and Waters Dimension; ECD, ELCD, NPD, FID, FPD with either packed or capillary columns.

As a GC Operator, he is responsible for the analysis of solid and aqueous sample extracts for detection of pesticides, PCBs, PNAs, and PHCs. Mr. Lemay has more than eight years experience in GC analysis and seven years of supervisory experience.

EDUCATION

B.A., Chemistry, University of Maine, Orono, ME, 1985

PROFESSIONAL EXPERIENCE

11/95-Present - GC Group Supervisor/GC Operator, Katahdin Analytical Services, Inc., Westbrook, ME

6/92-11/95 - GC Group Supervisor/GC Operator, PACE - New Hampshire Laboratory, Hampton, NH -- Mr. Lemay was responsible for the supervision of three analysts and the daily operations of the GC section performing pesticide, PCB, PNA, PHC, and herbicide analysis.

1987-6/92 - GC Group Supervisor/GC Operator, Resource Analysts, Inc., Hampton, NH -- Mr. Lemay was responsible for the supervision of three analysts and the daily operations of the GC section performing pesticide, PCB, PNA, PHC, and herbicide analysis.

1985-1987 - Chemist, Burgess Analytical Laboratory -- Mr. Lemay was responsible for performing chemical analyses on a variety of materials, sample preparation, instrument operation, data review and evaluation, and training new employees.

1977-1981 - Medical Laboratory Specialist, United States Air Force

AR300277

PETER LEMAY, GC Group Supervisor/GC Operator – Continued

CONTINUING EDUCATION

Introduction to GC/MS, Hewlett Packard, 1988

"Frontline Leadership," Managerial Training by Zenger-Miller, Millipore Corp., Bedford, MA, 9/90 - 10/90

Occupational and Environmental Radiation Protection, Harvard School of Public Health, August 1991

"Waste Testing and Quality Assurance," Washington DC, July 1993

updated: 1/96

AR300278

RICHARD LAVIGNE, Organic Extractions Supervisor/Extraction Chemist

PRESENT QUALIFICATIONS SUMMARY

As Organic Extractions Supervisor, Mr. Lavigne is responsible for coordinating daily operations of the extractions laboratory. Mr. Lavigne is also responsible for coordinating sample preparation for BNA, PCB, pesticide, PHC, PNA, and other analyses. He is responsible for scheduling the work load such that hold times are met and sample preparation turn-around time goals are routinely achieved. Mr. Lavigne delegates work and acts as liaison between the organic extraction and instrumental analysis sections. He also ensures sample preparation documentation is current and complete. As an extraction chemist, Mr. Lavigne performs EPA Methods 508, 608, 610, 625, 3510, 3520, 3540, 3550, fuel oils and other miscellaneous methods for free product, water and soil samples. He has performed GC/FID screening, surrogate and solvent lot checks, MDL studies, completion of corrective action report forms, sample tracking (LIMS), glassware prep, and waste disposal. He has also performed various clean-up techniques such as GPC, florisil, sulfur, alumina, and acid wash. Mr. Lavigne is CLP-qualified in both 02/88 and 09/91USEPA SOW methods and is experienced in sample preparation following New York ASP CLP protocol. He is also trained in oil and grease analysis by IR.

As an Extraction Chemist, Mr. Lavigne utilizes standard methods for the preparation of samples for organic analysis. He has more than two years laboratory experience as an organic extraction chemist for PACE, Inc. at the Hampton, NH and Westbrook, ME laboratories.

EDUCATION

B.S., Northland College, Ashland, WI, 1993.

PROFESSIONAL EXPERIENCE

11/95-Present - Organic Extractions Supervisor/Extraction Chemist, Katahdin Analytical Services, Inc., Westbrook, ME

8/95-11/95 - Organic Extractions Chemist, PACE - Maine Laboratory, Westbrook, ME - Mr. Lavigne was responsible for extracting commercial organic solid and aqueous samples to test for the following compounds: pesticides, BNAs, PCBs, PAHs, and PHCs. He also trained in performing oil and grease analyses, GC screening and GPC sample clean-up.

9/93-8/95 - Organic Extractions Chemist, PACE - New Hampshire Laboratory, Hampton, NH - Mr. Lavigne was responsible for extracting commercial organic solid and aqueous samples to test for the following compounds: pesticides, BNAs, PCBs, herbicides, PAHs, and PHCs.

updated: 1/96

AR300279

GEORGE BREWER, Metals Laboratory Supervisor

PRESENT QUALIFICATIONS SUMMARY

As Metals Laboratory Supervisor, Mr. Brewer is responsible for the direction and daily operation of the metals laboratory including scheduling of analyses, performing sample analysis, maintenance of instrumentation and maintenance of SOPs for method compliance. His responsibilities include the preparation and analysis of water and wastewater, soil, sludge and other solid waste matrices, particularly ash, for elemental parameters. In addition, he is responsible for equipment maintenance and training of laboratory personnel. Mr. Brewer has extensive experience in the operation of atomic absorption and inductively coupled plasma (ICP) spectroscopy equipment.

EDUCATION

M.S./Geological Sciences, 1986, University Of Maine At Orono, Orono, ME
B.S./Geology, 1979, Yale University, New Haven, CT

PROFESSIONAL EXPERIENCE

11/95-Present - Metals Laboratory Supervisor, Katahdin Analytical Services, Inc., Westbrook, ME

8/94-11/95 - Metals Laboratory Supervisor, PACE - Maine Laboratory, Westbrook, ME -- Mr. Brewer was responsible for supervision of the metals instrumentation laboratory including scheduling of analyses, performing sample analysis, maintenance of instrumentation and maintenance of SOPs for method compliance.

1/94-8/94 - Metals Laboratory Supervisor, Coast-to-Coast Analytical Services, Inc., Westbrook, ME -- Mr. Brewer was responsible for supervision of the metals instrumentation laboratory including scheduling of analyses, performing sample analysis, maintenance of instrumentation and maintenance of SOPs for method compliance.

Chief Chemist, Millipore Corp., Bedford, MA -- Mr. Brewer was involved in all aspects of the lab's work including sample log-in through analysis to report generation and customer service. He was also responsible for initiating a quality control program at the lab, and oversaw analyses of all EPA WP and WS performance evaluation samples.

Senior Atomic Spectroscopist, Clean Harbors Analytical Services, Inc., Braintree, MA -- Mr. Brewer's responsibilities included training and supervising new analysts, scheduling trace metals in complex matrices such as wastewater, soil, ash, and oil. He was responsible for bringing the laboratory's first ICP on line and developing all ICP methods used by the lab. He also assumed managing responsibility for the successful completion of analyses on EPA CLP inorganic performance evaluation samples during the 1987 bid period.

AR300280

GEORGE BREWER, Metals Laboratory Supervisor -- Continued

Various Government Programs -- Mr. Brewer supervised the inorganic analyses of performance evaluation samples and the production of data packages to successfully obtain laboratory approvals to perform work for HAZWRAP (Hazardous Waste Remedial Action Programs), the U.S. Army Corps of Engineers, and AFCEE (Air Force Center for Environmental Excellence). Mr. Brewer subsequently oversaw metals analyses of samples from site assessments and clean ups administered under these programs.

Elemental Analyses of Landfill, Confidential Client, Winthrop, ME -- Mr. Brewer supervised the elemental analyses of more than 80 soils, groundwaters, surface waters, and lake sediments sampled on a quarterly basis from this unremediated landfill site. He insured that all contractual Quality Control (QC) requirements were fulfilled and prepared the necessary QC documentation.

Baseline Studies, Proposed Mine Sites, ME -- Mr. Brewer directed the analysis of groundwater and sediment samples and monthly surface water samples in two recent baseline studies of pristine watersheds. Each study involved an extensive list of metals analyzed at trace and ultratrace levels, primarily by graphite furnace atomic absorption spectroscopy.

New York CLP -- Mr. Brewer directed the inorganic analyses of performance evaluation samples and the production of data packages to gain and maintain certification in the New York Contract Laboratory Program.

Special Analytical Services, U.S. EPA -- In two recent projects for the U.S. EPA, Mr. Brewer directed the preparation and analyses of high volume air filters and mine drainage samples. Both projects required adherence to U.S. EPA Contract Laboratory Program (CLP) analytical and reporting protocols.

Pulp and Paper Manufacturers, ME -- Mr. Brewer supervised the elemental analyses of monthly ash samples from boilers operated by various pulp and paper manufacturers throughout the state.

Hazardous Waste Characterization, ME -- Mr. Brewer directed and performed elemental analyses and TCLP testing to characterize waste materials from a Maine paper company in compliance with the Maine Solid Waste Regulations.

GEORGE BREWER, Metals Laboratory Supervisor – Continued

ADDITIONAL EXPERIENCE

Mr. Brewer's background has provided him with extensive experience in flame and graphite furnace atomic absorption spectrophotometry, plasma emission spectrometry, ion chromatography, and several other instrumental and wet chemical inorganic analytical techniques.

Mr. Brewer's graduate work involved the study of the history of acidification and heavy metal loading in a Maine watershed through the analyses of sediment cores and water samples by atomic absorption spectrophotometry and ion chromatography.

PROFESSIONAL AFFILIATIONS

American Chemical Society
Society for Applied Spectroscopy

updated: 1/96

AR300282

BETSY A. CARBONE, Wet Chemistry Laboratory Supervisor

PRESENT QUALIFICATIONS SUMMARY

As Wet Chemistry Laboratory Supervisor, Ms. Carbone is responsible for coordinating the daily operations of the wet chemistry laboratory. As an Analytical Chemist, Ms. Carbone is responsible for the preparation and analysis of solid and aqueous samples by standard inorganic wet chemistry methods. Ms. Carbone has more than four years of experience in wet chemistry procedures.

EDUCATION

B.S./Marine Biology, 1989, Gordon College, Wenham, MA

PROJECT EXPERIENCE

11/95-Present - Wet Chemistry Laboratory Supervisor, Katahdin Analytical Services, Inc., Westbrook, ME

8/92-11/95 - Analytical Chemist, PACE - Maine Laboratory, Westbrook, ME -- Performed wet chemistry analyses, including cyanide, chloride, total organic carbon, chemical oxygen demand, total dissolved solids, total suspended solids, fluoride, sulfide, and sulfite. She also prepared ASTM extractions of soils/solid samples for wet chemistry analyses, and was responsible for PM-10 and total suspended particulate testing of air monitoring projects. In the Elements Group, she was involved in sample digestion and analysis by atomic absorption (both furnace and flame) and atomic emission (ICP) for the detection of various metals.

1990-8/92 - Analytical Chemist, PACE - Maine Laboratory, Westbrook, ME -- Performed wet chemistry analyses, including cyanide, chloride, total organic carbon, chemical oxygen demand, total dissolved solids, total suspended solids, fluoride, sulfide, and sulfite.

Special projects following:

Sampling and Analyses of Landfill, Confidential Client, Winthrop, ME -- Was involved in the digestion and elemental analyses of soil, groundwater, lake water, and lake sediments on both quarterly and annual basis from this unremediated waste site. She was responsible for all particulate concentration parameters.

Ash and Sludge Testing, Confidential Client -- Performed elemental analyses of ash and sludge samples from various industrial incinerators and wastewater treatment facilities. The analyses included sample digestion, analysis by graphite furnace, ICP analyses, and ASTM extraction. Subsequent analyses for nitrite, nitrate, sulfate, fluoride, and chloride were her responsibility.

Surface and Groundwater Monitoring, ME -- Performed elemental and wet chemistry analyses for routine monitoring at municipal and industrial landfills in Maine. Specific responsibilities included COD analyses, all particulate concentration parameters, mercury analyses by cold vapor techniques, cyanide, chloride, and TOC.

Industrial Technology Division, U.S. EPA -- For a survey of various industries, including pulp and paper, wood preserving, and pharmaceutical manufacturing, conducted all particulate concentration parameters, alkalinity, DOD analyses, and fluoride analyses.

AR300283

BETSY A. CARBONE, Wet Chemistry Section Supervisor -- Continued

Baseline Monitoring, Confidential Client -- For the initial site monitoring of stream watersheds to determine baseline criteria at a potential mining site, conducted the following tests: total suspended solids, total dissolved solids, chloride, chemical oxygen demand, total organic carbon, sulfite, sulfide, and fluoride.

Air Monitoring Project, Confidential Client, MA -- Responsible for the PM - 10 and total suspended particulate testing of air monitoring filters for a project at a major road construction site in Massachusetts.

Special Analytical Services (SAS), U.S. EPA -- Was involved in numerous aspects of US EPA SAS work. Some projects have been done for metal finishing plants.

Hazardous Waste Remedial Action Program (HAZWRAP), Confidential Client, MA -- Performed cyanide analysis, following CLP protocol.

CLP Deliverables Projects (SAS), U.S. EPA -- Performed cyanide analysis following CLP protocol.

updated: 1/96

AR300284

VICTOR PIEKARSKI, Field Services Manager

PRESENT QUALIFICATIONS SUMMARY

As Field Services Manager, Mr. Piekarski is responsible for the daily operations of the Field Services Department. Mr. Piekarski has extensive experience in on-site operations and management of groundwater monitoring projects. In the field of wastewater treatment, Mr. Piekarski supervises NPDES collection programs and has considerable experience in the operations of flow monitoring projects.

Additionally, Mr. Piekarski has over 5 years experience in the sampling design and collection techniques of marine sediments, invertebrate and fishery studies.

EDUCATION

B.S., Natural Resource Management, University of Alaska, Fairbanks, 1982

A.A.S., Conservation Technology, Essex Agricultural and Technical Institute, Danvers, MA, 1980

PROFESSIONAL EXPERIENCE

11/95-Present - Field Services Manager, Katahdin Analytical Services, Inc. , Westbrook, ME

6/92-11/95 - Field Services Manager, PACE - New Hampshire Laboratory, Hampton, NH - Mr. Piekarski was responsible for the operations of the Field Services Office. He had extensive experience in on-site operations and management of groundwater monitoring projects. In the field of wastewater treatment, Mr. Piekarski supervised NPDES collection programs and was experienced in the operations of flow monitoring projects.

3/92-6/92 - Director of Field Operations, Environmental Field Services, Inc. (EFSI), a Division of Resource Analysts, Inc., Hampton, NH - Mr. Piekarski was responsible for the operations of EFSI. He had extensive experience in on-site operations and management of groundwater monitoring projects. In the field of wastewater treatment, Mr. Piekarski supervised NPDES collection programs and was experienced in the operations of flow monitoring projects.

7/88-3/92 - Field Supervisor, Environmental Field Services, Inc. (EFSI), a Division of Resource Analysts, Inc., Hampton, NH

1987-7/88 - Field Technician, Environmental Field Services, Inc. (EFSI), a Division of Resource Analysts, Inc., Hampton, NH

1981-1985 - Fisheries Biologist I, Alaska Department of Fish and Game, Anchorage, Alaska

1984 - Laboratory Technician, IWR-EES University of Alaska, Fairbanks, Alaska

1982-1983 - Laboratory Technician, Institute of Marine Sciences, Fairbanks, Alaska

AR300285

VICTOR PIEKARSKI, Field Services Manager – Continued

CONTINUING EDUCATION

"OSHA Hazardous Site Worker Training," (40 hours), 1989

"OSHA Hazardous Site Worker Supervisory Training," (8 hours), 1989

"OSHA Refresher Course," Hazardous Site Worker (40 hrs), 1990

"OSHA Refresher Course," Hazardous Site Worker (40 hrs), 1991

WMI/EML Groundwater Sampling Seminar, EML, IL, 1991

Eastern Regional Groundwater Issues, conference, NWWA, 1991

updated: 1/96

AR300286

JOHN C. MICHAUD, Field Supervisor/Technician

PRESENT QUALIFICATIONS SUMMARY

As Field Supervisor/Technician, Mr. Michaud is responsible for supervising the technical and logistical operations of the Field Services Division and two Field Technicians. He is also responsible for groundwater, wastewater, stormwater and soil sampling events performing field collections, measurements, analysis, data management and reporting.

PROFESSIONAL EXPERIENCE

11/95-Present - Field Supervisor/Technician, Katahdin Analytical Services, Inc., Westbrook, ME

6/92-11/95 - Field Supervisor/Technician, PACE - New Hampshire Laboratory, Hampton, NH -- As Field Supervisor/Technician, Mr. Michaud was responsible for supervising the technical and logistical operations of the Field Services Division and two Field Technicians. He was also responsible for groundwater, wastewater, stormwater and soil sampling events performing field collections, measurements, analysis, data management and reporting.

5/89-6/92 - Field Supervisor/Technician, Environmental Field Services, Inc. (EFSI), a Division of Resource Analysts, Inc., Hampton, NH -- As Field Supervisor/Technician, Mr. Michaud was responsible for supervising the technical and logistical operations of the Field Services Division and two Field Technicians. He was also responsible for groundwater, wastewater, stormwater and soil sampling events performing field collections, measurements, analysis, data management and reporting.

Mr. Michaud came to EFSI with seven years prior experience in the Environmental Industry. As a Fisheries Technician II, Mr. Michaud was responsible for collection and the management of data in the execution of fisheries management programs for Fish & Game, Anchorage, AK.

EDUCATION

B.S. University of Alaska, Fairbanks, Alaska, 1984

A.A.S. Essex Agricultural & Technical Inst. Danvers, MA, 1980

CONTINUING EDUCATION

"Environmental Monitoring Laboratory," groundwater sampling seminar

"Basic LOTUS 123," Millipore Corp., Bedford, Ma., April 1990

"Adult CPR and Standard First Aid," American Red Cross, Portsmouth, NH, October, 1990

"Applied Occupational Health Systems," 40 hour Technician Level Certificate in "Hazardous Waste Operations and Emergency Response" by AOAHS, Bow, NH, April 1991

"NPDES Permit Application Workshop" for Stormwater Discharge Sampling, USEPA, Boston, MA, July 1992

updated: 1/96

AR300287

JOHN L. SHIELDS, Field Technician

PRESENT QUALIFICATIONS SUMMARY

As Field Technician, Mr. Shields is responsible for day to day field implementation of sample collection and field analysis programs for land disposal facilities and groundwater contamination projects. He plans and conducts field projects, estimating and scheduling work to meet budgets and completion dates. Responsibilities include measurements of wells, purging wells, intermittent readings for pH and specific conductivity, collection of samples and decontamination (cleaning) of sampling equipment. Some projects included sampling for a pulp & paper mill in Maine, the Maine Public Health Laboratory, and a local oil company.

Mr. Shields is involved with interacting with clients and regulatory staff and assuming responsibility for field implementation of projects, recommending changes in field implementation or procedures as required, performing routine field/office assignments, maintaining and operating field equipment and gathering and tabulating field data.

EDUCATION

Criminology Courses, University of Southern Maine, Portland, ME, 1988

Assoc. Law Enforcement, SMVTI, South Portland, ME, 1986

Graduate, Sacopee Valley High School, Kesar Falls, ME, 1984

PROFESSIONAL EXPERIENCE

11/95-Present - Field Technician, Katahdin Analytical Services, Inc., Westbrook, ME

8/94-11/95 - Field Technician, PACE - Maine Laboratory, Westbrook, ME — Mr. Shields was responsible sample collection and field analysis programs for land disposal facilities and groundwater contamination projects. He planned and conducted field projects, estimated and scheduled work to meet budgets and completion dates. Responsibilities included measurements of wells, purging wells, intermittent readings for pH and specific conductivity, collection of samples and decontamination (cleaning) of sampling equipment.

6/93-8/94 - Field Technician, Coast-to-Coast Analytical Services, Inc., Westbrook, ME — Mr. Shields was responsible sample collection and field analysis programs for land disposal facilities and groundwater contamination projects. He planned and conducted field projects, estimated and scheduled work to meet budgets and completion dates. Responsibilities included measurements of wells, purging wells, intermittent readings for pH and specific conductivity, collection of samples and decontamination (cleaning) of sampling equipment.

AR300288

JOHN L. SHIELDS, Field Technician – Continued

3/91-6/93 - Sample Custodian/Chain of Custody Clerk, Coast-to-Coast Analytical Services, Inc., Westbrook, ME – Mr. Shields was responsible for processing samples which came into the laboratory for analysis using the Laboratory Information Management System (LIMS). He coordinated with the Client Services Department to assure clients' requests were accurate and complete. He checked samples, and completed and distributed sample log-in forms for analysis and QC criteria. Mr. Shields was also responsible for sample disposal, the staging area, and shipping and receiving orders.

CONTINUING EDUCATION

OSHA 40 Hour Hazardous Waste Health and Safety Training, 1992

OSHA 8 Hour Rem III Supervisor Training, 1992

updated: 1/96

AR300289

JEFFREY WORTH, Field Technician

PRESENT QUALIFICATIONS SUMMARY

Mr. Worth is responsible for sampling groundwater and wastewater, monitoring landfill gases, and performing field measurements and analyses. Mr. Worth reports to Mr. Piekarski, Field Services Manager.

EDUCATION

Chemistry, currently attending University of Southern Maine, Portland, ME

A.S., Applied Marine Biology and Oceanography, Southern Maine Technical College, South Portland, ME, 1990

PROFESSIONAL EXPERIENCE

11/95-Present - Field Technician, Katahdin Analytical Services, Inc., Westbrook, ME

6/92-11/95 - Field Technician, PACE - New Hampshire Laboratory, Hampton, NH -- Mr. Worth was responsible for sampling groundwater and wastewater, monitoring landfill gases, and performing field measurements and analyses.

3/91-6/92 - Field Technician, Environmental Field Services, Inc. (EFSD), a Division of Resource Analysts, Inc., Hampton, NH -- Mr. Worth was responsible for sampling groundwater and wastewater, monitoring landfill gases, and performing field measurements and analyses.

1989-3/91 - Field/Laboratory Technician, Southern Maine Technical College, Portland, ME -- Mr. Worth was responsible for chemistry and oceanographic sample collection and maintenance of ship-board oceanographic equipment.

CONTINUING EDUCATION

General Oceanography and Marine Biology, Penn State Consortium, Wallops Island, VA, 7/76

Winter Emergency Care Instructor, Shawnee Peak Ski Patrol, since 7/89

Avalanche Rescue and Mountaineering Training, National Ski Patrol, 4/90

Advanced First Aid/CPR Training, Waterboro Rescue Squad, renewed annually by National Ski Patrol

WMI/EML Groundwater Sampling Seminar, Environmental Monitoring Lab, Geneva, IL, 6/91

Health and Safety course - 40 hours, GZA/AET, Northeastern University, Dedham, MA, 11/91

updated: 1/96

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3.0 OBJECTIVES

Katahdin Analytical Services, Inc. is committed to the philosophy that quality operations result from quality planning, design, and work performance by skilled operational personnel. Katahdin's policy is to perform its varied types of technical work in accordance with standard quality assurance practices such as those put forth in the Good Laboratory Practices (GLP), the EPA Contract Laboratory Program (CLP) and other EPA guidance documents, and Standard Methods. The Quality Assurance Officer(s) are responsible for maintenance of standard operating procedures, laboratory audits, performance evaluations, federal and state certifications and quality assurance documentation.

Each laboratory worker is responsible for reviewing and understanding standard operating procedures; adhering to these procedures during routine analyses; recording quality control information required by those procedures in the proper location, and taking appropriate corrective action including suspending analyses when quality control criteria are not met.

Objectives of the quality program are:

- to provide representative data of documented quality to clients and regulators
- to provide a quality organization independent of the pressures of project performance with the responsibility and authority for auditing and recommending corrective action;
- to provide a quality organization with clear paths of communication with management;
- to perform regularly scheduled audits and thereby document an objective evaluation of quality-related practices;
- to promptly identify variances and implement corrective actions;
- to maintain readily identifiable and retrievable records that provide documentary evidence of the quality of activities performed;
- to provide procedures for implementing project-specific quality plans;
- to define responsibility and authority for developing and implementing quality plans; and
- to provide quality reference documentation for each project.

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Quality Assurance objectives for measurement data can be expressed in terms of completeness, representativeness, accuracy, precision, comparability and traceability.

3.1 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 normal conditions. The QA objective for completeness is to maximize the number of valid results. This can be attained by:

- selecting the appropriate methodology
- minimizing sample loss and breakage;
- performing sufficient QC samples to document control; and
- documenting all aspects of the analytical system.
- effectively understanding and communicating DQOs

The equation for completeness is:

$$\frac{\text{\# of data points obtained}}{\text{\# of data points expected}} \times 100 = \% \text{ completeness}$$

3.2 Representativeness

Representativeness is the extent to which reported analytical results truly depict the chemistry of the sampled environment. Representativeness is a qualitative objective which is optimized through proper selection of sampling protocols and sample handling procedures, appropriate selection of holding times and analytical procedures, proper sample preservation, and prompt extraction and analysis. Refer to Table 6.1 for Katahdin Analytical Services sample container, preservation, and holding time requirements.

Sample preservation follows USEPA guidance (40 CFR 136, Table II) unless dictated by other programs. Field preservation is checked upon sample receipt in the laboratory with the exception of volatiles which are checked immediately prior to analysis. Refer to the current revision of Katahdin Analytical Services SOP SD-001, Sample Receipt and Internal Control.

The Laboratory follows EPA guidance for sample holding times as stipulated in 40CFR 136, Table II or individual references.

3.3 Accuracy and Precision

Accuracy and precision data are optimized through the use of analytical procedures that minimize biases through the use of standard procedures, traceable standards and QA lots, calibration of analytical equipment within established acceptance limits and by implementing corrective action when measured accuracy and precision exceed pre-established limits.

Accuracy is assessed through the analysis of several types of quality control (QC) samples. Laboratory generated QC samples, such as method blanks, laboratory control samples (LCSs), and sample duplicates, are used to assess the accuracy and precision of measurements due to laboratory activities. Surrogate spikes and matrix spike/matrix spike duplicates (MS/MSDs) are used to monitor the effects of the sample matrix on precision and accuracy. Field blanks, field duplicates and trip blanks are used to assess the accuracy and precision of both sampling and laboratory activities. Accuracy and precision goals for the laboratory are based on laboratory historical data, specific method requirements and the requirements of each specific project. A more detailed discussion of these goals is provided in Section 11.0.

3.4 Comparability

Comparability is the extent to which comparisons among different measurements of the same quantity or quality will yield valid conclusions. Comparability is a qualitative objective that is attained by utilizing standard techniques for sample analysis and by reporting analytical data in appropriate units. Comparability between Katahdin's analytical results and those obtained by other environmental analytical laboratories will be ensured through the use of EPA, ASTM, and other recognized methods.

3.5 Traceability

Traceability is the extent to which results can be substantiated by hard-copy and/or electronic documentation. Traceability documentation exists in two forms: that which links final numerical results to authoritative measurement standards, and that which explicitly describes the history of each sample from collection to analysis. Refer to Sections 4.4, 6.0 and 10.0 for more specifics on Katahdin Analytical Services procedures.

4.0 STANDARD PRACTICES

4.1 Laboratory Safety

Sample receiving areas and laboratories shall be equipped with suitable hoods, respirators, protective clothing and eye wear, gloves and/or other measures to prevent or minimize staff contact with hazardous substances. Safety equipment such as eyewash stations, drench showers, spill adsorbents and neutralizers, fire extinguishers, first aid materials, and breathing oxygen shall be available.

As a matter of policy, Katahdin Analytical Services shall not accept known initiator explosives, known dioxin-contaminated materials, unusual biohazard materials or radioactive materials containing greater than background levels of radiation.

A laboratory staff member shall be designated as Safety Manager by the General Manager. The Safety Manager prepares and maintains safety-related SOPs, conducts safety and occupational health orientation, training and review sessions as required, and maintains up to date familiarity with safety and occupational health issues pertinent to the laboratory.

The Safety Manager prepares and maintains educational programs as required to comply with state and federal "right to know" legislation.

The Safety Manager or his designee shall conduct an orientation session with each new staff member to familiarize him/her with routine and emergency safety procedures and equipment. Eye protection and a lab coat shall be issued to the employee. A respirator will be issued, as required, after respiratory protection training. Refer to the current revision of Katahdin Analytical Services SOP QA-607, Respiratory Protection. A tour of the laboratory shall be conducted. During the tour, needs for eye, skin, and respiratory protection shall be discussed as well as the use of safety glasses, face shields, goggles, partial and full-face respirators, ventilated work areas, fume hoods, gloves and Tyvek coveralls. The location of eye wash stations, drench showers, fire extinguishers, and first aid equipment shall be shown to the employee and their use shall be described or demonstrated. Fire and spill notification, emergency procedures, and evacuation stations shall be taught during this session. Refer to the current revision of Katahdin Analytical Services SOP QA-602, Employee Training Safety Tours. The orientation concludes with an introduction to potential chemical hazards and the Material Safety Data Sheets (MSDS). MSDS shall be made available for review.

Employees shall be responsible for their own safety. The Operations Manager and Supervisors may require that certain levels of protective equipment be worn when in

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their judgment it is appropriate. Failure of an employee to wear required protective equipment will result in immediate disciplinary action.

4.2 Training

The Operations Manager within the laboratory facility shall be responsible for staff training programs, which may be administered by the Operations Manager, Senior Technical Analyst, Supervisors, Field Services Manager, Client Services Manager, General Manager, and/or QA Officer.

Training shall be conducted for each individual on each procedure that he or she is to perform. Refer to the current revision of Katahdin Analytical Services SOP AD-002, Personnel Training.

No individual shall conduct any analysis, experimental procedure or other professional function without continuous direct supervision until training in that procedure has been completed and the individual's ability to produce acceptable results has been documented.

Training documentation forms and written records of training activities shall be generated by the appropriate Supervisors and Analysts and maintained by the Quality Assurance Department and/or Supervisors.

Records of attendance at professional development seminars, conferences, courses and the like shall be kept in individual training files maintained for all technical staff. Refer to the current revision of Katahdin Analytical Services SOP AD-002, Personnel Training.

4.3 Security and Confidentiality

Three tiers of security shall be maintained within the Katahdin Analytical Services laboratory for the purpose of controlling external influences on samples, analytical processes, and data. This helps assure the completeness, representativeness, accuracy, and precision of analytical results.

The first tier of security maintained shall be controlled access to the laboratory building. Exterior doors to the laboratory building shall remain either locked or continuously monitored by a Katahdin Analytical Services staff member. Keys shall be relinquished to laboratory management every time an employee terminates employment at Katahdin Analytical Services. Posted signs shall direct visitors to the reception office and mark all other areas as off limits to unauthorized personnel. All visitors to the facilities must sign the Visitors' Logbook maintained by the receptionist. All visitors shall be accompanied by a staff member during the duration of their stay on the

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premises. The staff member shall escort the visitor back to the reception area at the end of their visit where they shall sign out in the Visitor's Logbook. Refer to the current revision of Katahdin Analytical Services SOP AD-004, Laboratory Facility Security and Confidentiality for more information. At the close of each day, all doors shall be checked and locked by the last staff member leaving the building.

The second security level shall be within the facility and may be designated as required by the Operations Manager in consultation with the General Manager. The laboratory Operations Manager or individual Supervisors may close specific areas under their responsibility to entry by unauthorized persons. A list of authorized persons shall be prepared and signed by the General Manager. "Closed Areas" shall be designated by prominent postings at all points of access.

The final tier of security shall be comprised of specific secure areas for sample, data and client report storage which shall be lockable within the facilities, and to which access shall be limited to specific individuals or their designees. Security of sample storage areas shall be the responsibility of the Sample Custodian. The current revision of Katahdin Analytical Services SOP SD-001, Sample Receipt and Internal Control. Security of samples and data during analysis and data reduction shall be the responsibility of Analysts, Supervisors and the Operations Manager. Security of client report archives shall be the responsibility of the Quality Assurance Officer or Reporting/Data Management Group Supervisor. These secure areas will be locked whenever these individuals or their designees are not present in the facility.

Designated laboratory sample storage locations are designed to limit access to authorized personnel only, and provisions for lock and key access shall be provided. No samples are to be removed without authorization, which consists of having a worklist requesting analysis on an aliquot. No samples are to be removed without filling out the associated chain-of-custody records.

Periodically, reports and raw data are sent to secure, confidential off-site storage to be archived. This material is retained for a period of time dependent on the state, client or specific program regulations attached to it and may only be retrieved by designated personnel. A list of designees is maintained by the laboratory and a copy by the storage company.

Standard business practices of confidentiality shall apply to all documents and information regarding client analyses. Specific protocols for handling confidential documents are described in the current revision of Katahdin Analytical Services SOP AD-004, Laboratory Facility Security and Confidentiality. Additional protocols for internal identification of samples and data by number only shall be implemented as required under contract-specific Quality Assurance Project Plans.

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4.4 Traceability of Standards, Instrumentation, and Data

Since standard solutions used for analytical method calibration affect all data derived from the method, the importance of quality and traceability shall be paramount.

Laboratory staff may order only materials of certified purity from reputable suppliers. Records of reference material purchased shall be maintained by the Quality Assurance Department or within the appropriate analytical Section. Lot information is kept within each department. Manufacturers may keep purity records on file at their facilities.

Katahdin Analytical Services strives to purchase only the highest quality materials. To that end, reference materials shall be NIST traceable, EPA certified (CRADA), or American Association for Laboratory Accreditation (A2LA) certified whenever possible. Other standards may be analyzed and compared to certified reference material in order to be considered traceable.

If assayed materials are unavailable, the material of highest purity available shall be obtained.

Reference material containers shall be identified with the standard serial reference number and dated upon receipt. Refer to Katahdin Analytical Services SOP CA-004, Standard Preparation and Documentation.

Bound laboratory notebooks shall be used by analysts and technicians to record preparation of working standards from the identified reference material. The following information shall be recorded:

- date of preparation
- analyst's initials
- components of reference material
- source of reference material (lot number and manufacturer)
- date of receipt and expiration of reference material
- source of solvent, if applicable (lot number and manufacturer)
- original concentration/original volume
- amounts used
- final volume of standard prepared
- final concentration(s)
- serial reference number (lab assigned) and expiration date of stock standard used, if applicable
- serial reference number (lab assigned) and expiration date of prepared working standard
- final volume or weight remaining

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All standards containers shall be labeled with, at minimum (as on small glass ampules), the standard serial reference number; when possible, the name, concentration, date of preparation and expiration date of the stock standard. The expiration date assigned to a prepared standard shall not exceed the expiration date of any individual component in the solution.

All diluted working standards not consumed during an analytical session shall be labeled fully, including the serial reference number of any stock standard used in its preparation. Refer to current revisions of Katahdin Analytical Services SOPs QA-004, Traceability of Standards - Organics, QA-010, Traceability of Standards - Metals and Cyanide, and CA-004, Standard Preparation and Documentation for more information.

Instrumentation used shall be as prescribed in the SOP for the analytical method.

All instruments used to collect samples, generate sample results and/or reduce data shall be designated by a unique alphanumeric identifier. This instrument identifier shall appear on the instrument, in the analysts' notebooks, instrument logbooks and/or computer-generated hardcopy for all sample analyses.

Preventive maintenance shall be provided for all instruments and equipment as specified by the manufacturer or as established by the Operations Manager (or Supervisor). Preventive maintenance shall be conducted in order to assure timely, accurate and reproducible analytical processes in a safe laboratory or field environment. Refer to individual SOPs for instrument calibration and maintenance procedures.

All maintenance activities shall be recorded in either the instrument run log or a separate logbook unique to the instrument in accordance with the current revision of Katahdin Analytical Services SOP CA-002, Equipment Maintenance.

All data generated in and/or reported from the laboratory shall include reference to the person(s) who performed the analysis, the date of analysis, the method used, the identification of the instrument and the acceptability of the results in the context of the QC system.

A Work Order created by sample management personnel when samples are logged in and issued to laboratory departments shall be used to initiate a laboratory data file for the project.

All data pertinent to sample preparation shall be recorded by the laboratory staff in bound notebooks with numbered pages, on preprinted bench sheet forms and/or in the Laboratory Information Management System (LIMS). If bench sheets are used, the original forms will be retained in a 3 ring binder and a true copy will be forwarded to the reporting group for inclusion with the archived report package. During the sample preparation process, a preparation record shall be prepared for the project by the preparation analyst. It shall contain the following information:

- Sample identification numbers
- Date of preparation
- Method reference
- Analyst's initials
- Preparation weights and/or volumes (initial and final)
- Reagent/solvents used including manufacturer and lot number
- Relevant blank
- Spike and surrogate data including the serial reference number
- Instrumental analysis to be performed on each extract
- Notable observations

The preparation record shall be filed with the Work Order in the laboratory project file.

At the time of sample analysis, the laboratory identification number, amount injected or otherwise analyzed, any dilution of the original sample and/or extract and other relevant sample data shall be entered into either an analyst's notebook or instrument logbook, or if possible into the instrument header.

All data relevant to the calculations should, where possible, be entered onto the instrument header including sample weight or volume, final volume, dilution, and spike level.

4.5 Accountability

All areas of the laboratory in which samples are received, stored, processed, or analyzed shall be kept in a condition that minimizes the risk of samples becoming lost or accidentally destroyed, contaminated, degraded, mis-identified, improperly handled or otherwise compromised. The following practices shall be followed to assure that data reported represent results on the sample as submitted to the facility.

All employees shall be responsible for the cleanliness and order of their work areas. The Operations Manager(s) and/or QA personnel shall routinely tour the facilities noting major and minor infractions. These shall be brought to the attention of the respective Supervisors who formulate and institute corrective action through their staff.

Each sample, defined as a unit of matrix enclosed by a single container, shall be assigned a laboratory sample number by the Sample Management staff member who receives the sample. Provisions to identify field replicates and additional sample volume shall be incorporated into this procedure as described in the current revision of Katahdin Analytical Services SOP SD-001, Sample Receipt and Internal Control.

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Cross-referencing of laboratory sample numbers and client sample IDs shall be implemented in Sample Management documents as described in the current revisions of Katahdin Analytical Services SOP SD-001, Sample Receipt and Internal Control.

Sample analyses shall be identified by laboratory sample number in analysts' notebooks or instrument logbooks, which shall consist of bound laboratory notebooks with pre-numbered pages or on pre-printed benchsheets.

Transfers of samples in and out of storage shall be recorded in internal custody records maintained by the Sample Custodian.

Standards shall be stored separately from samples, digestates and extracts.

Computerized systems for data generation designed in house shall be validated prior to implementation and shall contain provisions for password access and additional security measures as required.

Where commercial computer software is used for data generation within, the software producer is responsible for validation of their system.

4.6 Sample Analysis

Samples shall be analyzed within holding times as specified in Table 6.1, unless a more restrictive holding time is prescribed under a contract-specific QA Project Plan, State and/or Federal program.

Samples shall be analyzed and experimental procedures conducted following written Standard Operating Procedures (SOPs) which have been approved in writing by management. Where SOPs differ from EPA or Standard Methods, these differences will be noted in the SOP. Refer to Section 8.0, Analytical Procedures. Substantial changes to established procedures shall be authorized in writing by management via an SOP revision process as described in the current revisions of Katahdin Analytical Services SOP QA-553, Preparation of SOPs and SOP QA-013, Document Control Procedures.

Departures from SOPs require management approval prior to implementation and shall be recorded in the raw data. A copy of the logbook page should be filed with the associated report file.

Supervisors shall assure that samples are scheduled for analysis in compliance with the analytical request as issued by the Sample Custodian in the form of a Work Order.

A written worklist system shall be used to assign work to preparatory and instrumentation lab staff members.

4.7 Data Validation

Each department shall have written procedures incorporated into the working SOPs for data validation which incorporate the quality assurance goals of traceability, accountability, completeness, precision and accuracy.

No written reports shall be issued which have not undergone the data validation process. Refer to the current revision of Katahdin Analytical Services SOP QA-002, Data Reduction and Validation, for more information.

4.8 Documentation

All information related to the quality assurance practices outlined in this manual shall be contained in records. This shall include, but not be limited to, standard operating procedures, results of instrument calibrations, analysis of quality control samples, analysis of samples, sample custody and disposal, preparation of standards, corrective action reports, audits and inspections.

The Quality Assurance Department shall keep written inventories of quality-related documents.

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5.0 MATERIALS AND APPARATUS

5.1 Reagents, Solvents and Gases

Chemical reagents, solvents, gases, and standards, supplied by reputable chemical suppliers, are used in the laboratories. All chemical reagents used for analyses shall be at least "Analytical Reagent Grade". Individual method references may indicate specific reagent requirements.

Materials are dated upon receipt in the laboratories. Solvents are checked for purity before use (Section 5.2.2, Solvent Lot Checks). Filters are placed on gas lines supplying instruments as an extra precaution.

All solvents and gases used shall be chosen to assure compliance with specific method and SOP requirements.

5.2 Laboratory Equipment

5.2.1 Refrigerator/Freezer Temperature Logs

Refrigerators and freezers are checked every weekday to ensure that they are operating properly and within established temperature ranges. All information is recorded in bound logbooks. Routine maintenance such as defrosting is performed as needed. Refer to the current revision of Katahdin Analytical Services SOP QA-006, Laboratory QA: Self-Inspection System. Responsibility for performing the checks is assigned within the laboratory section where the units are located. The QA Department is responsible for ascertaining that checks have been performed and that necessary corrective actions have been instituted when needed. The QA Department is responsible for maintaining all historical temperature logsheets and/or logbooks.

5.2.2 Solvent Lot Checks

Solvents are checked for trace contaminants on a lot-by-lot basis. When a new lot is opened, the chromatogram for a concentrated volume of the new solvent lot is checked for any contamination. All information relevant to the check is recorded and maintained in a solvent check file. Responsibility for performing the checks and maintaining the records is assigned to the Extractions Laboratory Supervisor.

5.3 Glassware

All glassware used in the laboratory is maintained in good condition, cleaned, properly stored, and separated according to its specific function. Cracked,

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excessively chipped or otherwise defective glassware is either discarded or repaired. Katahdin Analytical Services purchases the majority of glassware from recognized commercial laboratory glassware suppliers such as Fisher Scientific and Baxter. All volumetric glassware utilized is class "A" certified.

Each laboratory maintains its own set of glassware, completely independent from the other laboratories. Glassware is segregated for cleaning either within each preparation laboratory or within the glassware cleaning laboratory to ensure that the glassware remains dedicated for use by specific laboratories.

5.4 Glassware Cleaning

Laboratory glassware is cleaned in accordance with its intended use at the end of the analytical process. Different cleaning procedures exist for different types of analyses and glassware. Refer to the current revision of Katahdin Analytical Services SOP CA-001, Lab Ware Cleaning.

5.5 Sample Preservation and Storage

Samples are preserved according to the EPA's recommendations (refer to Table 6.1), unless there are overriding considerations, e.g. QAPP, and stored to minimize sample contamination and degradation. The laboratory must rely upon information supplied by the sampling team to document any known hazards. If it is known from past experience that samples contain high levels of contamination, those samples are segregated. All samples are unpacked in a hood. For sample log-in procedures and supporting documentation, see Section 6.0 and the current revisions of Katahdin Analytical Services SOPs SD-001, Sample Receipt and Internal Control, and SD-006, CLP Sample Receipt, Identification and Storage.

A holding blank comprised of deionized (DI) water is placed into the volatiles storage refrigerators in the sample receiving area to monitor the ambient concentration of analytes of concern in that storage unit. The holding blank is created by the Sample Custodian on a weekly basis and is analyzed for volatile organics by GC or GC/MS. Results are maintained at the laboratory.

5.6 Instruments

Laboratory instrumentation used shall be as specified in the protocol for the analytical method. Table 5-1 lists the major analytical instrumentation in use in by Katahdin Analytical Services.

Preventive maintenance is performed for each instrument by manufacturers, analysts and field service technicians on an ongoing basis and the activities documented in a bound instrument maintenance logbook or in the instrument runlogs as described in the

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current revision of Katahdin Analytical Services SOP CA-002, Equipment Maintenance.

Corrective maintenance shall be provided as required for all instruments and equipment and documented in appropriate logbooks. Factory replacement parts, trained service technicians and first quality materials shall be used whenever necessary. It is Katahdin Analytical Services' policy to conduct repairs at the lowest level of complexity necessary and to obtain parts directly from primary manufacturers where critical. The purpose of this policy is to maintain efficiency, economy and reliability of quality maintenance.

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TABLE 5-1
ANALYTICAL INSTRUMENTATION

KEY INSTRUMENTATION	DATE IN SERVICE
Hewlett Packard 5972 GC/MS with Tekmar ALS 2016 automatic sampler and Tekmar LSC 2000 purge and trap sampler equipped with sample heating assembly	1993
Hewlett Packard 5970 GC/MS with Tekmar ALS 2016 automatic sampler and Tekmar LSC 2000 purge and trap sampler equipped with sample heating assembly	1988
Hewlett Packard 5970 GC/MS with Tekmar ALS 2016 automatic sampler and Tekmar LSC 2000 purge and trap sampler	1986
Hewlett Packard 5970 GC/MS with Model 7673A automatic sampler	1989
Hewlett Packard 5970 GC/MS with Model 7673A automatic sampler	1989
Hewlett Packard 5970 GC/MS with Model 7673A automatic sampler	1988
Hewlett Packard Model 5890 gas chromatograph with microcoulometric (Hall) and photoionization detectors and Tekmar ALS 2016 automatic sampler and Tekmar LSC 2000 purge and trap sampler equipped with sample heating assembly	1991
Hewlett Packard Model 5890 gas chromatograph with microcoulometric (Hall) and photoionization detectors and Tekmar ALS 2016 automatic sampler and Tekmar LSC 2000 purge and trap sampler equipped with sample heating assembly	1986
Hewlett Packard Model 5890 gas chromatograph with dual electron capture detectors(ECD), and Hewlett Packard Model 7673A auto samplers	1993
Hewlett Packard Model 5890 gas chromatograph with dual electron capture detectors(ECD), and Hewlett Packard Model 7673A auto samplers	1993
Hewlett Packard Model 5890 gas chromatograph with dual electron capture detectors(ECD), and Hewlett Packard Model 7673A auto samplers	1989
Hewlett Packard Model 5890 gas chromatograph with dual electron capture detectors(ECD), and Hewlett Packard Model 7673A auto samplers	1989
Hewlett Packard Model 5890 gas chromatograph with dual electron capture detectors(ECD), and Hewlett Packard Model 7673A auto samplers	1988
Hewlett Packard Model 5890 gas chromatograph with dual flame ionization detectors and Hewlett Packard Model 7673A auto samplers	1993

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KEY INSTRUMENTATION	DATE IN SERVICE
Hewlett Packard Model 5890 gas chromatograph with dual flame ionization detectors and Tekmar ALS 2016 automatic sampler and Tekmar LSC 2000 purge and trap	1991
Hewlett Packard Model 5890 gas chromatograph with dual flame ionization detectors and Tekmar ALS 2016 automatic sampler and Tekmar LSC 2000 purge and trap	1988
Hewlett Packard Model 5890 gas chromatograph with flame ionization detector and photo ionization detector, and Tekmar ALS 2016 automatic sampler and Tekmar LSC 2000 purge and trap	1988
Hewlett Packard Model 5890 gas chromatograph with dual flame ionization and nitrogen-phosphorous detectors, and Hewlett Packard Model 7673A auto samplers	1992
Hewlett Packard Model 5890 gas chromatograph with flame ionization and nitrogen-phosphorous detectors, and Hewlett Packard Model 7673A auto sampler	1987
Waters HPLC system with 490E programmable wave length detector and 470 scanning fluorescence detectors and auto sampler	1991
ABC Autoprep 1000 GPC with UVD-1 ultraviolet detector, and chart recorder	1994
Thermo Jarrell Ash 61E "Super trace" axial ICAP with autosampler	1994
Thermo Jarrell Ash 61 simultaneous ICAP with autosampler	1991
Perkin-Elmer Plasma II inductively coupled plasma emission spectrophotometer (ICP) with Model 7700 data system and Model AS-51 autosampler	1987
Perkin-Elmer Model 5100 atomic absorption spectrophotometer with Model AS-60 auto sampler, and Model HGA-600 graphite furnace.	1989
Perkin-Elmer Model 4100 atomic absorption spectrophotometer with zeeman graphite furnace, and Model AS-70 auto sampler	1991
Leeman Labs PS200 Automated Mercury Analyzer with auto sampler	1994
Questron micro-processor controlled microwave digestion system	1993
LaChat Quickchem AE Ion Analyzer, and autosampler	1992

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KEY INSTRUMENTATION	DATE IN SERVICE
LaChat Quickchem AE Ion Analyzer, and autosampler	1992
Dionex Ion Chromatograph	1991
Dohrmann DC80 carbon analyzer with infrared gas analyzer and autosampler	1987
Dohrmann DC80 carbon analyzer with infrared gas analyzer, Dohrmann solids furnace, and autosampler	1994
Mattson Galaxy Model 2020 FT-IR spectrometer equipped with FIRST software package	1991

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6.0 SAMPLE CUSTODY

Chain-of-Custody encompasses three major elements: field sampling, laboratory analysis and final data file. A Chain-of-Custody (COC) documents possession of a sample from time of receipt through the analytical process. Katahdin Analytical Services has implemented standard operating procedures to ensure that sample custody objectives of traceability and responsibility are achieved for every project. This section covers quality related activities from the receipt of samples at the laboratory through the issuance of final analytical data and the storage of data in its final data file.

6.1 Chain-of-Custody

The National Enforcement Investigations Center (NEIC) of EPA defines evidence of custody in the following manner:

- It is in your actual possession, or
- It is in your view, after being in your physical possession, or
- It was in your possession and then you locked or sealed it up to prevent tampering, or
- It is in a secure area.

Katahdin Analytical Services sample custody and sample control procedures ensure that:

- All samples are uniquely identified;
- Samples are analyzed as requested and are traceable to their records;
- Important sample characteristics are preserved;
- Samples are protected from loss or damage;
- Any alteration of samples (e.g., filtration, preservation) is documented; and
- A record of sample integrity is established for legal purposes.

Samples may be physical evidence and should be handled according to certain procedural safeguards. In order to facilitate documentation of sample monitoring from

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collection through analysis, several forms are used by Katahdin Analytical Services personnel. Field personnel document field activities on standardized field data records and laboratory personnel record sample handling activities on internal chain-of-custody forms and/or sample control records.

A Chain-of-Custody Form (Figure 6-1) is completed by field personnel or client representatives for all samples received by the laboratory; the form accompanies the samples received by the laboratory. The completed Chain-of-Custody Form should include the following information:

- Client and project name
- Project location
- Field sample number/identification
- Number and type of containers
- Date and time sampled
- Sample matrix
- Preservative
- Analysis requested
- Sampler signature
- Signature of person relinquishing samples
- Date and time relinquished
- Sampler remarks
- Custody Seal Number (if applicable)

The record is filled out completely and legibly. Errors are corrected by drawing a single line through and initialing and dating the error. The correct information is then recorded with indelible ink. All transfers of samples except to and from commercial couriers must be recorded on the Chain-of-Custody via the "relinquished" and "received by" sections. All information except signatures may be printed.

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When samples are received into the laboratory (refer to Section 6.3), Sample Management Personnel sign and note date/time received on the accompanying airbill. The Chain-of-Custody is signed after Sample Management Personnel have verified the contents of the sample shipment. Sample Management Personnel verify the integrity of samples as they are unpacked, ascertain whether the Custody Seal is intact, whether the samples are received intact or broken, whether the samples are appropriately preserved and properly identified, what packing material was present in the shipping container, the temperature of the container, and any other notable observations. This information is explicitly documented on the Sample Receipt Condition Report (SRCR) and the client is contacted if any discrepancies or problems are found. If the integrity requirements are met or after any discrepancies are resolved, the sample is assigned a laboratory identification number and transferred to the appropriate storage location for storage until preparation and analysis. Pertinent information concerning each sample is entered into the Laboratory Information Management System (LIMS); refer to Section 6.3 for more information on log-in procedures.

Once samples are in the laboratory, an internal custody record is generated to track the transport and status of each sample from storage to the laboratory and back to storage. After sample log-in, a project file is started by the client services representative and/or document control officer which includes the Chain-of-Custody record and all sample receipt documentation. Further detail on internal laboratory custody procedures is provided in subsequent subsections.

6.2 Sampling Kits

In general, sampling kits comprise the following:

- Sampling containers
- Preservatives (upon request) and appropriate MSDSs
- Chain-of-Custody forms
- Custody Seals (upon request)
- Sample labels
- Packing Material
- Shipping containers
- Ice Packs (upon request)
- Temperature blanks

Sample kit requests are received by the laboratory personnel from a project manager or sampling team members via telephone request, memo, or facsimile.

Based upon the specific request, the Sample Custodian or Project Manager determines the appropriate containers, preservatives and the necessary volume/quantity to specify for the analysis. This information is outlined in Table 6-1. Refer to the current

revision of Katahdin Analytical Services SOP QA-014, Sample Container Preparation and Shipping.

6.2.1 Sample Containers

All volatile organics analysis (VOA) vials (40 mL) and some containers for other analyses are purchased pre-cleaned from a commercial source. In some cases pre-cleaned containers are received with certificates of analysis documenting the concentration levels of applicable analytes for each container type and lot. Certificates of analysis accompanying container lots are maintained by the laboratory, and a record is kept of sample container lot numbers utilized for each project. All sample containers are purchased from reputable suppliers with products meeting project or protocol requirements.

Sample containers that have not been purchased in a pre-cleaned condition with accompanying documentation are tested internally for cleanliness. An internal lot number is assigned to each batch of containers purchased so that the batch may be tracked and tested for contaminants. One or two bottles per batch per type of analysis is taken at random and tested. Katahdin Analytical Services tests its glassware for cyanide, 23 metals, acid/base/neutrals (ABNs), pesticides, PCBs, and volatile organics analyses (VOAs) as follows:

Cyanide:	Fill a one liter plastic bottle with DI water and preserve with sodium hydroxide (NaOH). Analyze in accordance with standard laboratory procedures.
Metals:	Fill a 500 mL polyethylene bottle with 100 mL of 2% nitric acid solution from the metals instrumentation room. Shake. Analyze for metals following standard laboratory procedures.
ABNs,	Pesticides, PCBs: Submit an empty 1 L glass jar to the Organics Extractions Laboratory for testing with instructions for special extraction procedures to be employed as follows - Add 60 mL MeCl_2 , shake for 2 minutes, KD to appropriate test volume and analyze for ABNs, pesticides and PCBs following standard laboratory procedures.
VOA:	Submit an empty 120 mL jar to the volatiles laboratory with instructions to fill the jar with VOA-free DI water. Let stand for 24 hours and analyze following standard laboratory procedures.

Under no circumstances are used bottles sent out to the field.

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Sampling containers are stored in an area of the Katahdin Analytical Services laboratory designated for staging sampling events and separate from the analytical laboratories. The containers are stored by lot number in the boxes in which they are received. Refer to the current revision of Katahdin Analytical Services SOP QA-014, Sample Container Preparation and Shipment, for more information.

6.2.2 Assembling Kits

All glass containers are to be surrounded with packing material to prevent damage.

All preservatives are stored in 10 - 20 mL plastic squeeze bottles, contained within 250 mL plastic wide mouth jars which are appropriately labeled or containers may be pre-charged.

The appropriate number of labels and COCs are affixed to the ziplock plastic bag that is included with the kit.

All the above contents are to be placed inside a cooler with an appropriate cooling medium (if requested) and a temperature blank. Field personnel are responsible for packing the shipping container to maintain the proper temperature. Ice packs may be provided upon request. Sample containers are secured for shipment using appropriate packing materials.

Sample kits are delivered to the sampling team via the appropriate courier or personally picked up by the sampling team.

Refer to current revision of Katahdin Analytical Services SOP QA-014, Sample Container Preparation and Shipment.

6.3 Sample Receipt and Log-In

Refer to the current revisions of Katahdin Analytical Services SOPs SD-001, Sample Receipt and Internal Control, and SD-006, CLP Sample Receipt, Identification, and Storage.

Typically, samples are received by the laboratories during normal business hours (8:00 am to 6:00 pm), Monday through Friday and, when known in advance, from 8:00 am to noon on Saturday.

Shipments for after hours and Sunday delivery are prearranged with laboratory personnel to ensure that personnel will be available to sign the airbill, record the date

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and time of sample receipt and place the cooler in the sample management area under refrigeration until the next business day.

Upon sample receipt, the coolers are inspected for the general condition of the Custody Seal, if present. The coolers are then opened and each sample is inspected for damage. The sample containers are removed from the packing material and identities are verified against the Chain-of-Custody. All information regarding sample condition upon receipt is documented on the Sample Receipt Condition Report (SRCR). The report documents:

- Name of person if hand delivered;
- Presence/Absence of COC forms and Custody Seals;
- Condition of the custody seals if present;
- Discrepancies noted;
- Holding times and preservatives used;
- Proper sample containers;
- Appropriate sample volume; and
- Cooler temperature

The Sample Receipt Condition Report is completed by signing and recording the date and time of sample receipt. If there are any discrepancies or problems with the samples or accompanying documentation, the Sample Custodian immediately notifies the client or the appropriate Katahdin Analytical Services project manager for resolution.

The samples are logged into the Katahdin Analytical Services Laboratory Information Management System (LIMS) by the Sample Custodian or Project Manager. Each group of samples received is assigned a unique laboratory number (work order number) at log-in. Each sample within the group is assigned a unique Sample Number by appending to the work order number a numerical suffix serialized to account for the number of samples in the sample group. All pertinent sample information, as detailed on the Chain-of-Custody, SCRC, and other project related documentation, is entered into the LIMS and dispatched to the analytical groups for LIMS generation of preparation and analysis worklists. Upon completion of the log-in process, samples are placed into appropriate storage area. Transfer of the samples from the Sample

Custodian to each storage location is documented by the Sample Custodian on internal chain-of-custody records. Refer to the current revision of Katahdin Analytical Services SOP SD-001, Sample Receipt and Internal Control, and SD-006, CLP Sample Receipt, Identification and Storage, for more information.

6.4 Initiation of Testing Program

Once samples have been logged into the laboratory system, the Chain-of-Custody, Sample Receipt Condition Report, and other related documentation are assembled into a project file. If a sample group is a priority or rush order, or if samples have short holding times, Sample Management Personnel will immediately provide notification to the appropriate laboratory personnel that samples have arrived and are ready for processing; the Sample Custodian may deliver the samples directly to the lab. LIMS-generated worklists for each laboratory section list all samples requiring preparation and analysis, the type of quality control samples required, the priority status, and test(s) required.

A system for tracking the status and chain-of-custody of samples within the laboratory is in place once sample processing begins. Internal chain-of-custody records are used by sample preparation and analysis (as applicable) personnel to document the transfer of samples from storage locations to the preparation/analysis lab. These records also document the transfer of prepared sample extracts from sample preparation through analysis. Each internal chain-of-custody record documents the following:

- Who removed the sample or extract from storage;
- When the sample or extract was removed from storage;
- Which sample(s) was removed from storage;
- If the entire sample was entirely consumed; and
- When and by whom the remainder of sample was returned to storage.

Completed internal chain-of-custody records are maintained by the Sample Management Group.

The second system for tracking samples is the LIMS generated worklist. The worklist is generated daily (at minimum) and lists the status for each sample batch/project within each analytical section. The worklist is distributed to or generated within each laboratory section. To update the worklist status of each sample or sample batch/project, pertinent information is entered into the LIMS once sample preparation and/or analysis has been completed.

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6.5 Sample Disposal

After completion of sample analysis and submission of the analytical report, unused portions of samples are retained by the laboratory for a minimum of two weeks. Unless otherwise specified by the client or analytical program (e.g., USEPA CLP), a minimum of two weeks after submission of the data report, samples will be disposed of according to the nature of the samples. The designated hazardous waste manager receives a copy of each data report or a LIMS-generated sample disposal summary (created from analytical data report entries accessed through LIMS) and uses that information to select the appropriate waste stream for the samples. Samples determined to be hazardous waste are handled by state and federally licensed hazardous waste disposal firms.

Upon disposal of samples, a record is generated by the hazardous waste manager listing the sample number, inherent waste stream and date disposed. This record is maintained by the hazardous waste manager and Sample Management.

6.6 Subcontracting Analytical Services

Every effort is made to perform all requested chemical analyses at Katahdin Analytical Services for our clients. There are, however, instances where subcontracting of analytical services is necessary. Currently, the following analyses require subcontracting by Katahdin Analytical Services:

- Bacteriological (other than total and fecal coliforms)
- Asbestos
- Dioxins
- Radiological

When subcontracting becomes necessary, a preliminary verbal communication with an appropriate laboratory is undertaken. Work performed under specific protocols may involve special consideration; for instance, work involving NFESC samples may be subcontracted only to NFESC approved laboratories. The contact and preliminary arrangements and terms of agreement are made between the Katahdin Analytical Services Project Manager and the appropriate subcontract laboratory personnel (i.e., laboratory manager, client services contact, or the appropriate laboratory section manager). The specific terms of the subcontract laboratory agreement should include (when applicable):

- Method of analysis (including method reference, e.g., EPA SW-846, APHA, etc.);

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- Target analyte list required;
- Number and type of samples expected;
- Project specific QA/QC requirements (including reporting limit considerations);
- Deliverables required (including electronic deliverable if applicable);
- Applicable laboratory certification status;
- Price per analysis; and
- Turn around time requirements.

Chain-of-Custody forms shall be generated for samples which require subcontracting to other laboratories. The sample management personnel repackage the samples for shipment, create a transfer chain-of-custody form and record the following information:

- Katahdin Analytical Services Sample Number(s);
- Sample matrix;
- Requested analysis;
- Special instructions (quick turn around, required detection limits, unusual information about the samples or analytical procedure); and
- Signature in "Relinquished By".

All subcontracted sample data reports are reviewed for completeness after receipt by Katahdin Analytical Services. The subcontracted data results may be reported through Katahdin Analytical Services's LIMS or the subcontracted data report may be appended in whole to Katahdin Analytical Services's analytical data report. The final report format is determined through communication between the Katahdin Analytical Services Project Manager, Data Management/Reporting Group, and the client.

Table 6-1
 Sampling and Preservation Requirements

Parameter	Method	Required Volume & Containers ²	Preservation	Holding Time (days)
<u>Organics:</u>				
Drinking water GC/MS VOA	EPA 524.2	4 x 40 ml Glass vial	HCl; 4°C ¹ ; No headspace	14
Wastewater GC/MS VOA	SW846 8240/EPA 624	2 x 40 ml Glass vial	HCl; 4°C ¹ ; No headspace	14
	SW846 8260	4 x 40 ml Glass vial	HCl; 4°C ¹ ; No headspace	14
Purgeable Halocarbons	EPA 601/SW846 8010	2 x 40 ml Glass vial	HCl; 4°C ¹ ; No headspace	14
Aromatics	EPA 602/SW846 8020	2 x 40 ml Glass vial	HCl; 4°C ¹ ; No headspace	14
TOX	SW846 9020	250 mL Glass, amber	H ₂ SO ₄ ; 4°C; No headspace	28
Acids/Base Neutrals	EPA 625/SW846 8270	1000 ml/30 g Glass, amber	4°C ¹	7(14)/40
Pesticides/PCB's	EPA 608/SW846 8081	1000 ml/30 g Glass	NaOH, H ₂ SO ₄ , pH 5-9; 4°C ¹	7(14)/40
Herbicides (SDWA)	SW846 8150	1000 ml/30 g Glass	4°C ¹	7(14)/40
Petroleum Hydrocarbons-GC/FID	ASTM D-3328-78	1000 ml/30 g Glass	H ₂ SO ₄ ; 4°C	7(14)/40 ⁴
Petroleum Hydrocarbons-IR	EPA 418.1	1000 ml/30 g Glass	H ₂ SO ₄ ; 4°C	28
Oil & Grease - Gravimetry	EPA 413.1	1000 ml/30 g Glass	H ₂ SO ₄ ; 4°C	28
Oil & Grease - IR	EPA 413.2	1000 ml/30 g Glass	H ₂ SO ₄ ; 4°C	28
NM2P	EPA 625/SW846 8270	1000 ml/30 g Glass	4°C	7(14)/40
Total Phenolics	EPA 420.3	200 ml/30 g Glass, amber	H ₂ SO ₄ ; 4°C	28
Dioxins (subcontracted)	SW846 8280	1000 ml/100 g Glass	4°C ¹	8280=14(28)
	SW846 8290	1000 ml/100 g Glass		8290=no HT
Glycols(propylene,ethylene,diethylene)	Katahdin SOP	2 x 40 ml Glass vial/20 g	4°C	N/A
Gas Range Organics (GROs)	SW846 8015 mod.	2 x 40 ml Glass vial	HCl; 4°C ¹ ; No headspace	
<u>Metals:</u>				
Mercury	245.1/7470 (7471)	50 ml/10 g	HNO ₃	28
Arsenic & Selenium	EPA 200/7000 Series	50 ml/10 g	HNO ₃	180
Lead, Thallium, Antimony	EPA 200/7000 Series	50 ml/10 g	HNO ₃	180
All other metals (ICP metals)	EPA 200.7/SW 6010	50 ml/10 g	HNO ₃	180
plus Hardness	SM 314A/EPA 200.7	(Included)	HNO ₃	180
CLP Metals	USEPA CLP SOW	100 ml/10 g	HNO ₃	

The following elements can be analyzed by ICP: Al, Ag, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mo, Mn, Si, Sr, Sn, Na, Ni, Pb, Ti, V and Zn in water, wastewater, and digested solids. As, Pb (water), Se, Ti and other metals normally analyzed by furnace may be determined by ICP but only with reduced sensitivity and therefore higher detection limits. Hg is analyzed by cold vapor.

NOTE: If detection limits lower than normal are desired, triple the sample volume for water samples.
 If duplicates and spikes are required, triple the sample volume for water samples.

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TABLE 6-1 (cont.)
Sampling and Preservation Requirements

Parameter	Method	Required Volume & Containers ¹	Preservation ²	Holding Time (days)
Inorganics:				
Acidity	EPA 305.1	125 ml/ 2 g		4°C 14
Alkalinity	EPA 310.1	125 ml/ 2 g		4°C 14
Asbestos (subcontracted)		1000 ml Glass/ 30 g		4°C
Bromide	EPA 300.0	10 ml/20 g		4°C 28
BOD	EPA 405.1	250 ml		4°C 2
Chloride	EPA 300.0 or 325.1	10 ml/20 g		4°C 28
COD	EPA 410.4	50 ml	H ₂ SO ₄	4°C 28
Coliform Bacteria	APHA 9222	125 ml sterile		4°C ² 24(6) Hour
Color	EPA 110.2	100 ml		4°C 2
Conductance	EPA 120.1	100 ml		4°C 28
Cyanide, Total	EPA 335.2/SW 9010	1000 ml/25 g	NaOH;	4°C ¹ 14
Cyanide, Amenable	EPA 335.1/SW 9010	1000 ml/25 g	NaOH;	4°C ¹ 14
Flashpoint	ASTM D 93-77	80 ml/80 g		4°C N/A
Fluoride	EPA 340.1/340.2	100 ml (NPDES=500ml) Plastic		4°C 28
Free Liquids (paint filter test)	SW846 9095	100 g		4°C N/A
Hexavalent Chromium	SW846 7196	125 ml/20 g		4°C 1
Ignitability	SW846 1010	80 ml/80 g		4°C N/A
MBAS (Surfactants)	EPA 425.1	150 ml		4°C 2
Nitrogen - Ammonia	EPA 350.1 or .3	200 ml/ 5 g	H ₂ SO ₄	4°C 28
- Nitrate	EPA 300.0 or 353.2	25 ml/20 g		4°C 2
- Nitrite	EPA 300.0 or 354.1	25 ml/20 g		4°C 2
Nitrogen - Nitrate+nitrite	EPA 353.2	25 ml/20 g	H ₂ SO ₄	4°C 28
- TKN	EPA 351.3	200 ml/ 5 g	H ₂ SO ₄	4°C 28
- TON (NH ₄ & TKN)	EPA 350.3/351.3	250 ml/ 5 g	H ₂ SO ₄	4°C 28
Ortho Phosphate-P	EPA 365.1 or .3	100 ml		4°C 2
pH	EPA 150.1	25 ml		Field T
Phosphorus, Total	EPA 365.3 or .4	100 ml/ 5 g	H ₂ SO ₄	4°C 28
Radiology - R,U,Alpha,Beta,Gamma(sub'ed)		3000 ml	HNO ₃ ;	4°C 180
Radon (subcontracted)		2 x 40 ml Glass		4°C 2
Reactivity- Sulfide Spot Test	SM 427.3C	10 ml/10 g		4°C N/A
Reactivity- Cyanide Spot Test	SM 412J	10 ml/10 g		4°C N/A
Reactivity- Releasable Cyanide	SW 846, Sec. 7.3.3.2	10 g	No Headspace, 4°C	N/A
Reactivity- Releasable Sulfide	SW 846, Sec. 7.3.4.1	10 g	No Headspace, 4°C	N/A
Silicate, Reactive (subcontracted)	EPA 370.1	100 ml/ 2 g Plastic		4°C 28
Solids, Settleable	EPA 160.5	1000 ml		4°C 2
Solids, Total (TS)	EPA 160.3	100 ml ⁴		4°C 7
Solids, Total Suspended (TSS)	EPA 160.2	100 ml ⁴		4°C 7
Solids, Total Dissolved (TDS)	EPA 160.1	100 ml ⁴		4°C 7
Solids, Total Volatile (TVS)	EPA 160.4	100 ml ⁴		4°C 7
Solids, Total Suspended Volatile	EPA 160.4 or .2	100 ml ⁴		4°C 7
% Solids (% moisture)	APHA 2540G	30 g		4°C N/A
Specific Gravity	EPA/CE 1981	30 ml		4°C N/A
Sulfate	EPA 375.4	250 ml/20 g		4°C 28
Sulfide	EPA 376.2	500 ml	ZnAc; NaOH, pH > 9; 4°C	7
Sulfite	EPA 377.1	100 ml		Field Te:
Tannins and Lignins (subcontracted)	APHA 3550B	100 ml		4°C N/A

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TABLE 6-1 (cont.)
Sampling and Preservation Requirements

Parameter	Method	Required Volume & Containers ¹	Preservation ⁷	Holding Time (days)
Inorganics:				
TIC (Total Inorganic Carbon)	EPA 415.1 mod	60 ml/ 2 g	No Headspace H ₂ SO ₄	4°C 28
TOC	EPA 415.1	60 ml/ 2 g		4°C 28
Turbidity	EPA 180.1	100 ml		4°C 2
Viscosity	ASTM D-445	300 ml		4°C N/A
EPTOX	SW846 1310	250 grams	N/A	N/A
TCLP	Fed.Reg.Vol. 55 June 29, 1990 Rules and Reg.	250 grams (2 X 250 g containers if VOAs are required)	4°C	See Below
	Waters	4 L	4°C	

TCLP PARAMETER	FROM COLLECTION TO TCLP EXTRACTION	FROM TCLP EXTRACTION TO PREPARATIVE EXT'N	FROM PREP EXT'N TO ANALYSIS
VOLATILES	14	N/A	14
SEMIVOLATILES	14	7	40
MERCURY	28	N/A	28
METALS EXCEPT MERCURY	180	N/A	180
PESTS/HERBS	14	7	40

References:

- EPA = 40 CFR 136
- SW846 = Test Methods for Evaluating Solid Waste Physical/Chemical Methods, US EPA SW846, 3rd edition, 1986
- SM = Standard Methods For The Examination of Water and Wastewater, 16th ed., 1985
- APHA = Standard Methods For The Examination of Water and Wastewater, 17th ed., 1989
- ASTM = American Society for Testing and Materials

¹ 6g/L ascorbic acid if residual chlorine is present.

² 10% sodium thiosulfate if residual chlorine is present.

³ Plastic or glass jars are suitable unless otherwise indicated.

⁴ TSS, TDS and TSVS are performed on the same 100 ml sample. TS & TVS are performed on the same 100 ml sample.

⁵ "Holding time is not to exceed six hours if the data is to be used in litigation."

⁶ No holding time is published - these times are suggested/borrowed from the ABN hold time.

⁷ Acid preservations (H₂SO₄, HNO₃, HCl) are adjusted to pH < 2, base preservations (NaOH) are adjusted to pH > 12 unless otherwise noted.

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TABLE 6-1 (cont.)

CLP ORGANIC SAMPLE HOLDING TIME REQUIREMENTS
OLM01.9, ILMO3.0

Parameter	Preservation	Holding Time (days)
Volatiles Waters and Solids	dark; 4°C ± 2°C	10 ^a
ABN Liquid-Liquid Procedures	"	5
ABN Soil/Sed. Extractions by Sonication	"	10
ABN Analysis	"	40 ^b
Pesticides - Water Extraction by Sep. Funnel	"	5
Pesticides - Water Extraction Liquid-Liquid Cont.	"	5
Pesticides - Soils/Sed. Extraction by Sonication	"	10
Pesticides - Analysis of Extracts	"	40 ^b

^a Holding times are all "days from VTSR" (Validated Time of Sample Receipt)

^b Days from time of extraction

NYASP HOLDING TIME REQUIREMENTS

PARAMETER	START EXTRACTION WITHIN	FINISH TIME
ABN all matrices	5 days	7 days
Pesticide Waters	5 days	7 days
Pesticide Solids/Oils	5 days	10 days
Re-extract ABN all matrices	10 days	12 days
Re-extract Pesticide Waters	10 days	12 days
Re-extract Pesticide Solids/Oils	10 days	14 days

^a Holding times are all "days from VTSR" (Validated Time of Sample Receipt)

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7.0 CALIBRATION PROCEDURES AND FREQUENCY

All instruments and equipment used in Katahdin Analytical Services laboratories must follow a well defined calibration routine. Calibration may be accomplished by laboratory personnel using certified reference materials traceable to NIST or EPA certified materials or by external calibration agencies or equipment manufacturers. The discussion presented here is general in nature because the requirements for calibration are instrument (or equipment) and method specific. Details of calibrations can be found in Katahdin Analytical Services Standard Operating Procedures, analytical methods, and operations manuals.

7.1 Standards and Traceability

Analytical standards are prepared from pure compounds or are purchased prepared from reputable vendors. These standards provide the stock used to prepare serial dilutions for calibration and spiking standards. Each laboratory section is responsible for the preparation, storage and disposal of its standards. Pertinent standards preparation information is recorded into section specific standards logbooks in order to document traceability of prepared standards to their source material(s).

Each standard is given an internal identification number. The preparation of all stock standards shall be documented in a standards notebook which is used to record the date of preparation, analyst's initials, source of the reference material, standard components, amounts used, final volume, final concentration(s), solvent used, expiration date of prepared standard, and the assigned serial reference number (internal identification number) of the stock solution. All standards shall be labeled, at minimum, with the standard serial reference number and expiration date, and, if space permits, the name of the standard, concentration, date of preparation and initials of the preparer. All diluted working standards not consumed during an analytical session shall be labeled fully, including the serial reference number of any stock standard used in its preparation.

If no expiration date has been assigned by the manufacturer, then an expiration date of one year from the date of preparation (or the date first opened in the case of sealed ampules) is generally reported unless degradation prior to this date is observed. The expiration date assigned to a prepared standard shall not exceed the expiration date of any individual component in the solution. To help determine if a standard has degraded, one must note inconsistencies. For instance, very poor recoveries from newly prepared quality control spikes or abnormally low instrument response to a specific standard are indications of possible standard degradation. However, for some standards, degradation is more easily noted. For instance, DDT breaks down to form DDD and DDE. Here one can visually note, on a chromatogram, the degradation of

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DDT by the increased concentrations of DDD and DDE. If degradation is observed before the default expiration date, it should be noted in the standards notebook for that standard entry and the standard removed from service. Refer to the current revision of Katahdin Analytical Services SOP CA-004, Standard Preparation and Documentation, for more information.

Reference standards must be traceable to national standards of measurement (e.g. NIST) whenever possible. Standards used for calibration must be traceable, when possible, to national standards of measurement, either directly through supplier documentation or by verification against a second source traceable reference standard.

Refer to the current revisions of Katahdin Analytical Services SOPs QA-004, Traceability of Standards - Organics, and QA-010, Traceability of Standards - Metals and Cyanide, for more information on standards traceability procedures.

7.2 Calibration Procedures

Calibration standards for each parameter are chosen to bracket the expected concentrations of those parameters in the sample, and to operate within the linear response range of the instrument. Sample concentrations that fall above calibration range are diluted and reanalyzed until they are within the calibration range. Calibration standards are prepared typically at a minimum of three concentration levels, usually chosen at approximately two times, three to five times, and five to ten times the estimated method detection limit plus a calibration blank, with the exception of most organic analyses which do not require a calibration blank. Either an internal standard or external standard quantification technique can be utilized. The reporting limit is verified by analysis of a standard at the reporting limit.

Instrumental responses to calibration standards for each parameter are subjected to an appropriate statistical test of fitness (least squares linear regression, quadratic equation, or relative standard deviation of response factors) or as required by the method or QAPP. The calibration must reflect an acceptable correlation of data points or linearity to be acceptable. In cases where the calibration data are outside of these criteria, the analyst must rerun the calibration standards (meeting the same criteria), changing instrumental conditions as necessary until appropriate acceptance limits for the method are achieved.

For analyses which are performed frequently and for which substantial calibration data are available, a complete recalibration is not required each time an analysis is performed providing that the following criterion is met: one calibration standard is analyzed at the beginning of the analysis which may vary from the expected response (based on the most recent initial calibration curve) by no more than $\pm 25\%$ or as

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specified by the method, SOP or QAPP, whichever is more stringent. If this criterion is not met, a complete recalibration is necessary.

During the course of analysis, calibration standards are routinely analyzed to ensure that the instrumental response has not exceeded the method acceptance limits. The continuing calibration criteria stipulated in each method or SOP are used by the analyst to determine whether the instrument must be recalibrated or the instrument conditions further optimized.

The accuracy of working standards is verified by comparison with a standard from an independent source.

All organic standards are refrigerated or frozen as specified in the applicable analytical methods. Inorganic standards are refrigerated as necessary.

7.2.1 Analytical Balances

Every six months, calibration of the entire analytical range shall be checked by a qualified service technician. The calibration of each balance is checked each day of use using weights traceable to the National Institute of Standards and Technology (NIST). Calibration weights are certified to ASTM Class 1 and are recertified every five years. If balances are calibrated by an external agency, verification of their weights shall be provided. All information pertaining to balance maintenance and calibration is found in the individual balance logbook and/or is maintained by the QA Department.

7.2.2 Thermometers

Certified, or reference, thermometers are maintained for checking calibration of working thermometers. Reference thermometers are provided with NIST traceability for initial calibration and are recertified every five years with equipment directly traceable to the NIST.

Each thermometer is individually numbered and tagged with the identification number. Working thermometers are compared with the reference thermometers on an annual basis; digital working thermometers are verified for accuracy on a quarterly frequency. In addition, working thermometers are visually inspected by laboratory personnel prior to use. Calibration temperatures and acceptance criteria are based upon the working range of the thermometer and the accuracy required for its use. An inventory of thermometers, their identification, calibration status and due date of next calibration is maintained by the QA Department or designated area.

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7.2.3 pH/Electrometers

The meter is calibrated using buffer solutions before use each day, and once after each four hours of use. Refer to the current revision of Katahdin Analytical Services SOP CA-055, Hydrogen Ion Concentration Measurement (pH) in Aqueous Samples and Solutions.

7.2.4 Spectrophotometers

During use, spectrophotometer performance is checked against initial calibration verification standards (ICVs) and continuing calibration verification standards (CCVs). The instrument operating capability is also evaluated every year by an outside service. Wavelength verification occurs every six months.

7.2.5 Ovens

Oven temperatures are monitored using a mercury thermometer which is placed in a beaker of sand and kept inside the oven. This thermometer is compared to a NIST traceable thermometer annually. Oven temperature is checked every day of use and recorded in the appropriate logbook.

7.3 GC/MS Calibration Procedures

The minimum operations necessary to satisfy analytical requirements associated with the determination of organic compounds in water and soil/sediment samples are listed below. The following operations should be performed routinely in the laboratory:

- Documentation of GC/MS mass calibration and abundance pattern
- Documentation of GC/MS response factor stability
- Internal standard response and retention time

Prior to initiating data collection, it is necessary to establish that a given GC/MS meets the standard mass spectral abundance criteria. This is accomplished through the analysis of decafluorotriphenylphosphine (DFTPP) for base/neutral and acid (BNA) semivolatile compounds or p-bromofluorobenzene (BFB) for volatile compounds. Each GC/MS system used for the analysis of semivolatile organic compounds or volatile organic compounds must be tuned to meet method or program specific ion abundance criteria before analysis of standards, blanks, or samples can proceed.

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Prior to the analysis of samples and after tuning criteria have been met, the GC/MS system must be initially calibrated with the method specified number (typically three to five) of concentrations of each compound being analyzed to determine the linearity of response. USEPA methods typically specify the concentration levels to be used for initial calibration and the specific internal standard to be used on a compound-by-compound basis for quantification. The response factor (RF) for each compound at each concentration level is calculated using the following Equation 7.1:

$$RF = \frac{A_x}{A_{is}} * \frac{C_{is}}{C_x} \quad (7.1)$$

where:

A_x = area of the characteristic ion for the compound to be measured.

A_{is} = area of the characteristic ion for the specific internal standards.

C_{is} = concentration of the internal standard

C_x = concentration of the compound to be measured

Using the RF from the initial calibration, the percent relative standard deviation (%RSD) for compounds identified as Calibration Check Compounds (CCCs) is calculated using Equation 7.2:

$$\%RSD = \frac{S}{X} \times 100 \quad (7.2)$$

where:

RSD = relative standard deviation

S = standard deviation of initial five response factors (per compound).

X = mean of initial five response factors (per compound).

The %RSD for each individual CCC should be less than 25% or as specified by the method. This criteria must be met for the initial calibration to be valid.

A calibration check standard containing all compounds of interest as well as all required internal standards and surrogates, is performed each day of analysis. The RF data from

the standard is compared each day against the average RF from the initial calibration for a specific instrument. If the response to a calibration check standard differs from the initial calibration by more than $\pm 25\%$ or as specified by the method, then investigation and corrective action must be performed, including a complete recalibration if necessary.

7.4 Non GC/MS Chromatography Calibration Procedures

Initially, a three or five point calibration curve, consisting of all compounds of interest plus a calibration blank, is established to define the usable range of the instrument. Calibration may be accomplished as best-fit line, quadratic equation, or average RF in accordance with the applicable method. The curve is determined to be linear if the correlation coefficient is ≥ 0.995 . Linearity may also be determined using response factors. Response factors are calculated for each compound at each concentration level. These RFs will be averaged to generate the mean RF for each compound over the range of the standard curve. The curve is determined to be linear if the RSD of the response factors is $< 25\%$ or as specified in the method. The mean response factor will be used to calculate the sample concentration of the compound of interest. When sample responses exceed the range of the standard curve, the sample must be diluted to fall within the range of the standard curve and be reanalyzed. The results of the daily GC standardization are tabulated and filed with the corresponding sample analyses. Daily full calibration is not necessary if a calibration check standard verifies the initial calibration curve. If the response to a calibration check standard differs from the initial calibration by more than $\pm 15\%$ for any analyte being quantitated or as specified by the method, then investigation and corrective action will be performed, including complete recalibration, if necessary.

Continuing Calibration is checked as described in Katahdin Analytical Services SOPs or methods.

7.5 Calibration of Inductively Coupled Argon Plasma Spectrophotometer (ICP) and Atomic Absorption Spectrophotometer (AAS)

ICP and AAS instruments are standardized for the metal of interest by the analysis of a set of calibration standards prepared by diluting a stock solution of known concentration. For the AAS, the concentration of the calibration standards is chosen to cover the working range of the instrument. For ICP analysis, a linearity range standard (LRS) is run at the time of calibration to establish the upper limit of quantitation. Subsequently, all sample measurements are made within this working range. Once the working standards are prepared, they are analyzed on the ICP or AAS and the instrument response is calibrated to provide a direct readout in concentration.

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The calibration is accomplished by entering the metal concentration equivalent to the readout in absorbance units (or emission intensity) during analysis of the working standards.

Once the instrument has been initially calibrated, the analysis of the working standards is repeated during sample analysis to verify calibration. A typical analysis sequence is presented below.

- Working standards are prepared by dilution of a stock standard solution of the metal of interest.
- A calibration curve within the working range of the instrument is established by analysis of three to five working standards.
- An independent standard is analyzed to confirm the calibration. If the calibration is not within acceptance limits, the instrument is recalibrated.
- The samples are analyzed for the metal of interest.
- During sample analysis, a check standard (Continuing Calibration Verification, CCV) is analyzed to monitor instrument stability. If the CCV indicates that instrument calibration has changed by more than $\pm 10\%$ for ICP or AAS, the instrument is recalibrated and the analysis is repeated.
- Following completion of the sample analyses, the check standard is reanalyzed to confirm calibration. If calibration verified, the analysis is completed. However, if the calibration is not verified, appropriate corrective action is taken and effected samples are reanalyzed.

Written records of all calibrations shall be kept with the raw data.

7.6 Classical (Wet) Chemistry Calibration Procedures

The minimum operations necessary to satisfy analytical requirements associated with the determination of classical wet chemistry parameters in water and soil/sediment samples is method dependent. Refer to individual methods for specific requirements.

Wet chemistry instruments are standardized for the parameter of interest by the analysis of a set of calibration standards prepared by diluting a stock solution of known concentration. The concentration of the calibration standards is chosen to cover the working range of the instrument. Subsequently, all sample measurements are made within this working range.

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Once the instrument has been initially calibrated, the analysis of the working standards is repeated during sample analysis to verify calibration. A typical analysis sequence is presented below.

- Working standards are prepared by dilution of a stock standard solution of the parameter of interest.
- A calibration curve within the working range of the instrument is established by analysis of one to five working standards.
- An independent standard is analyzed to confirm the calibration. If the calibration is not within acceptance limits, the instrument is recalibrated.
- The samples are analyzed for the analyte of interest.
- During sample analysis, a check standard (Continuing Calibration Verification, CCV) is analyzed to monitor instrument stability. If the CCV indicates that instrument calibration has changed by more than the method specified acceptance limits, the instrument is recalibrated and the analysis is repeated.
- Following completion of the sample analyses, the check standard is reanalyzed to confirm calibration. If calibration verified, the analysis is completed. However, if the calibration is not verified, appropriate corrective action is taken and effected samples are reanalyzed.

A calibration curve is not prepared for titrations. Titrants are purchased or are prepared as standards and their use is recorded in the appropriate standards logbook.

Written records of all calibrations shall be kept with the raw data.

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8.0 ANALYTICAL PROCEDURES

Katahdin Analytical Services is capable of analyzing a broad range of environmental samples from diverse media, including surface and groundwater, soil, sediment, tissue, and waste. Refer to Table 8-2 for a listing of specific analytical capabilities. Methodologies are employed with guidance from agencies such as EPA, ASTM, USGS, NIOSH and in certain instances, state regulatory agencies. In some situations, Katahdin Analytical Services develops and validates methodologies which are more applicable to a specific problem or objective.

Analytical procedures are detailed descriptions of any and all processing, preparation and analysis of samples in the laboratory. In some instances, data format, presentation and delivery are also described. All analytical procedures shall be conducted in strict adherence to the QA Manual and written Standard Operating Procedures which have been reviewed and approved by the Operations Manager, the QA Officer(s) and the General Manager. Documents from which SOPs are developed include the references listed in Table 8-1. Additional SOPs may be adapted from other sources or generated in-house as project needs require.

8.1 Analytical Methods

Numerous sources of information are available to offer guidance in analytical methods. Selection of the appropriate method is dependent upon data usage and/or regulatory, client or program requirements. Table 8-1 describes the analytical references routinely used by Katahdin Analytical Services. Katahdin Analytical Services may modify existing methods based on the following considerations: 1) in order to meet project specific objectives; 2) in order to incorporate modifications or improvements in analytical technology; 3) in order to comply with changing regulations and requirements; 4) in order to address unusual matrices not covered in available methods.

Katahdin Analytical Services will make every effort to disclose to its clients any instances in which modified methods are being used in the analysis of samples.

8.2 Method Validation

When non-promulgated methods (i.e., methods other than EPA, NIOSH, ASTM, AOAC, etc.) are required for specific projects or analytes of interest, or when the laboratory develops a method, the laboratory establishes the validity of the method prior to applying it to client samples. Method validity is established by meeting specified criteria for precision and accuracy or ascertaining the precision and accuracy which is achievable.

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8.3 Method Detection Limits

Method detection limit (MDL) studies are performed annually at a minimum for each method in use; MDL studies are also performed after any significant procedural or instrument configuration change. Refer to Katahdin Analytical Services, Inc. SOP QA-009, Method Detection Limit and Instrument Detection Limit Studies.

Method detection limits are determined at Katahdin Analytical Services using replicate spiked analyte-free water samples. A minimum of seven replicates of a sample spiked for the purpose are processed through the entire analytical method. The concentration of the detection limit sample should be between one and five times the anticipated detection limit.

The laboratory calculates the detection limit as the student's $t(n-1, 1-\alpha = 0.99)$ times the standard deviation ($n-1$) of the replicate spiked sample measurements. Refer to 40 CFR Part 136, Appendix B for further discussion. Detailed procedures and acceptance criteria for MDL studies are described in the current revision of Katahdin Analytical Services SOP QA-009, Method Detection Limit and Instrument Detection Limit Studies.

IT IS IMPERATIVE TO NOTE THAT METHOD DETECTION LIMITS ARE HIGHLY MATRIX DEPENDENT. LIMITS DETERMINED BY KATAHDIN ANALYTICAL SERVICES MAY NOT BE ACHIEVABLE IN ALL MATRICES.

8.4 Compliance

8.4.1 Definition - Compliance is the proper execution of recognized, documented procedures which are either approved or required. Adherence to these procedures is required in order to provide data products acceptable to a regulatory body of competent jurisdiction in a specific regulatory context. Compliance is separate from, but not inconsistent with, technical scientific quality. Katahdin Analytical Services understands that the expectations of our clients commonly include the assumption that data and reports will satisfy a regulatory purpose and will be found acceptable *and compliant* with regulatory requirements for the performance of tests and generation of data.

8.4.2 Understanding the Regulatory Framework - Compliance is not likely to be achieved in the absence of an understanding of the regulatory framework. Katahdin Analytical Services will attempt to ascertain, prior to beginning a project, what regulatory jurisdiction (USEPA, NJDEP, etc.) pertains to a project; within the regulatory jurisdiction, what body of regulation is meant to be satisfied (RCRA, SDWA, MCP 21E, etc.); and finally, within this context, what protocols are required/expected (CLP, AFCEE, NFESC, NYASP, etc.). Katahdin Analytical Services will work with the client to achieve a mutual

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understanding of all requirements, based on our best understanding of the information available.

- 8.4.3 **Commitment** - Clients may, but often do not, fully understand their compliance needs. Clients may sometimes fail to communicate their compliance requirements to Katahdin Analytical Services. Nevertheless, Katahdin Analytical Services, in defining quality as in 8.4.1 above, accepts much responsibility for compliance.

Katahdin Analytical Services makes the following commitments to its clients:

- Katahdin will proactively attempt to identify and understand the regulatory context of clients' needs.
- Katahdin will strive to be expert in understanding and executing the regulatory requirements for compliance.
- Katahdin will identify and disclose to clients instances of non-compliance in a forthright fashion.

- 8.4.4 **Resolving Compliance Contradictions and Hierarchies** - It is a common occurrence that multiple regulatory jurisdictions overlap in a specific case. This causes uncertainty or even contradictions to arise in a work plan. Katahdin Analytical Services will make every effort to detect such inconsistencies, and will communicate them to clients so that an informed decision can be made by the client regarding execution of the project. Similarly, methods and protocols will often be prescribed in a scope of work or QAPP which either will not achieve stated or implied data quality objectives (DQOs) or which are in conflict with the regulatory requirements. Katahdin Analytical Services will attempt to detect these inconsistencies, and upon detection, disclose same to our client. Katahdin Analytical Services voluntarily accepts a responsibility to provide advice to clients; however, the primary responsibility for this issue remains with the client.

- 8.4.5 **Disclosure of Noncompliance** - As stated previously, it is Katahdin Analytical Services' policy to disclose in a forthright manner any detected noncompliance that may affect the usability of data produced by Katahdin Analytical Services. It is not within our expertise to predict the manner in which a specific regulator or regulatory body will interpret the rules governing analysis; Katahdin Analytical Services is unable to guarantee compliance. It is Katahdin Analytical Services' policy that our responsibility begins with a bona fide and competent attempt to evaluate potential compliance issues and ends with disclosure of any findings that may be useful to our client in their making the final judgment.

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TABLE 8-1
ANALYTICAL PROTOCOLS

- "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act." Federal Register, 40 CFR Part 136, October 26, 1984.
- "Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods." SW-846. 2nd edition, 1982 (revised 1984), 3rd edition, 1986, and Updates I, II, and IIA, 1994, Office of Solid Waste and Emergency Response, U.S. EPA.
- "Methods for Chemical Analysis of Water and Wastes", EPA 600/4-79-020, 1979 Revised 1983, U.S. EPA.
- U.S. EPA Contract Laboratory Program Statement of Work for Organic Analysis, SOW 2/88, OLM01.8, 8/91, OLM01.9, OLM02.0, and OLM03.0.
- U.S. EPA Contract Laboratory Program Statement of Work for Inorganic Analysis, SOW No. 788, ILM01.0, 3/90 through ILM03.0.
- "Standard Methods for the Examination of Water and Wastewater", 15th, 16th and 17th and 18th editions, 1980, 1985, 1989, 1992. APHA-AWWA-WPCF.
- "Annual Book of ASTM Standards", Section 4: Construction, Volume 04.04: Soil and Rock; Building Stones, American Society for Testing and Materials, 1987.
- "Annual Book of ASTM Standards", Section 11: Water and Environmental Technology, American Society for Testing and Materials, 1987.
- "NIOSH Manual of Analytical Methods", Third Edition, 1984, U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health.
- "Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water", U.S. EPA, Environmental Monitoring and Support Laboratory - Cincinnati (September 1986).
- New York State Department of Environmental Conservation. Analytical Services Protocol, December, 1991.

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TABLE 8-2
ANALYTICAL CAPABILITIES

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ORGANIC ANALYSES

ANALYTE	METHODS	
	WATER	SOIL
GC/MS Drinking Water Volatiles	524.2/524.2 SAS	
GC/MS Wastewater/Solids Volatiles	624/8240/8260	8240/8260
Purgeable Halocarbons	601/8010	8010
Purgeable Aromatics	602/8020	8020
Combined Purgeables	601,602/8010,8020	8010 & 8020
CLP Volatiles Analysis and Deliverables	3/91 SOW	3/91 SOW
Gasoline Hydrocarbons - BTEX+MTBE	602/8020	8020
Gasoline Range Organics (GRO)	8015 modified	8015 modified
GRO - Maine DEP	4.2.17	4.2.17
Diesel Range Organics (DRO) - Maine DEP	4.1.25	4.1.25
GRO/DRO - Maine DEP	4.2.17/4.1.25	4.2.17/4.1.25
DRO/GRO Mass Risk Assessment	MA DEP Method	MA DEP Method
Total Petroleum Hydrocarbons (TPH) by IR	418.1	418.1
Semivolatile Organics - Extractables	625/8270	8270
Acid Extractables Only	625/8270	8270
Base/Neutral Extractables Only	625/8270	8270
CLP Semivolatiles Analysis and Deliverables	3/91 SOW	3/91 SOW
Polynuclear Aromatics (PAH) by GC/MS	625/8270	8270
Polynuclear Aromatics by GC/MS SIM	625/8270	8270
Polynuclear Aromatics by HPLC	8310	8310
Organochlorine Pesticides & PCBs	608/8081	8081
Organochlorine Pesticides & PCBs (Tissue)	608/8081	8080/8081
Chlorinated Phenoxy Herbicides	8150	8150
PCBs in oils		ASTM
PCBs wipes/filters		ASTM
CLP Organochlorine Pesticides & PCBs	3/91 SOW	3/91 SOW

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METALS ANALYSES

ANALYTE	REQUIRED DIGEST	EPA METHODS
Aluminum (ICP)	3010/3050	200.7 or 6010
Antimony	3010/3050	200.7 or 6010
Arsenic	3010/3050	200.7 or 6010
Barium	3010/3050	200.7 or 6010
Beryllium	3010/3050	200.7 or 6010
Boron	3010/3050	200.7 or 6010
Cadmium	3010/3050	200.7 or 6010
Calcium	3010/3050	200.7 or 6010
Chromium	3010/3050	200.7 or 6010
Cobalt	3010/3050	200.7 or 6010
Copper	3010/3050	200.7 or 6010
Iron	3010/3050	200.7 or 6010
Lead	3010/3050	200.7 or 6010
Magnesium	3010/3050	200.7 or 6010
Manganese	3010/3050	200.7 or 6010
Molybdenum	3010/3050	200.7 or 6010
Nickel	3010/3050	200.7 or 6010
Potassium	3010/3050	200.7 or 6010
Selenium	3010/3050	200.7 or 6010
Silver	3010/3050	200.7 or 6010
Sodium	3010/3050	200.7 or 6010
Strontium	3010/3050	200.7 or 6010
Tin	3010/3050	200.7 or 6010
Titanium	3010/3050	200.7 or 6010
Thallium	3010/3050	200.7 or 6010
Vanadium	3010/3050	200.7 or 6010
Zinc	3010/3050	200.7 or 6010
Antimony (furnace)	3010/3050	204.2 or 7041
Arsenic (furnace)	7060/3050	206.2 or 7060
Cadmium (furnace)	3020/3050	213.2 or 7131
Chromium (furnace)	3020/3050	218.2 or 7191
Lead (furnace)	3020/3050	239.2 or 7421
Selenium (furnace)	7740/3050	270.2 or 7740
Thallium (furnace)	3020/3050	279.1 or 7841
Mercury (cold vapor)	245.1 or 7470/7471	245.1 or 7470/7471
Hardness (calculation)	EPA 200.7 and SM 314 B	EPA 200.7 and SM 314 B
Digestions		
Water	3010,3020,7060,7740	
Soil/ICP	3050	
Soil/GFAA	3050	
Mercury-water/soil	245.1 or 7470/7471	

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INORGANIC ANALYSES

ANALYTE	METHODS
Acidity	EPA 305.1
Alkalinity	EPA 310.1
Bicarbonate/Carbonate	APHA 2320
Biochemical Oxygen Demand	EPA 405.1
Bromide	EPA 300.0/320.1
Carbon - Total Inorganic (water)	EPA 415.1 modified
- Total Organic (water)	EPA 415.1
- Total Organic (soil)	modified Lloyd Kahn
Chemical Oxygen Demand	
Detection limit of 20 mg/L	EPA 410.4
Detection limit of 5 mg/L	EPA 410.4/410.2
Chloride	EPA 325.1
Coliform Bacteria - Total	APHA 9222B
- Fecal	APHA 9222D
Color	EPA 110.2
Chromium - Hexavalent	SW846 7196
Cyanide - Total	EPA 335.2/SW9010
Cyanide - Total & Ammenable	EPA 335.1/SW9010
Fluoride EPA 340.2	
Hardness (Titrimetric)	EPA 130.2
Halides, Total Organic (TOX) - Water	9020
Lime Equivalence	University of ME Method
Nitrogen - Ammonia	EPA 350.1
- Nitrate plus Nitrite Nitrogen (combined)	EPA 353.2
- Nitrate	EPA 300.0 or 353.2
- Nitrite	EPA 300.0 or 353.2
- Total Kjeldahl	EPA 351.2
- Total Organic - TKN and NH ₃	
Oil & Grease (Gravimetric or IR)	EPA 413.1/413.2/9071
Free Liquid Content (Paint Filter Test)	EPA 9095
Total Petroleum Hydrocarbon IR	EPA 418.1
pH	EPA 150.1
Phenols - Total	EPA 420.1
Phosphorus - Total	EPA 365.4
- Ortho	EPA 365.3
Solids - Total Aqueous	EPA 160.3
- Suspended	EPA 160.2
- Dissolved	EPA 160.1
- Volatile Aqueous	EPA 160.4
- Suspended Volatile	EPA 160.2 or 160.4
- Settleable	EPA 160.5
Specific Conductance	EPA 120.1
Specific Gravity	EPA/COE 1981
Sulfate	EPA 375.2
Sulfide	EPA 376.1
Sulfite	
Surfactants - MBAS	EPA 377.1
Tannins and Lignins	EPA 425.1
Turbidity	APHA 5550B
Sample Prep: Compositing	EPA 180.1
Filtration	APHA 3030B

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TCLP ANALYSES

ANALYTE	EPA METHODS
Extraction for Volatiles (ZHE)	1311
Extraction for Non-Volatiles	1311
Volatiles - TCLP List	8240/8260
benzene	
carbon tetrachloride	
chlorobenzene	
chloroform	
1,2-dichloroethane	
1,1-dichloroethylene	
methyl ethyl ketone	
tetrachloroethylene	
trichloroethylene	
vinyl chloride	
Semi-Volatiles - TCLP List	8270
pyridine	
m-cresol (3-methyl phenol)	
o-cresol (2-methyl phenol)	
p-cresol (4-methyl phenol)	
1,4-dichlorobenzene	
2,4-dinitrotoluene	
hexachloro-1,3-butadiene	
hexachlorobenzene	
hexachloroethane	
nitrobenzene	
pentachlorophenol	
2,4,5-trichlorophenol	
2,4,6-trichlorophenol	
Pesticides - TCLP List	8081
chlordane	
endrin	
heptachlor	
heptachlor epoxide	
lindane	
methoxychlor	
toxaphene	
Herbicides - TCLP List	8150
2,4-dichlorophenoxyacetic acid	
2,4-5-trichlorophenoxypropionic acid	
Metals - TCLP List	6010
As, Ba, Cd, Cr, Pb, Hg, Se, Ag	

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WASTE CHARACTERIZATION

ANALYTE	EPA METHODS

CORROSIVITY

pH	9040/9045

REACTIVITY

Releasable Cyanide	SW 846 7.3.3.2
Releasable Sulfide	SW 846 7.3.4.1

IGNITABILITY	SW 846 1010

NON-ROUTINE ANALYSIS

Katabdin Analytical Services has the capability to perform the following analyses upon request.

ANALYSIS	METHODS
Flash point	ASTM D 93-77
pH - solids	SW846 9045
% Moisture	APHA 2540G
EDB & DBCP by GC	EPA 504
Alcohols by GC/FID	
EPTOX Extraction	EPA 1310/1330
Non-routine Furnace or ICP Metals	
Method Development for Organic Compounds by HPLC, GC/MS, or GC	

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FORM 2C ANALYSES FOR NPDES PERMITS

ANALYTE	METHODS
PART A Biochemical Oxygen Demand	EPA 405.1
Chemical Oxygen Demand	EPA 410.4
Total Organic Carbon	EPA 415.1
Total Suspended Solids	EPA 160.2
Ammonia as Nitrogen	EPA 350.1
pH	EPA 150.1
PART B Total Residual Chlorine	EPA 330.5
Color	EPA 110.2
Fecal Coliform	APHA 9222D
Fluoride	EPA 340.2
Nitrate	EPA 353.2
Nitrite	EPA 353.2
Total Organic Nitrogen	350.2/350.3/351.3 or 350.2/350.1/351.2
Oil and Grease	EPA 413.1 or 413.2
Total Phosphorus	EPA 365.4
Sulfate	EPA 375.2
Sulfide	EPA 376.1
Sulfite	EPA 377.1
Surfactants	EPA 425.1
Aluminum	EPA 200.7
Barium	EPA 200.7
Boron	EPA 200.7
Cobalt	EPA 200.7
Iron	EPA 200.7
Magnesium	EPA 200.7
Molybdenum	EPA 200.7
Manganese	EPA 200.7
Tin	EPA 200.7
Titanium	EPA 200.7
Metals Digestion	3010
PART C Antimony	EPA 200.7
Arsenic	EPA 206.2
Beryllium	EPA 200.7
Cadmium	EPA 200.7
Chromium	EPA 200.7
Copper	EPA 200.7
Lead	EPA 239.2
Mercury	EPA 245.1
Nickel	EPA 200.7
Selenium	EPA 270.2
Silver	EPA 200.7
Thallium	EPA 279.1
Zinc	EPA 200.7
Total Cyanide	EPA 335.2
Total Phenols	EPA 420.3
Volatile Organic Compounds	EPA 624
Acid and Base Neutral Compounds	EPA 625
Pesticides and PCBs	EPA 608
Metals Digestions	3010,3020,7060

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APPENDIX NINE ANALYSES

Appendix IX is derived from Appendix VIII Hazardous Constituents. These parameter lists are intended to apply to groundwater monitoring at hazardous waste storage and disposal sites and are applied to uncontrolled site investigations and remediations.

ANALYTE	EPA METHODS
Volatile Organics (extended list 19 Compounds)	8240
Acid and Base Neutrals (extended list 48 Compounds)	3510/3520/3540/3550/8270
Pesticides and PCBs	3510/3520/3540/3550/8081
Herbicides	8150
Total Cyanide	9010
Hydrogen Sulfide	376.1
pH	150.1
17 Metals	
Arsenic	6010/7060
Antimony	6010
Barium	6010
Beryllium	6010
Cadmium	6010
Cobalt	6010
Chromium	6010
Copper	6010
Mercury	7470
Nickel	6010
Lead	6010/7421
Selenium	6010/7740
Silver	6010
Tin	6010
Thallium	6010/7841
Vanadium	6010
Zinc	6010
Metals Digest	3010,3020,7060,7470

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9.0 DATA REDUCTION, VALIDATION AND REPORTING

All analytical data generated within Katahdin Analytical Services laboratories undergo a well-defined, well-documented multi-tier review process before being reported to the client.

9.1 Data Reduction

Primary analytical data, otherwise known as "raw data", may be manually generated or captured in electronic format. When raw data are manually generated, they are recorded either in bound logbooks with numbered pages or on preprinted forms. Records of analysis indicate the method used, raw data, calculations, and final results. Entries are made in black ink and are initialed and dated by the individual making the entry. It is acceptable to initial and date once for an entire page. Errors are corrected by drawing a single line through the entry; corrections are initialed and dated by the individual making the change. Errors are coded using the descriptive codes listed in Figure 9-1. Raw data may not be obscured in any way. The use of white-out is prohibited on all raw data, including instrumental hardcopy.

The analyst who completes the analysis assembles all relevant raw data and results together with chromatograms, strip chart recordings, instrument settings and other information essential to data interpretation. For data which are reduced by manual calculations, the calculations are documented in a laboratory notebook or on an analyst's worksheet. The results are transferred to a standardized laboratory reporting form which has been approved by the appropriate Supervisor and Operations Manager. Reporting forms include at a minimum the sample identification number, the date analyzed, the result expressed per unit volume, the method reference and the analyst's initials.

9.2 Data Validation

Data validation is the internal process of review by which data are shown to be valid as evidenced by the soundness of the analytical system and successful meeting of the DQOs. In this process, the Laboratory makes no judgment as to the usability of the data by the end-user except with respect to the methodology applied.

Analysts performing an analysis and subsequent data reduction have the primary responsibility for the quality of the data produced. The primary analyst initiates the data validation process by reviewing and accepting the data, provided the associated quality control criteria have been met for the samples being reported. Data review checklists may be used to document the data validation process.

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The completed data package is then sent to the Supervisor or designated senior technical data reviewer. The Supervisor or designated data reviewer provides a technical assessment of the data package and technical review for accuracy according to methods employed and laboratory protocols. The review includes a thorough evaluation of manual calculations. For data which are reduced via computer, calculations are checked by the analyst (or designee) assigned to this task at a frequency designed to assure that the final data generation is valid. This data validation step is documented by the analyst's initials on the hardcopy of the raw data. The results are either manually transferred to a standard reporting form or reported via computer generation of forms.

Once the data have been technically reviewed and approved, authorization for release of the data from the analytical section is indicated by initialing and dating the data review checklist or otherwise dating and initialing the data. The Supervisor or technical designee drafts any narrative comments if required by the Quality Assurance Project Plan. Any items noted during technical and QC review are included in the narrative if deemed to impact the quality of the data.

All analytical data segments and other relevant paperwork pertaining to a particular Katahdin Analytical Services data report are channeled to the Data Management Department for assembly into the final report format and generation of the analytical narrative.

9.3 Data Reporting

The Data Management Department assembles all data from a sample set, generates the final report, checks for transcription errors, and provides the final report to the Operations Manager or Client Services Manager for final signature. The Operations Manager or Client Services Manager may delegate the final review and signing of reports to qualified individuals as necessary.

The final reviewer examines the report for method appropriateness, detection limits, completeness and accuracy and whether or not QC criteria were satisfied. Any deviations from the referenced methods are checked for documentation and validity, and QC corrective actions are reviewed for successful resolution. The final reviewer signs the cover letter or authorization line within the report indicating acceptance of the report prior to its release to the client.

The standard commercial report to the client consists of the following sections:

1. a cover letter
2. a technical narrative (narrative information may be summarized in the cover letter)

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3. sample receipt condition report
4. sample results
5. Chain-of-Custody forms

The narrative briefly describes the condition of the samples upon receipt, sample holding time performance, instrument calibration information, and the quality control results. Any discrepancies discovered and/or matrix problems encountered during preparation or analysis are also addressed in this section.

The sample results are tabulated by sample number and parameter. Katahdin Analytical Services number, client identification, and dates of sample preparation and analysis are presented along with the concentrations detected for each parameter analyzed and corresponding reporting limits. Katahdin Analytical Services is also able to provide alternate report formats (e.g., CLP data package) and additional deliverables (e.g., quality control reports, electronic diskette deliverable). All reports are processed through the data validation and reporting steps described in Sections 9.2 and 9.3.

9.4 Data Archive

Once the final report has been approved, signed, and submitted to the client, one copy of the report remains with all the raw data and is stored in the data archive under the control of the QA Department and/or Data Management Department. The purpose for the data archive is to ensure the continued integrity of all documentation generated in support of laboratory analyses.

The archive room is a secure storage area with limited access to non-authorized personnel. Sign-out procedures are in place where every document removed from the archive room must be manually or electronically signed out for use by authorized personnel.

Periodically, reports and raw data are sent to secure, confidential off-site storage to be archived. This material is retained for a period of time dependent on the state, client or specific program regulations attached to it, generally no longer than seven years, and may only be retrieved by designated personnel. A list of designees is maintained by the laboratory and a copy by the storage company.

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FIGURE 9-1.

Error Codes

1	(or E1)	Misspelled
2	(or E2)	Mathematical Error
3	(or E3)	Wrong Entry
4	(or E4)	Transposition or Sequencing Error
5	(or E5)	Transcription Change (copy error)
6	(or E6)	Procedural Change
7	(or E7)	Wrong Conclusion
8	(or E8)	Illegible Entry
9	(or E9)	Unnecessary Entry
10	(or E10)	Footnoted Explanation
11	(or E11)	Additional Comment
12	(or E12)	Instrumentation Error/Failure

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10.0 RECORDS MANAGEMENT

Records are the means by which an organization documents its operations and activities. They are an integral part of the Quality Assurance program since they provide documented evidence for program functionality and necessary information for performance evaluation and quality assurance audits.

10.1 Standard Operating Procedures

Standard Operating Procedures (SOPs) are written for specific procedures or operations. Complex tasks of inspection, testing, calibration, monitoring, maintenance, data handling and quality control as well as methods utilized in the laboratory are specified and documented by SOPs.

As a minimum requirement, each SOP must include a title, the purpose or application, list of materials or references, and detailed procedures. SOPs are updated when necessary. Each has a Katahdin Analytical Services reference number and revision date at the upper right corner of each page. More detailed information regarding SOPs can be found in Section 12.0 and in the current revision of Katahdin Analytical Services SOP QA-53. Preparation of SOPs.

All personnel are required to follow SOPs when a specific operation or method is being utilized. It is the responsibility of the Supervisor to make sure that employees are aware of and follow the SOPs. Any suggestions for additional SOPs or changes to existing SOPs should be directed to the appropriate Supervisor, the Operations Manager or the QA Department.

10.2 Sample Tracking

Samples are tracked from the time they are received, through storage, preparation, analysis, and final disposition. More information on the following discussion can be found in the current revisions of Katahdin Analytical Services SOPs SD-001, Sample Receipt and Internal Control, and SD-006, CLP Sample Receipt, Identification and Storage.

Proper sample identification must be established during sample collection. This information must be clearly and permanently written on a label and attached to the sample. In addition, a Chain-of-Custody must be initiated with the appropriate information recorded. Samples should also be properly preserved and stored.

Sample Management Personnel verify the samples' integrity as they are unpacked. The Katahdin Analytical Services Project Manager and/or the client are notified of samples

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that are broken or have not been properly stored or preserved. The sample identification label must also be checked against Chain-of-Custody identification. Any discrepancies must be verified by the client or sampler. All these checks and any discrepancies or changes must be documented on the Sample Receipt Condition Report.

Sample Management Personnel assign each sample a sequential laboratory identification number, which is placed on the sample container. Samples are stored in the appropriate locations.

Upon receipt the Sample Management Personnel also initiate an internal custody record for the sample set. These forms are used to document sample removal from and return to sample storage. The final disposition of a sample is documented on the hazardous waste disposal spreadsheet.

10.2.1 Chain-of-Custody

The Chain-of-Custody Form traces the possession of a sample from the time the sample is obtained in the field through analysis in the laboratory. To initiate a Chain-of-Custody, the field sampler must fill in the appropriate information: Client or Project Name, Signature of Sampler, Sample Identification, Date and Time Sampled, Type of Sample, and Analysis Requested. After the sample is brought into the laboratory, sample integrity, preservation, and identification are checked. Any inconsistencies are noted in the sample management documentation. For samples accepted into the laboratory, the Sample Custodian verifies that the sample label IDs are consistent with the sample IDs provided on the Chain-of-Custody, signs in the space marked "Received for Laboratory" and records the date and time received.

10.2.2 Internal Sample Custody Record

The internal custody record is a mechanism for tracking samples from sample management (sample storage) to sample preparation and/or analysis and back to the appropriate storage location. When laboratory personnel remove samples from sample storage, the sample transfer is recorded on the internal custody record. Upon returning any remaining sample, the individual records the date in the "Returned By" box for the appropriate sample. The original internal custody record is archived by the QA Department or the Sample Management Department, with the exception of internal custody records associated with the USEPA Contract Laboratory Program (CLP); for CLP projects, true copies of the internal custody records are archived and originals are submitted to the client.

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10.3 Standards

Standards preparation is documented in the Katahdin Analytical Services laboratories in standards logbooks maintained by each laboratory section. All information needed to maintain proper traceability of standards is recorded in the appropriate standards logbook by the individual preparing the standard. More complete information regarding standard is provided in Section 7.1 and in the current revision of Katahdin Analytical Services SOP CA-004, Standard Preparation and Documentation.

10.4 Maintenance Logbooks

Maintenance logbooks are kept for each instrument. Each logbook is unique to its instrument. In the logbook, an analyst records initial instrument setup, routine preventive maintenance, outside contractor services, instrumental malfunctions and repair performed, dates taken in and out of service, and resolutions. Instrument logs not only describe the instrument's history, but can be helpful when troubleshooting. Additionally, runlogs may describe problems noted, maintenance performed and return to control. Refer to the current revision of Katahdin Analytical Services SOP CA-002, Equipment Maintenance for more information.

10.5 Data Report/Raw Data Package

A Data Report contains the results of analyses as presented to the client. The Data Report also includes Chain-of-Custody documentation and a narrative and/or cover letter describing the general condition of the samples and a summary of any discrepancies encountered during sample analysis. For more information see Section 9.3.

The Raw Data Package contains information needed to reconstruct how the results of the analysis of a batch of samples including QA/QC samples were derived. Information such as inorganic or organic preparation, chromatograms or strip chart recording, and regression analysis data are usually included.

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11.0 QUALITY CONTROL

A quality control program is a systematic process that controls the validity of analytical results by measuring the accuracy and precision of each method and matrix, developing expected control limits, using these limits to detect errors or out-of-control events, and requiring corrective action techniques to prevent or minimize the recurrence of these events.

11.1 Accuracy and Precision Measurements

The results of quality control samples created in the laboratory represent estimates of accuracy and precision for the preparation and analysis steps of sample handling. This section describes the quality control information provided by each of these analytical measurements. Information on the procedures to follow in preparation of the samples or spiking solutions is described for each method and matrix in the respective method Standard Operating Procedure.

Method Blank

A method blank is a volume of analyte-free matrix (e.g. deionized and/or distilled laboratory water for water analyses, or a purified solid matrix for soil/sediment analyses) carried through the entire analytical procedure. The volume or weight of the blank must be approximately equal to the sample volume or weight processed. A method blank is performed with each batch of samples or one with every 20 field samples whichever is more frequent. Analysis of the blank verifies that method interferences caused by contaminants in solvents, reagents, glassware, and other sample processing hardware are known and minimized. Optimally, a method blank should contain no greater than five times (5X) the practical quantitation limit for common laboratory solvents and phthalate esters; less than the PQL for all other parameters unless otherwise specified in the method or project QA plan. Results of method blank analyses are maintained with other QC data in the respective laboratories. If requested by the client, these data will be included in the report.

Accuracy Measurements

Laboratory Control Samples (LCSs) consist of aliquots of analyte-free matrices (water, sand, etc.) spiked with analytes of interest or well-characterized materials, e.g. NBS river sediment. LCSs for methods with extensive lists of analytes that may interfere with one another may include a limited number of analytes, but the analytes included are representative of as many analytes as is practical. In the case of metals analysis, all analytes of interest must be included. Laboratory pure water is used to prepare most LCSs for methods for analysis of water. Highly characterized solids, where available, are used for LCSs for methods for analysis of solids. Where no such

solid LCS is available, spiked laboratory pure water or spiked reagent blanks may be substituted. LCSs provide an estimate of accuracy based on recovery of the compounds from a clean, control matrix. They provide evidence that the laboratory is performing the method within accepted guidelines generally in the absence of matrix interferences. They are prepared at a rate of one per batch of twenty or fewer samples.

Matrix Spikes/Matrix Spike Duplicates are similar to Laboratory Control Samples except the analytes used for spiking are added to a second and third separate aliquot from the client samples in a batch of analyses. They incorporate sample matrix effects and field conditions. Matrix spikes are routinely prepared at a frequency of one set (MS/MSD) per twenty samples for organic analyses and one MS per twenty samples for inorganic analyses when adequate sample volume is provided.

Surrogates provide an estimate of accuracy for each sample analyzed by GC/MS and most GC analyses. The accuracy measurement incorporates sample matrix effects and field conditions and is based on recovery of compounds similar to the target analytes, but not expected to be present in the sample as received. Surrogates are added to all samples analyzed by GC/MS, certain GC, and certain HPLC analyses prior to sample preparation.

An **Internal Standard** is an analyte that has the same characteristics as the analyte(s) of interest, but is added to each sample in a batch, just prior to analysis and is used for quantitation. It corrects for bias or change in instrument performance from sample to sample, incorporating effects associated with the analytical process only.

Accuracy is expressed as Percent Recovery (%R). For LCSs and surrogates, percent recovery (%R) is calculated as:

$$\%R = (SR / SA) * 100$$

where: SR is the concentration determined
SA is the concentration spiked

For matrix spike samples, the percent recovery is calculated as:

$$\%R = (SSR-SR)/SA \times 100$$

where: SSR is the spiked sample determined result
SR is the original sample determined result
SA is the amount of spike added (expected)

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Precision Measurements

A **Sample Duplicate** is a sample that has been homogenized and split into two equal portions before the method sample preparation process. It measures sample precision associated with the preparation through analysis and is prepared and analyzed at a rate of one per batch or one per twenty samples (if a batch is less than twenty samples) in the inorganic laboratories. For organic analyses the MS/MSDs fill this function and provide an measure of overall precision.

The comparison of the values determined for a sample and its duplicate (S/DUP or MS/MSD) is expressed as relative percent difference (RPD). This calculation is as follows:

$$RPD = \left| \frac{S-D}{[(S+D)/2]} \right| \times 100$$

where: S is the determined result of the original sample
D is the determined result of the duplicate sample

The vertical bars in the above equation indicate the absolute value of the difference, hence RPD is always expressed as a positive value.

11.2 Control Charts

Control charts are quality control tools which graphically display the QC parameters over time. Accuracy (Figure 11-1) control charts are maintained for each method. Each chart can be broken into three parts: sample identification, sample response/calculation, and graphic representation (the plot).

11.2.1 Accuracy

Accuracy charts are maintained for Surrogate and Laboratory Control Sample recovery. Each sample is identified by the date it was analyzed and its Katahdin Analytical Services sample number.

The percent recovery is plotted onto the graph where:

- the x-axis is the sample ID; and
- the y-axis is the range of percent recoveries.

11.2.2 Precision

In cases where precision charts are maintained, the relative percent difference is plotted on the graph where:

- the median, zero, represents 0% difference
- the x-axis is the number of data points per chart; and
- the y-axis is the range of relative percent differences.

Both samples are identified by the date(s) analyzed and their Katahdin Analytical Services number.

11.2.3 Limits

Both upper and lower warning limits and upper and lower control limits are established to interpret performance. Warning limits express a narrower confidence interval and are used to warn the analyst or supervisor of possible system inconsistencies or failures, before an out-of-control event occurs. Control limits express the outer limits of accepted method variability. Control limits and warning limits are reviewed periodically against performance. Based on statistical considerations, an evaluation is made to determine whether the control limits need to be revised.

Warning Limits

When not mandated by the method, Katahdin Analytical Services adopts warning limits to be the mean ± 2 standard deviations or a 95% confidence interval, where:

Mean
$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

Standard Deviation
$$s^2 = \frac{\sum_{i=1}^n x_i^2 - (1/n) \left(\sum_{i=1}^n x_i \right)^2}{n-1}$$

where: X = mean value
X = individual values
n = total number of values

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Control Limits

Unless otherwise specified by the analytical method in use or by the project QA plan, Katahdin Analytical Services uses the 99% confidence interval as the control limits, which is defined as the mean ± 3 standard deviations. Where the method specific ranges have been determined, Katahdin Analytical Services' goal is for their control limits to fall within these specified.

Suspicious/Out-of-Control Events

Plotting and connecting successive data points on control charts enables the laboratory to detect many types of suspicious and out-of-control situations. These events can be caught by monitoring the following: outliers (suspicious and out-of-control), runs (suspicious), trends (suspicious), and periodicity (suspicious).

Outliers

There are two types of outliers: any particular point that falls outside the control limits or any point that falls outside the warning limits. A point that falls outside the control limits is classified as an out-of-control event; a point that falls outside the warning limits is classified as a suspicious event.

Runs

A run is defined as a series of points that line up on one side of the central line (the mean). Any run that has a length of seven points is indicative of a potential abnormality in the process, a suspicious event. A run can suggest several potential problems such as a leak in the system, elevated contamination, or incorrect dilutions of standards.

Trends

A trend is defined as a series of points that are marked by an unbroken rise or fall. Any trend with a length of five points is classified as a suspicious event. A trend may indicate a change in instrument sensitivity due to a dirty source or injection port or standard degradation, to name a few.

Periodicity

Periodicity is a term used to describe a recurring pattern of change over equal intervals. This occurrence may be of any length or amplitude; thus, careful observation of the control chart is necessary

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11.3 Utilization of Quality Control Data

The purpose for preparing and analyzing quality control samples is to demonstrate, through the known entities, how accurate and precise the investigative sample data are. Tables 11-1 and 11-2 summarize the quality control assessment criteria by matrix for the methods most commonly used by the Katahdin Analytical Services laboratory. Different criteria may be dictated by different methods or by project QA plans.

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TABLE 11-1
Katahdin Analytical Services, Inc..
Typical Quality Control Criteria For Organic Analyses

Parameter	Type	Frequency	Compounds	Performance Criteria			
WATER							
Volatiles (method #240B)	Method blank Surrogate spike	1/20 or 1/batch every sample	---	+ R.L.			
			d,1,2-Dichloroethane	76 to 114%			
	BFB	86 to 115%					
	d ₄ -Toluene	88 to 110%					
	Laboratory Control Sample	1/20 or 1/batch	Benzene	78 to 128%	26		
			1,1-Dichloroethene	53 to 136%	17		
			Trichloroethene	716 to 119%	23		
			Chlorobenzene	74 to 125%	24		
			Toluene	75 to 121%	24		
	MS/MSD	1 set/20	Benzene	76 to 127%	11		
			1,1-Dichloroethene	61 to 145%	14		
			Trichloroethene	71 to 120%	14		
			Chlorobenzene	75 to 130%	13		
			Toluene	76 to 125%	13		
	Calibration check	every 12 hours	≤ 25% difference for CCC compounds; minimum response factor for SPCC compounds				
	Base/neutral Acid compounds (method #270B)	Method blank Surrogate spike	1/20 or 1/batch every sample	---	+ R.L.		
d ₄ -Phenol				10 to 110%			
2-Fluorophenol		22 to 110%					
2,4,6-Tribromophenol		23 to 123%					
d ₄ -Nitrobenzene		35 to 114%					
2-Fluorobiphenyl		43 to 116%					
d ₁₀ -Terphenyl		33 to 141%					
Laboratory Control Sample		1/20 or 1/batch	Phenol	32 to 145%	26		
			2-Chlorophenol	48 to 143%	27		
			1,4-Dichlorobenzene	44 to 128%	24		
			n-Nitrosodipropylamine	55 to 141%	24		
			1,2,4-Trichlorobenzene	40 to 137%	27		
			4-Chloro-3-methylphenol	53 to 135%	30		
			Acenaphthene	59 to 136%	18		
			2,4-Dinitrotoluene	40 to 121%	32		
			4-Nitrophenol	11 to 129%	42		
			Pentachlorophenol	D to 144%	59		
			Pyrene	47 to 149%	33		
			MS/MSD	1 set/20	Phenol	12 to 89%	42
					2-Chlorophenol	27 to 123%	40
					1,4-Dichlorobenzene	36 to 97%	28
					n-Nitrosodipropylamine	41 to 116%	38
					1,2,4-Trichlorobenzene	39 to 98%	28
					4-Chloro-3-methylphenol	23 to 97%	42
Acenaphthene		46 to 118%			31		
2,4-Dinitrotoluene		24 to 96%			38		
4-Nitrophenol		10 to 80%			50		
Pentachlorophenol		9 to 103%			50		
Pyrene		26 to 127%	31				
Calibration check		every 12 hours	≤ 25% difference				
Pesticides & PCBs (method #080A)		Method blank Surrogate spike	1/20 or 1/batch every sample	---	+ R.L.		
	Decachlorobiphenyl			34 to 148%			
	Tetrachloro-meta-xylene	13 to 121%					

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TABLE 11-1 (Continued)

Parameter	Type	Frequency	Compounds	Performance Criteria	
				Recovery	RPD
SOIL Volatiles (method #240B)	Laboratory Control Sample	1/20 or 1/batch	Lindane Heptachlor Aldrin Dieldrin Endrin 4,4-DDT	58 to 131 % 54 to 101 % 47 to 104 % 68 to 127 % 66 to 135 % 64 to 132 %	24 27 29 24 21 36
	MS/MSD	1 set/20	Lindane Heptachlor Aldrin Dieldrin Endrin 4,4-DDT	32 to 127 % 34 to 111 % 42 to 122 % 36 to 146 % 30 to 147 % 25 to 160 %	30 30 30 30 30 30
	Calibration check	every 10 samples		≤ 15% difference	
	Method blank Surrogate spike recovery	1/20 or 1/batch every sample	--- d ₁ ,1,2-Dichloroethane BFB d ₄ -Toluene	+ R.L. 73 to 116 % 74 to 121 % 81 to 117 %	
	Laboratory Control Sample	1/20 or 1/batch	Benzene 1,1-Dichloroethene Trichloroethene Chlorobenzene Toluene	67 to 130 % 56 to 137 % 55 to 140 % 69 to 125 % 65 to 125 %	26 36 41 25 25
	MS/MSD	1 set/20	Benzene 1,1-Dichloroethene Trichloroethene Chlorobenzene Toluene	66 to 142 % 59 to 172 % 62 to 137 % 60 to 133 % 59 to 139 %	21 22 23 21 21
	Calibration check	every 12 hours		≤ 25% difference for CCC compounds; minimum response factor for SPCC compounds	
	Method blank Surrogate spike	1/20 or 1/batch every sample	--- d ₄ -Phenol 2-Fluorophenol 2,4,6-Tribromophenol d ₄ -Nitrobenzene 2-Fluorobiphenyl d _{1,1} -Terphenyl	+ R.L. 24 to 113 % 25 to 121 % 19 to 122 % 24 to 120 % 30 to 115 % 18 to 137 %	
	Laboratory Control Sample	1/20 or 1/batch	Phenol 2-Chlorophenol 1,4-Dichlorobenzene n-Nitrosodipropylamine 1,2,4-Trichlorobenzene 4-Chloro-3-methylphenol Acenaphthene 2,4-Dinitrotoluene 4-Nitrophenol Pentachlorophenol Pyrene	40 to 117 % 43 to 120 % 43 to 129 % 41 to 141 % 39 to 132 % 5 to 146 % 43 to 132 % 6 to 127 % D to 154 % D to 164 % 29 to 169 %	32 28 27 26 21 31 25 51 74 106 54
	MS/MSD	1 set/20	Phenol 2-Chlorophenol 1,4-Dichlorobenzene n-Nitrosodipropylamine	26 to 90 % 25 to 102 % 28 to 104 % 41 to 126 %	35 50 27 38

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TABLE 11-1 (Continued)

<u>Parameter</u>	<u>Type</u>	<u>Frequency</u>	<u>Compounds</u>	<u>Performance Criteria</u>	
Pesticides & PCBs (method 8080A)	Calibration check	every 12 hours	1,2,4-Trichlorobenzene	38 to 107%	23
			4-Chloro-3-methylphenol	26 to 103%	33
			Acenaphthene	31 to 137%	19
			2,4-Dinitrotoluene	28 to 89%	47
			4-Nitrophenol	11 to 114%	50
			Pentachlorophenol	17 to 109%	47
			Pyrene	35 to 142%	36
				≤25% difference	
	Method blank Surrogate spike	1/20 or 1/batch every sample	—	± R.L.	
			Decachlorobiphenyl	20 to 150%	
	Laboratory Control Sample	1/20 or 1/batch	Tetrachloro-mes-xylyene	20 to 150%	
				<u>Recovery</u>	<u>RPD</u>
			Lindane	D to 181%	50
			Heptachlor	D to 164%	31
			Aldrin	D to 175%	43
			Dieldrin	34 to 147%	38
	MS/MSD	1 set/20	Endrin	59 to 166%	45
			4,4-DDT	57 to 156%	50
			Lindane	32 to 127%	50
			Heptachlor	34 to 111%	50
	Calibration check	every 10 samples	Aldrin	42 to 122%	50
			Dieldrin	36 to 146%	50
			Endrin	30 to 147%	50
			4,4-DDT	25 to 160%	50
				≤ 15% difference	

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TABLE 11-2
Katahdin Analytical Services, Inc.
Typical Quality Control Criteria For Inorganic Analyses

Parameter	Type	Frequency	Performance Criteria
SOIL AND WATER			
Metals by ICP (Method 6010A)	Calibration Blank	every calibration	+ D.L.
	Calibration verification	every calibration	90 to 110%
	Continuing calibration	1/10 samples	90 to 110%
	Method blank	1/20 or 1/batch	+ R.L.
	Laboratory Control Sample *	1/20 or 1/batch	80 to 120%
	Sample duplicate	1/20 or 1/batch	+ R.L. or 20% RPD
Metals by Furnace AA (7000 series methods)	Matrix Spike	1/10	75 to 125%
	Calibration blank	every calibration	+ D.L.
	Calibration verification	every calibration	90 to 110%
	Continuing calibration	1/10 samples	90 to 110%
	Method blank	1/20 or 1/batch	+ R.L.
	Laboratory Control Sample *	1/20 or 1/batch	80 to 120%
Cold Vapor AA (Mercury)	Sample duplicate	1/20 or 1/batch	+ R.L. or 20% RPD
	Matrix Spike	1/10	75 to 125%
	Duplicate injections	every sample and standard	+ 20% RPD
	Calibration blank	every calibration	+ D.L.
	Calibration verification	every calibration	80 to 120%
	Continuing calibration	1/10 samples	80 to 120%
Total Petroleum Hydrocarbons	Method blank	1/20 or 1/batch	+ R.L.
	Laboratory control sample	1/20 or 1/batch	80 to 120%
	Sample duplicate	1/20 or 1/batch	+ R.L. or 20% RPD
	Matrix Spike	1/10	75 to 125%
	Calibration blank	every calibration	+ D.L.
	Calibration verification	every calibration	85 to 115%
Total Cyanide	Continuing calibration	1/10 samples	85 to 115%
	Method blank	1/20 or 1/batch	+ R.L.
	Laboratory Control Sample (CLP)	1/20 or 1/batch	85 to 115%
	Laboratory Control Sample (non-CLP)	1/20 or 1/batch	67 to 130%
	Sample duplicate	1/20 or 1/batch	+ 20% RPD
	Matrix Spike	1/10	75 to 125%
General Wet Chemistries	Calibration blank	every calibration	+ D.L.
	Calibration verification	every calibration	85 to 115%
	Continuing calibration	1/10 samples	85 to 115%
	Method blank	1/20 or 1/batch	+ R.L.
	Laboratory Control Sample **	1/20 or 1/batch	80 to 120%
	Sample duplicate	1/20 or 1/batch	+ 20% RPD
	Matrix Spike	1/10	75 to 125%

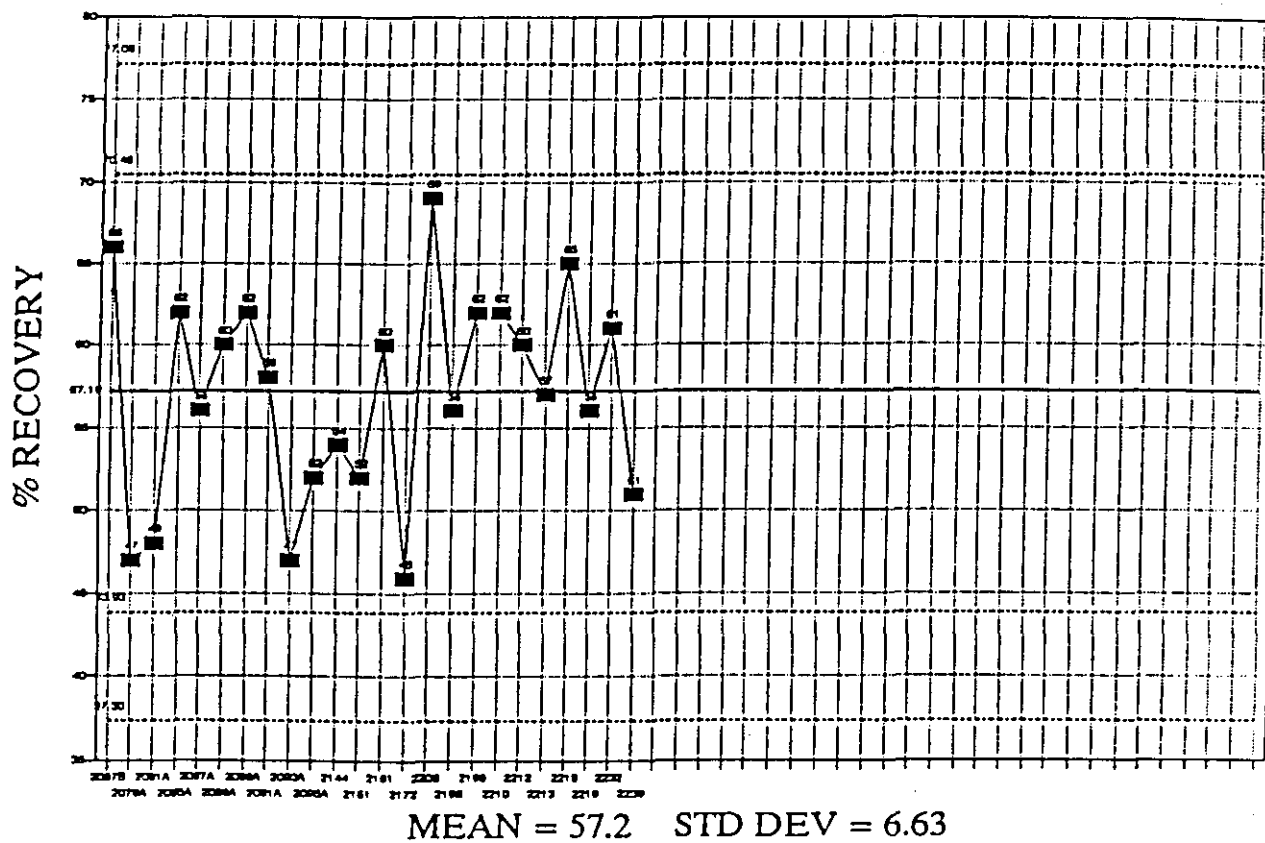
* Recovery acceptance criteria for metals solid LCS (solid reference material) are manufacturer specified where available; otherwise nominal limits of 80 to 120% apply.

** Laboratory statistically derived control limits are utilized where sufficient data exist; otherwise nominal limits of 80 to 120% apply.

FIGURE 11-1

Example of Accuracy Control Chart

ABN SOLID 3550/8270, 2-CHLOROPHENOL-D4
COMMERCIAL LIMITS 2/95



12.0 STANDARD OPERATING PROCEDURES

12.1 Purpose and General Provisions

Standard Operating Procedures (SOPs) are formal, revision-controlled documents that:

1. provide standard methods for execution and documentation of work, to maximize consistency, uniformity and reliability of products;
2. establish the basis for similar training of personnel and set a standard for assessment;
3. facilitate coordination among individuals performing separate, but interdependent tasks; and
4. define, to Katahdin Analytical Services' clients and to regulatory agencies, the methods used by Katahdin Analytical Services in the performance of tasks having an effect on the quality of data, findings or conclusions;

SOPs describe standard methodologies that may at times be inappropriate for a specific project. In such cases, exceptions to the SOPs are stated in the raw data or the analytical narrative with rationale.

12.2 Responsibilities

Supervisors and analysts are responsible for determining, through consultation with the Quality Assurance Officer and Management, the activities that require SOPs. Supervisors are also responsible for working with the appropriate technical personnel to develop the SOPs.

The Quality Assurance Department is responsible for obtaining technical review and approval of SOPs, for maintaining control of new SOPs and revisions, and for maintaining an up-to-date distribution list for SOPs.

Katahdin Analytical Services personnel are responsible for performing tasks in accordance with applicable SOPs, except as explicitly directed by the relevant Quality Assurance Project Plan, contract, or Health and Safety policy. Katahdin Analytical Services personnel are also responsible for assisting in designing accurate and practical SOPs and in keeping the SOPs up-to-date.

Technical reviewers of SOPs are responsible for providing review of drafts sent to them within the schedule indicated in the request.

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12.3 Minimum Contents of SOPs

Each Standard Operating Procedure shall contain at a minimum, the following information:

Title - The name of the concerned task

SOP Number - The internal document control number assigned and tracked by the QA Department

Acceptance - The signature of the originator(s), Quality Assurance Officer and appropriate operations management authority to officially adopt the procedure

Date - Date of issue of most recent revision

Purpose and Applicability - An explanation of the objectives of the procedure, typical applications and limitations

Definitions - A listing of any terms, expressions, or acronyms found in the procedure

Applicable Documents/References - A listing of pertinent, supporting procedure or reference documents such as methods, manuals and/or SOPs

Apparatus and Materials - A complete list of the equipment, apparatus, reagents, etc. needed for the procedure

Method/Procedure - A clear description of the task on a step-by-step basis. The method description should be written clearly enough, and in sufficient detail, to ensure that any two persons performing the procedure will achieve equivalent results, and to provide clients and reviewing agencies with a thorough understanding of the procedure. Acceptable and equivalent alternatives should be addressed whenever possible, and described in the same detail. Where applicable to the SOP, the procedure should include a discussion of sample preservation and storage requirements, potential interferences, sample preparation and calibration requirements.

Quality Control Requirements and Acceptance Criteria - An outline of quality control requirements, including procedures, frequency requirements, and acceptance criteria. Acceptance criteria may take the form of an illustration such as a chart of acceptable results with tolerances, or other appropriate forms

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Calculations, Data Management and Reporting of Results - A summary of the automated and manual calculations performed as well as reporting requirements, including data flow charts as appropriate

Corrective Actions - A description of what must be done, when and by whom in instances when the QC requirements are not met

Responsibilities - Identification of the individuals (by title or organizational position) who are responsible for performing and facilitating the tasks governed by the SOP

Health and Safety Considerations - A discussion of specific Health and Safety issues that must be considered prior to and during the performance of the procedure described.

12.4 SOP Development and Approval

Laboratory SOPs are developed by the laboratory's technical staff, working with the QA Department. The QA Department will also assist by assigning SOP numbers and by coordinating word processing, review and approval. Laboratory SOPs must be reviewed and approved by the management of the laboratory operations to which the SOPs apply. Thus, the following people must review and approve each laboratory SOP:

- the Supervisor of the specific operation to which the SOP pertains or the Operations Manager - This signature indicates that the written SOP reflects the current practice in the laboratory.
- the Laboratory Operations Manager - This signature indicates that the SOP is technically adequate to handle the analysis of environmental samples expected to be received at Katahdin Analytical Services and technically compliant within the framework given in Section 8.0 and with any known exceptions noted.
- the Quality Assurance Officer - This signature indicates that the SOP has been reviewed for compliance with the referenced methods and that discrepancies between the method and practice have been resolved.
- the General Manager - This signature signifies a management review and approval of the practices detailed in the SOP.

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12.5 Numbering

Each SOP is assigned a unique Katahdin Analytical Services number from the inventory of Katahdin Analytical Services SOPs maintained by the QA Department.

12.6 Revisions

SOP revisions may be necessitated by regulatory requirements, technological advancements or other causes, but not by the requirements of a single project alone. Contradictions between standard procedures and the requirements of a specific project are resolved in the quality assurance plan for that project and are communicated internally through an incoming sample information sheet (Figure 12-1) or checklist, generally initiated by project management.

Revisions may be proposed initially by the Quality Assurance Department or they may be recommended by users. Recommendations for revisions must be sent to the Quality Assurance Department.

Technical changes to an SOP need to be made immediately, but revisions must not be made by an individual to only his/her personal copy. If there are changes to an SOP, they need the approval of the appropriate Supervisor, Operations Manager, and QA, and the changes, written up as a "Memo To File", must be appended to ALL copies of that SOP in use in the lab until a formal full revision is complete. A formal revision should be initiated ASAP. Recommendations for minor revisions will be accumulated by the QA Department until sufficient to warrant a document revision.

Revisions are accomplished by the preparation of a new typed draft with the changes incorporated and listed on the cover page. (The cover page is a permanent document and stays with the SOP despite revisions.) Approval of the revisions is signified by dated acceptance signatures adjacent to the listed revisions in the lower section of the cover page. The QA Officer is authorized to approve minor revisions. Revisions which affect the technical approach or content will also require review and approval by the Supervisor or Operations Manager. Once formally accepted, the revised document replaces the previous version and is distributed to controlled copy holders with instructions as to what document(s) it replaces. All out-dated copies of the SOP are retrieved by the QA Department or designee and destroyed.

Occasionally, revisions are significant enough to warrant a complete rewrite. In such cases, the changes are not listed on the cover page. Instead the words "complete rewrite" are entered and the new document must undergo review and approval as for a new SOP. The judgment as to whether a complete rewrite is required shall be made by the Quality Assurance Officer in cooperation with the Supervisor and/or Operations Manager.

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Technical revisions and complete rewrites will necessitate training recertification for all personnel involved. The Supervisor or Operations Manager is responsible for ensuring that training is accomplished and documented. Required training documentation and instructions will be distributed with the SOPs by the QA Department.

12.7 Document Control and Distribution

SOPs must reflect current operating conditions and be compliant with applicable method and program requirements. To meet these needs, all Katahdin Analytical Services SOPs and SOP revisions used within the laboratory must be controlled documents which are administered by the QA Department. Each page of a controlled copy is marked as such in red to prevent the use of un-controlled photocopies. The QA Department maintains an inventory of all SOPs developed by the laboratory and their revision status.

The QA Department distributes SOPs to technical staff as required, maintains distribution lists to ensure that revisions and new SOPs are distributed to all appropriate individuals, periodically verifies that SOPs in use in the lab are current, controlled copies and ensures that obsolete versions are removed from use and destroyed. A Receipt Acknowledgment Form is completed for each SOP for tracking and distributing updates of the documents. Refer to Katahdin Analytical Services SOP QA-013, Document Control for Standard Operating Procedures.

12.8 SOP Archive

An archive of all laboratory SOPs, in the form of both hard-copy and electronic masters of current revisions, is maintained by the Quality Assurance Department within Katahdin Analytical Services. The archive also contains a hard-copy master of all obsolete versions of each revised SOP.

SOPs are distributed from the archive. Access to originals is obtained through QA personnel.

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FIGURE 12-1

INCOMING SAMPLE INFORMATION SHEET

Initials/Date: _____

INCOMING SAMPLE
INFORMATION SHEET

CLIENT NAME: _____ ROA CC: _____

ATTENTION: _____

ADDRESS: _____

TELEPHONE NO: _____ FAX NO: _____

OTHER CLIENT CONTACTS: _____

PURCHASE ORDER NO: _____ CLIENT ID: _____

QUOTATION NO: _____ MEANS OF DELIVERY: _____

PROJECT NAME: _____ SAMPLE RECEIPT DATE: _____

NUMBER/TYFE OF SAMPLE(S): _____

PARAMETERS: _____

TURNAROUND TIME: _____ QC LEVEL: _____

COST: _____

GROUP: WC _____ AA _____ GC _____ GC/MS _____ Prep _____ Sub/Network _____ Sampling _____

PRIMARY LAB CONTACT: _____

Please summarize pertinent and unusual information from the reverse.

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FIGURE 12-1, continued

INCOMING SAMPLE INFORMATION SHEET

QUOTATION CHECKLIST

- Who is the client and what is the purpose of the analytical work?
(Regulatory, Site Assessment)
- What is the specific project name/site name?
- Is this a proposal or project? If it's a proposal, what are the main considerations for award, and what is the probability of being awarded the work?
- What is the expected number, frequency and date of submittal of the samples in this program?
- What is/are the sample types? Please provide additional information if the matrix is non-standard (other than aqueous/soil/sediment).
- What sample analyte concentrations are available? What are the expected contamination levels?
- What are the parameters?
 - Are there specific method requirements guided by specific regulations?
 - Are there special or required reporting limits?
 - What are the sample handling plans- filtration, collection, field QC samples?
- What level of Quality Control Reporting is required? Is this guided by a regulatory program where specific quality control samples are needed (i.e. MS/MSDs)?
- Will the laboratory provide sample containers?
- What is the required turnaround time? Are there specific regulatory or report deadlines, late delivery penalties, or sample batching requirements?
- Are there any other special deliverables required (i.e. diskette deliverables, separate/additional copies of ROAs, verbal reporting, explanatory cover letters)?
- May the samples be returned to the client?
- Are there any unusual or new DETS to be used for login?

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13.0 PERFORMANCE AND SYSTEM AUDITS

Katahdin Analytical Services participates in a variety of interlaboratory tests and intralaboratory and performance checks to provide periodic assessment of the effectiveness of the overall quality control program.

13.1 Interlaboratory Performance Surveys

Performance surveys conducted by the USEPA constitute the bulk of interlaboratory comparisons.

- EPA Performance Evaluations - Water Supply - Semiannual

- * Trace Metals
- * Nitrate/Nitrite/Fluoride
- * Trihalomethanes (THMs)
- * Volatile Organic Compounds
- * Turbidity
- * Total Filterable Residue
- * Calcium (as CaCO_3)
- * pH
- * Alkalinity
- * Corrosivity
- * Sodium
- * Sulfate
- * Total Cyanide

- EPA Performance Evaluations - Water Pollution - Semiannual

- * Trace Metals
- * Minerals
- * Nutrients
- * Demand
- * PCBs
- * PCBs in Oil
- * Pesticides
- * Volatile Halocarbons
- * Volatile Aromatics
- * Total Cyanide
- * Non-Filterable Residue
- * Oil and Grease
- * Total Phenolics

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The performance of each laboratory is evaluated by the respective agency after each round of testing and reported to the appropriate Laboratory Operations Manager. The Laboratory Operations Manager forwards the results to the QA Department in charge of certifications. The QA Department distributes copies of the results to Supervisors (if applicable).

In addition to the EPA WP/WS performance evaluation studies, Katahdin Analytical Services participates in a number of state, federal and commercial studies such as the State of New York, US Navy NFESC, US Army COE, US DOE HAZWRAP and US EPA DMR PE studies.

13.2 Periodic Internal Audits

Internal auditing is conducted by the QA Department or designee. Typically these audits focus on either performance relative to an SOP or a specific project. Internal audits take two forms - performance audits and systems audits. Performance audits involve submittal of blind spikes to the laboratory by the Quality Assurance Department for assessment of analytical accuracy. Systems audits consist of a thorough review of procedures and documentation to confirm that work is being performed in accordance with this Manual, SOPs, and/or project QA Plan and that adequate documentation exists to satisfy the project requirements.

13.2.1 Performance Audits

Audit Standards

As required on specific projects, the Quality Assurance Department provides spikes for analysis as independent check samples (audit standards). The QA Department prepares any audit standards that can be prepared readily from relatively non-hazardous, pure materials or certified concentrated standards. In some cases, preparation of reliable audit standards requires special facilities and equipment due to the hazardous nature of the materials and/or the requirement for precise measurement of minute quantities. In such cases, audit standards are obtained from the USEPA, Environmental Monitoring and Support Laboratory (EMSL), Cincinnati, Ohio, or from an equivalent source. The nature of the audit standards and the frequency of performance audits are specified in the Quality Assurance Plan of each project for which performance auditing is required. When practical, audit standards are provided in matrices resembling real project sample matrices, and undergo the full sample preparation and analysis procedure. However in many cases this is impractical, and it is necessary to submit audit samples as extracts, for analysis only. All measurable constituents in the audit standards should be within the expected

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range of concentrations to be encountered in the real samples (or in the extracts).

13.2.2 Systems Audits

Systems audits address general laboratory operations and conformance to the Laboratory Quality Assurance Manual. Systems audits of laboratory operations are performed at a minimum frequency of once per year per laboratory group (i.e. wet chemistry, metals, organic extractions, GC, GC/MS).

Some quality assurance project plans, QAPPs, require project-specific laboratory systems audits (Project Audits).

Systems Audit Procedures

The systems audits are performed by the QA Department. Audit checklists are used to ensure that all salient points are addressed and documented. The checklists are filled out legibly and reproducibly, in ink, by the auditor, and are signed and dated by the auditor when completed. The audit checklist is based on EPA laboratory evaluation criteria, the provisions of the Laboratory Quality Assurance Manual and Katahdin Analytical Services SOPs. Project audit checklists are drawn from the applicable QAPPs, as well as relevant provisions of the QA Manual.

Audit checklists will cover at least the following areas:

- Systems Audit
 - * Personnel qualifications and training records
 - * Adequacy of laboratory facilities, including work space, lighting, ventilation, and supplies
 - * Maintenance and calibration recordkeeping for analytical equipment
 - * Safety (facility configuration and practices)
 - * General operations, including glassware cleaning, inventory and checking of reagents and standards, and storage procedures
 - * Recordkeeping, including sample log-in and tracking, traceability of standards, control charts, and raw data recording and tracking.
- Project Audit
 - * Sample log-in and chain-of-custody records
 - * Sample storage procedures and records

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- * Sample preparation and analysis procedures
- * Method validation (where applicable)
- * Conformance to QAPP
- * Control charts (if applicable)
- * Precision and accuracy assessment
- * Method blanks, reagent blanks, duplicates, check samples, fortifications, surrogates, etc.
- * Calibration
- * Data packages
- * Analyst qualifications
- * Data validation and reporting

13.3 External Audits

In addition to internally conducted systems audits, the laboratory is regularly audited by clients, potential clients, state and federal program regulators, and other organizations (e.g. A2LA). These audits may be specific to program or project requirements, encompass a complete review of laboratory systems, or both.

Katahdin Analytical Services uses these external audits to additionally evaluate laboratory function and performance. The QA Department distributes audit reports to supervisors and management, coordinates corrective actions to any findings, formalizes and documents the responses required, and may use external audit findings as the basis for future internal audits.

13.4 QA Reporting and Corrective Action

Each systems audit (internal or external) is immediately followed by a debriefing, in which the auditor discusses his/her findings with the laboratory representatives. The debriefing serves a two-fold purpose. First, laboratory management is afforded an early summary of findings, which allows them to begin formulating corrective strategies, and second, the auditor has a chance to test preliminary conclusions and to correct any misconceptions before drafting his/her report.

The systems audit report (which may or may not contain performance audit findings) is issued to the Operations Manager and appropriate Supervisors and personnel for corrective action. Responses to the findings are forwarded, in writing, to the auditor. The auditor then circulates the report to the QA Officer and laboratory management.

Results of interlaboratory performance surveys and in-house audits, along with unresolved corrective action items are reported to the General Manager by the Quality Assurance Officer.

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14.0 PREVENTIVE MAINTENANCE

To minimize downtime and interruption of analytical work, preventive maintenance is routinely performed on each analytical instrument. Designated laboratory personnel are trained in routine maintenance procedures for all major instrumentation. When repairs are necessary, they are performed by either trained staff or instrument manufacturer service personnel.

SOPs are written for each instrument that cover basic operation and maintenance procedures. Refer to Katahdin Analytical Services SOPs CA-002, Equipment Maintenance, and CA-003, Balance Calibration. Detailed logbooks documenting preventive maintenance, non-routine maintenance and repairs are also maintained for each instrument. The following are brief summaries of maintenance for each major instrument.

14.1 Preventive Maintenance - GC/MS

Regularly performed maintenance includes, but is not limited to the following for GC/MS instrumentation:

- hard tune with calibration gas (PFTBA)
- removal of 2-3 inches from the injection end of the capillary columns
- injection port liner replacement
- replace injection port septum
- clean ion source as needed
- check vacuum pump oil level
- check carrier gas tanks
- replace or recondition vent traps

14.2 Preventive Maintenance - GC

Regularly performed maintenance includes, but is not limited to, the following for GC extractable organics instrumentation:

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- replacement of 5-10 inches of guard column (if applicable) and 2-3 inches from the injection end of the capillary columns
- injection port liner and RP seal replacement
- replacement of septum
- check carrier and support gases
- fill solvent rinse bottles as needed
- NRC wipe test ECD

Regularly performed maintenance includes, but is not limited to, the following for GC volatile organics instrumentation:

- clean and bake sparge tubes
- replace trap as needed
- check carrier and support gases
- replace transfer line as needed
- replace nickel tube as needed
- clean or replace PID as needed

14.3 Preventive Maintenance - ICP

- check liquid argon tank level
- change pump tubing
- clean nebulizer and spray chamber as needed
- replace and realign plasma torch when required
- check cooling system water level
- empty waste reservoir when full

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14.4 Preventive Maintenance - AA Graphite Furnace

- check and align source lamps
- clean and inspect graphite tube, replacing when surface appears excessively burnt or cracked
- clean and inspect contact ring, replacing when excessively worn
- clean mirrors for optical sensor and sample compartment windows
- check autosampler injector alignment and deposition

14.5 Preventive Maintenance - Mercury Analyzer

- Check and align source lamp
- remove and clean sample cell and connecting tubes
- check sparger for proper operation
- clean sample compartment windows

14.6 Preventive Maintenance - General Laboratory Areas

- clean and calibrate balances biannually (minimum)
- check balance calibration each day of use
- clean balance pan prior to each use
- calibrate ASTM Class 1 weights every five years
- calibrate automatic pipettes and burettes monthly
- calibrate thermometers yearly against an NIST traceable thermometer; calibrate digital thermometers quarterly
- record refrigerator, freezer, and oven temperatures each weekday

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- clean, check, calibrate to manufacturers' specifications all pH, DO, conductivity, and Turbidity meters annually (minimum); clean, check, calibrate to manufacturers' specifications all spectrophotometers biannually
- general housekeeping: keep counter tops, hoods, and floors clean
- check airflow in hoods once a week

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15.0 CORRECTIVE ACTION

When errors, deficiencies, unusual occurrences, or out-of control situations exist, the QA program provides systematic procedures, called "corrective actions", to resolve problems and restore proper functioning to the analytical system. Within Katahdin Analytical Services, a distinction is made between out-of-control events and unusual occurrences for the purposes of requiring corrective actions.

An out-of-control event is any event which is beyond the acceptance limits established for laboratory operation by Katahdin Analytical Services SOPs, EPA methods, or client specific contracts or protocols. This can be due to data which are outside of the accepted bounds for accuracy and/or precision, method contamination, improper instrument calibration or maintenance, or deviations from the scope of work or SOP detected by a QA audit.

An unusual occurrence is a situation in which the analytical system is, strictly speaking, compliant with the protocol or SOP and therefore in control but an atypical or undesirable incident has occurred which warrants further investigation. Such an occurrence could be a holding blank which is contaminated or differences in the pattern of non-spiked target compounds between a spiked and unspiked aliquot of a sample used as the matrix spike.

Both out-of-control events and unusual occurrences are noted on a Katahdin Analytical Services Corrective Action Report (Figure 15-1). A corrective action report must be generated whenever either type of event is noted.

15.1 Out-of Control Events

The analyst generating the data is responsible for reviewing all results against the established limits. Any deviations are immediately evaluated as potential out-of-control events. This review process may include the application of statistics. If data are outside accepted limits, the analyst immediately takes appropriate action. In the event that the analyst is unable to achieve return to control, he/she notifies their Supervisor. If the Supervisor and analyst are unable to achieve return to control, the Supervisor shall notify the Operations Manager and the Quality Assurance Officer. The Operations Manager and technical team are responsible for identifying the source of the problem and achieving return to control. Completion of corrective action is evidenced by the documented return of data to prescribed acceptable limits.

Events which do not readily cause an immediate obvious effect on data quality are more difficult to identify. Such events could be samples stored at an incorrect temperature or held beyond prescribed holding times, or improper maintenance of records. Everyone in the laboratory is responsible for reporting "system" problems. Analysts should report out-of-control events to their Supervisor, who should in turn report to the Operations Manager. Corrective action is again the

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ultimate responsibility of the Operations Manager and the Supervisors. They shall review and approve the action taken.

If an out-of-control event does occur during analysis, for instance an LCS recovery falls outside the expected range, the analyst must describe on the corrective action report the event, the investigative and corrective actions taken, the cause of the event, and notify the QA Officer. In some cases, investigation of an out-of-control event will reveal no problems. In such cases, only the event and the investigative action is recorded.

The investigative action taken is somewhat dependent on the analysis and the event. However, listed below is a progression of steps which may be taken to find the cause of an out-of-control event:

- Check calculations to ensure there are no errors
- Check standard and spiking solutions for degradation or contamination
- Check instrument performance

If the problem is with the standards or instrument performance, the analyst must recalibrate or retune the instrument before reanalyzing the sample extracts affected. If the out-of-control condition is still not remedied, the samples may require reextraction and reanalysis or data qualification.

It is occasionally necessary to qualify data when the accompanying quality control data are not within either the expected or established performance criteria. Qualifying data alerts the data end user that the analytical process did not provide data which fully satisfies the analytical data quality objectives (DQOs) for that particular project. Based on the project DQOs, analytical data with qualifiers may or may not be appropriate for the intended use.

15.1.1 Volatile Organic Analyses

Method Blanks

If target compounds are detected in the method blank above the detection or reporting limit, as applicable (above 5 times the applicable limit for methylene chloride, acetone, toluene, and 2-butanone) the corrective action consists of checking the calculations, reanalyzing the blank, qualifying the associated sample data, and investigating the source of the problem to implement corrective action for the future. When target list compounds are detected in a method blank, the following condition applies:

- When any target compound is detected in a method blank above the action levels listed earlier, but not in associated samples, then no qualifier is applied.

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Surrogates

The % recovery of the surrogates is calculated for each sample, blank, and LCS. Corrective action is taken whenever one (or more) surrogate recovery is outside the acceptance criteria. The following corrective actions are taken when required as stated above:

- Check calculations to assure there are no errors;
- Check internal standard and surrogate solutions for degradation, contamination, etc., and check instrument performance;
- If instrument failure is indicated, reanalyze the sample;
- If a method blank surrogate is outside of acceptance criteria, then the problem must be corrected before proceeding with sample analysis. This may include reanalysis, reextraction or recalibration;
- If the surrogate could not be measured because the sample required a dilution, no corrective action is required. The recovery of the surrogate is recorded with the note "surrogate diluted out".
- If all QC associated with the sample is within acceptance limits (the method blank surrogate recovery and LCS spike recovery), the problem may be attributed to a matrix effect. Samples exhibiting a matrix effect as indicated by out-of-criteria surrogate recoveries will be qualified and discussed in the report narrative.

Laboratory Control Samples

The % recovery of Laboratory Control Samples (LCS) is calculated. Corrective action is taken whenever the % recovery is outside the established acceptance criteria. The following corrective actions are taken when required as stated above:

- Check calculations to assure there are no errors;
- Check internal standard and spiking standard solutions for degradation, contamination, etc., and check instrument performance;
- Reanalyze samples associated with a failed LCS, if available;

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- If that does not correct the problem, then the data is reported and a qualifying statement included in the report narrative.

For Matrix Spike and Matrix Spike Duplicates, if all QC associated with a sample is within acceptance limits (method blank and LCS spike recoveries), the problem may be attributed to a matrix effect.

Calibration

Individual methods specify calibration frequency and criteria. The following is a general representation of a calibration procedure.

For an initial 5 point calibration curve to be valid, the % relative standard deviation of the individual relative response factors (RRF) for the Calibration Check Compounds (CCC) shall be less than or equal to 25% or as specified in the method. If this criterion is not met, then the calibration curve shall be reanalyzed.

For continuing calibration checks to be valid, the relative response factor for each of the System Performance Check Compounds (SPCC) should be at least 0.300 (0.250 for Bromoform) and the RRF for each of the CCC should be $\leq 25\%$ (or as specified in the method) different from the average RRF from the initial calibration. If these criteria are not met, then the following corrective actions should be taken:

- Check internal standard and standard solutions for degradation, contamination, etc.,
- Check instrument for contamination at the injection port inlet and front end of the column;
- If no source of the problem is identified, then a complete 5 point initial calibration must be performed.

The SPCC and CCC for Volatiles are:

SPCC

Chloromethane
1,1-Dichloroethane
Bromoform
1,1,2,2-Tetrachloroethane
Chlorobenzene

CCC

Vinyl Chloride
1,1-Dichloroethene
Chloroform
1,2-Dichloropropane
Toluene
Ethylbenzene

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15.1.2 Semivolatile Organic Compounds

Method Blanks

If target compounds are detected in the method blank above the detection limit or reporting limit, as applicable (above 5 times the applicable limit for phthalate esters) the corrective action consists of the following:

- checking the calculations;
- reanalyzing the blank;
- re-extract the blank and associated samples and reanalyze, where appropriate;
- flagging the associated sample data;
- investigating the source of the problem to implement corrective action for the future.

When target list compounds are detected in a method blank, the following data condition applies:

- When any target compound is detected in a method blank above the action levels listed earlier but not in associated samples, then no flag is applied.

Surrogates

The % recovery of the surrogates is calculated for each sample, blank, and standard. Corrective action is taken whenever one (or more) surrogate recovery from either the base/neutral or acid fraction is outside the acceptance criteria. The following corrective actions are taken when required as stated above:

- Check calculations to assure there are no errors;
- Check internal standard and surrogate solutions for degradation, contamination, etc., and check instrument performance;
- If instrument failure is indicated, reanalyze the sample;

- If one method blank surrogate is outside of acceptance criteria, then the problem must be corrected before proceeding with sample analysis. This may include reanalysis, reextraction or recalibration;
- If the surrogate could not be measured because the sample required a dilution, no corrective action is required. The recovery of the surrogate is recorded with the note "surrogate diluted out";
- If all QC associated with the sample is within acceptance limits (the method blank surrogate recovery and LCS spike recovery), the problem may be attributed to a matrix effect. Samples exhibiting a matrix effect as indicated by out-of-criteria surrogate recoveries will be qualified and discussed in the report narrative.

Laboratory Control Samples

The % recovery of Laboratory Control Samples is calculated. Corrective action is taken whenever recovery is outside the acceptance criteria. The following corrective action is taken when required as stated above:

- Reanalyze the LCS
- Check calculations to assure there are no errors;
- Check internal standard and spiking standards solutions for degradation, contamination, etc., and check instrument performance;
- Reanalyze all associated samples, if available;
- If that does not correct the problem, then the data is reported and a qualifying statement regarding the laboratory control sample is included in the report narrative.
- Re-extract and re-analyze the LCS and associated samples, if available.

For Matrix Spike and Matrix Spike Duplicates, if all QC associated with a sample is within acceptance limits (the method blank and LCS spike recovery), the problem may be attributed to a matrix effect.

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Calibration

Individual methods specify calibration frequency and criteria. The following is a general representation of a calibration procedure.

For an initial 5 point calibration curve to be valid, the % relative standard deviation of the individual relative response factors (RRF) for the Calibration Check Compounds (CCC) should be less than or equal to 40% or as specified in the method. If this criterion is not met, then the calibration curve should be reanalyzed.

For continuing calibration checks to be valid, the relative response factor for each of the System Performance Check Compounds (SPCC) should be at least 0.050 and the RRF for each of the CCC should be $\leq 40\%$ (or as specified in the method) different from the average RRF from the initial calibration. If these criteria are not met, then the following corrective actions should be taken:

- Check internal standard and standard solutions for degradation, contamination, etc.,
- Check instrument for contamination at the injection port inlet and front end of the column;
- If no source of the problem is identified, then a complete 5 point initial calibration must be performed.

The SPCC and CCC for Semivolatiles are method specific. The following compounds are a general representation:

SPCC

N-Nitroso-di-n-propylamine
Hexachlorocyclopentadiene
2,4-Dinitrophenol
4-Nitrophenol

CCC

Acenaphthene	4-Chloro-3-Methylphenol
1,4-Dichlorobenzene	2,4-Dichlorophenol
Hexachlorobutadiene	2-Nitrophenol
N-Nitroso-di-phenylamine	Phenol
Di-n-octylphthalate	Pentachlorophenol

Fluoranthene
Benzo(a)pyrene

2,4,6-Trichlorophenol

15.1.3 Gas Chromatography

Method Blanks

If target compounds are detected in the method blank above the detection limit or reporting limit, as applicable, the corrective action consists of the following:

- checking the calculations;
- reanalyzing the blank;
- flagging the associated sample data;
- Investigating the source of the problem to implement corrective action for the future.

When target compounds are detected in a method blank, the following conditions apply:

- when any target compound is detected in a method blank above the action levels listed earlier, but not in associated samples, then no flag is applied.

Surrogates

The % recovery of the surrogates is calculated for each sample, blank, and standard. Corrective action is taken whenever one (or more) surrogate recovery is outside the acceptance criteria. The following corrective action is taken when required as stated above:

- Check calculations to assure there are no errors;
- Check standard and surrogate solutions for degradation, contamination, etc., and check instrument performance;
- If instrument failure is indicated, reanalyze the sample;

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- If the surrogate could not be measured because the sample required a dilution, no corrective action is required. The recovery of the surrogate is recorded with the note "surrogate diluted out";
- If all QC associated with the sample is within acceptance limits (the method blank surrogate recovery and LCS spike recovery), the problem may be attributed to a matrix effect. Samples exhibiting a matrix effect as indicated by out-of-criteria surrogate recoveries will be qualified and discussed in the report narrative.

Laboratory Control Samples

The % recovery of Laboratory Control Samples is calculated and corrective action is taken whenever recovery is outside the acceptance criteria. The following corrective action is taken when required as stated above:

- Check calculations to assure there are no errors;
- Check standard and spiking standard solutions for degradation, contamination, etc., and check instrument performance;
- If that does not correct the problem, then the data is reported and a qualifying statement regarding the laboratory control sample is included in the report narrative.

Calibration

For an initial 5 point calibration curve to be valid, the responses for each compound should be linear over the calibration range. If this criterion is not met, then the calibration curve should be reanalyzed.

For continuing calibration checks to be valid, the % difference in the calibration factor for each compound in calibration should not exceed 15% from the initial calibration or as specified in the method. If these criteria are not met, then the following corrective actions should be taken:

- Check standard solutions for degradation, contamination, etc.,
- Check instrument for contamination at the injection port inlet and front end of the column;

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- If no source of the problem is identified, then a complete 5 point initial calibration must be performed.

15.1.4 Metals Analyses

Method Blanks

If target analytes are detected in the method blank above the detection limit or reporting limit, as applicable, the corrective action consists of the following:

- checking the calculations;
- reanalyzing the blank;
- investigating the source if the problem to implement corrective action for the future;
- redigesting and reanalyzing the associated samples if the analyte concentration in the samples is less than 5 times the blank concentration and greater than the reporting limit.
- Data that cannot be regenerated acceptably are flagged as non-compliant.

When target analytes are detected in a method blank, the following data condition applies:

- when any target analyte is detected in a method blank above the action levels listed earlier but not in associated samples, then no flag is applied.

Laboratory Control Samples

The % recovery of Laboratory Control Samples is calculated for each spiked sample. Corrective action is taken whenever recovery is outside the acceptance criteria. The following corrective action is taken when required as stated above:

- Check calculations to assure there are no errors;
- Check standard and spiking standard solutions for degradation, contamination, etc., check instrument performance;
- Reanalyze LCS

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- Redigest and reanalyze samples if there is no indication of failure in any of the above;
- If that does not correct the problem, then the data are reported and a qualifying statement regarding the laboratory control sample is included in the report narrative.

For Matrix Spike, Matrix Spike Duplicates and Sample Duplicates, if all QC associated with a sample is within acceptance limits (method blank and LCS spike recoveries), the problem may be attributed to a matrix effect.

Calibration

For an initial and continuing instrument calibration to be valid, the responses for each analyte must be linear over the calibration range and the accuracy of calibration, as determined by analysis of an independent check standard, must be within $\pm 10\%$ of the true value for ICP/AA analyses and within $\pm 20\%$ for cold vapor AA analyses. If these criteria are not met, then the following corrective actions taken:

- Check standard solutions for degradation, contamination, etc.,
- Check instrument for contamination, incorrect operating conditions, etc.;
- If no source of the problem is identified, then a complete instrument calibration must be performed.

15.1.5 Classical Wet Chemistry Techniques

Method Blanks

If target analytes are detected in the method blank above the detection limit or reporting limit, as applicable, the corrective action consists of the following:

- checking the calculations;
- reanalyzing the blank;
- investigating the source if the problem to implement corrective action for the future;

- redigesting and reanalyzing the associated samples if the analyte concentration in the samples is less than 5 times the blank concentration.

When target analytes are detected in a method blank, the following data condition applies:

- when any target analyte is detected in a method blank above the action levels listed earlier but not in associated samples, then no flag is applied.

Laboratory Control Samples

The % recovery of Laboratory Control Samples is calculated for each spiked sample. Corrective action is taken whenever recovery is outside the acceptance criteria. The following corrective action is taken when required as stated above:

- Check calculations to assure there are no errors;
- Check standard and spiking standard solutions for degradation, contamination, etc., and check instrument performance;
- Reanalyze the sample if no problems are indicated by checking the items above;
- If reanalysis is not possible (i.e. the sample was consumed), then the data may be reported with a qualifying statement regarding the laboratory control sample which is included in the report narrative.

For Matrix Spike, Matrix Spike Duplicates and Sample Duplicates, if all QC associated with a sample is within acceptance limits (method blank and LCS spike recoveries), the problem may be attributed to a matrix effect.

Calibration

For an initial and continuing instrument calibration to be valid, the responses for each analyte must be linear over the calibration range and the accuracy of calibration, as determined by analysis of an independent check standard, must be within $\pm 10\%$ of the true value or as specified in the method. If these criteria are not met, then the following corrective actions taken:

- Check standard solutions for degradation, contamination, etc.,

- Check instrument for contamination, incorrect operating conditions, etc.;
- If no source of the problem is identified, then a complete instrument calibration must be performed.

15.2 Unusual Occurrences

Whereas out-of-control events involve occurrences outside of pre-established acceptance windows, unusual occurrences are more subjective and involve incidents which may be compliant with the assessment criteria but still warrant investigation. Many of these investigations will be the result of the professional judgment of the analyst, auditor or data reviewer that the analysis was not typical or reasonable. Another example of this type of investigation is an inquiry or questioning of data received from a client or from the results of performance evaluation samples.

FIGURE 15-1

KATAHDIN ANALYTICAL SERVICES, INC.
CORRECTIVE ACTION REPORT

CLP_ NEESA_ SW846_ NPDES_ Drinking water_ AFCEE_ ACOE_

Sample ID Number(s) Involved and QC batch #: _____

Type of Event: ☐ Out-of Control Event ☐ Attachments ☐ Unusual Occurrence

Disposition of Samples: ☐ Reprepped ☐ Reanalyzed ☐ Narrated

1) Description of Event:

☐ 1. LCS Failure	☐ 4. Prep Error	☐ 7. Detection Limit	☐ 11. Sample Contamination
☐ 2. Blank Contamination	☐ 5. Hold Time	☐ 8. Calibration Failure	☐ 12. Surrogate Failure
☐ 3. Poor Precision	☐ 6. Login Error	☐ 9. Retention Time Window	☐ 13. Matrix Spike Failure
	☐ 10. Linearity		☐ 14. Other (Describe Below)

1) Discussion of Known or Suspected Cause: _____

2) Corrective Action(s) Taken (include date, person and action): _____

4) Return to Control: _____

Initial and Date below please

1) Reported by _____ / _____ 2) Corrective Action Taken By: _____ / _____ 3) Corrective Action Approved _____ / _____
4) Documented Return to Control _____ / _____ 5) Supervisor _____ / _____ 6) QA _____ / _____

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16.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The Quality Assurance Department is responsible for preparing reports to management indicating the effectiveness of the Katahdin Analytical Services Quality Assurance Program.

16.1 Quality Assurance Auditors

Results of audits performed by the QA staff are detailed in formal, written audit reports. These reports are distributed to the appropriate department personnel, Supervisor, Laboratory Operations Manager, QA Officer, and General Manager for review and appropriate action. These and other QA-related reports are distributed as produced, with no set schedule.

Auditor reports will include, but not be limited to:

- Results of internal laboratory review activities
- Results of internal data review activities
- Results of Proficiency Evaluation studies
- Results of state certification applications
- Summary of holding time violation and data qualification
- Method detection limit study status

To demonstrate management review, the audit report will contain a page which will be signed and dated by the QA Officer and General Manager acknowledging that they have received the report and have reviewed its contents, and taken the necessary action dictated by their position.

16.2 Quality Assurance Officer

The Quality Assurance Officer will issue a report of QA activities and findings on a periodic basis to the General Manager. The status report will include:

- Results of internal systems or performance audits
- Corrective Action recommendations
- Discussion of QA issues raised by laboratory users
- Results of third party or external audits
- Status of laboratory certifications
- Other significant events
- Performance Evaluation Sample Results

16.3 Management Review of the Quality Assurance Program

Review of the appropriateness and adequacy of the Quality Assurance Program is ongoing. At a minimum, the General Manager, Operations and Client Services Managers, and QA Officer(s) review the QA Program Manual and its effectiveness on an annual basis (generally in January) and make modifications as deemed appropriate to improve or update the program. Any laboratory employee may present recommended changes to the Quality Assurance Officer, Supervisors or Operations Manager at any time.

During system audits, the Quality Assurance Program should be discussed. The audit report will document recommendations made by the Operations Manager or the auditor for revision.

AR300390

REFERENCES

1. U.S. EPA, "EPA Requirements for Quality Assurance Plans For Environmental Data Operations, EPA QA/R-5, August 1994
2. U.S. EPA, "Interim Guidelines and Specifications For Preparing Quality Assurance Project Plans, QAMS-005/80, EPA-600/4-83-004, February 1983
3. U.S. EPA, SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, 3rd Edition, 1986 and Updates I, II, and IIA, September 1994, Office of Solid Waste and Emergency Response.
4. U.S. EPA, Federal Register, 40 CFR Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act", October 26, 1984
5. U.S. EPA, Contract Laboratory Program Statement of Work for Organic Analysis, SOW 2/88, OLM01.8, OLM01.9, OLM02.0, OLM03.0
6. U.S. EPA, Contract Laboratory Program Statement of Work for Inorganic Analysis, SOW 7/88, ILM03.0, ILM03.1
7. Standard Methods For the Examination of Water and Wastewater, 15th, 16th, 17th, and 18th editions, 1980, 1985, 1989, 1992. APHA-AWWA-WPCF.

AR300391

APPENDIX D
HASP REVIEW AND SIGNATURE FORM AND
HASP FIELD MODIFICATION FORM

AR300392

Health and Safety Plan
PROJECT 32329.500
Review Sheet
Please sign and date.

Prepared By:

CIH/RHSS Review By:

HSO Review By:

Project Manager Review By:

Pre-Site Briefing

RUST E&I

Contractor(s)

AR300393

Page No. ____ of ____

Project: _____

Project Location: _____

Project No.: _____

Site Safety Officer: _____

Field Modification To HASP: _____

Prepared By: _____	Site Safety Officer	Date

Accepted By: _____	RUST Environment & Infrastructure Field Manager	Date

Accepted By: _____	Contractor Representative (If Applicable)	Date

Approved By: _____	RUST Environment & Infrastructure Regional Health and Safety Specialist or Alternate HASP Reviewer	Date

NOTE: Field Modifications to HASPs must be discussed with the RUST Environment & Infrastructure RHSS or CHSM with subsequent written approval. Secure approval through fax.

APPENDIX E
WORK ZONE ENTRY AND EXIT LOG

AR300395

Project: _____
Project No.: _____
Site Safety Officer: _____
Date: _____

[illegible]

ev. 4/93

AR300396

APPENDIX F
SUPERVISOR'S INCIDENT REPORT

AR300397

Date of this report: ____/____/____

Fax this report within 24 hours to RUST International Inc.: 708-947-3781

Telephone: 708-947-3525

Attention: Claims Management Department

Group: G01 (RUST E&I)

Region: _____ Office/Division: _____

TYPE OF INCIDENT: Inspection: _____ Accident: _____ Injury: _____ Spill: _____ Fire: _____ Other: _____

Agency: _____ Inspector's Name: _____ Type Inspection: _____

Agency Address: _____ Phone: _____

EMPLOYEE INFORMATION:

Employee's Name: _____ Social Security No: _____

Address: _____ Phone: _____

Date of Birth: _____ Number of Minor Dependents: _____ Marital Status: _____ Single _____ Widowed _____

Married _____ Divorced _____

Date of Hire: _____ Wage Rate: S _____ Hourly: _____ Annually: _____ Job No.: _____

Employee Hours on Date of Incident: _____ Employee Hrs. on Project: _____ Days/Wk.: _____ Hrs./Day: _____

Employee's Occupation _____ Years of Experience in _____

When Incident Occurred?: _____ This Occupation?: _____

INCIDENT INFORMATION:

Date of Incident: _____ Time: _____ Witness(s): _____

Date Reported to Supervisor: _____ Was Incident Believed to be Result of Employment?: Yes _____ No _____

If on Job Site, _____ Location on Job Site _____

Name of Job: _____ Where Incident Occurred: _____

Address Where Incident Occurred: _____

If First Aid Applied, by Whom: _____

Type of Injury and Part of Body Affected?: _____

Name/Address Medical Provider: _____

Brief Description of Incident: _____

Employee Activity at Time of Incident: _____

Description of Property Damaged: _____

OSHA 200 LOG INFORMATION:

Is incident OSHA recordable?: Yes ☐ No ☐ Does incident involve fatality?: Yes ☐ No ☐ Does incident involve lost time/restricted activity?: Yes ☐ No ☐Does incident involve medical treatment?: Yes ☐ No ☐ Does incident involve first aid only?: Yes ☐ No ☐ Current Status: _____

Employee's Supervisor: _____ Project Manager: _____

APPENDIX G
TOXICITY SUMMARIES

AR300399

ANILINE

(C₆H₅NH₂, Benzeamine, aniline oil, phenylamine, aminobenzene)

INDUSTRIAL USES: This compound is used as in the manufacture of dyes, resins, varnishes and as a solvent.

EXPOSURE LIMITS:

TLV:	2 ppm TWA, Skin
PEL:	2 ppm TWA, Skin
IDLH:	100 ppm (Ca)

PHYSICAL DATA:

Description:	Colorless to brown oily liquid with a characteristic odor and burning taste.
Solubility:	34000 mg/l in water
Incompatibilities:	Strong oxidizers, solutions of iron, zinc and aluminum, acids, alkalis, TDI
Boiling Point:	185°C
Melting Point:	-6.3°C
Vapor Pressure:	0.3 mm Hg @ 20°C
Vapor Density:	3.81 @25 C
Ionization Potential:	7.70 eV
Flammability:	Class IIIA Combustible Liquid
Flash Point:	169
LEL:	1.3%
UEL:	11%
Respirator Cartridge	
Breakthrough Time:	
HNu Sensitivity:	
OVA Sensitivity:	

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Intoxication
	Ingestion:	Poisonous
	External Contact:	Ataxia

Carcinogenic Effects: B2; Probable human carcinogen. National Cancer Institute studies (of aniline hydrochloride) showed hemangiosarcomas and fibrosarcomas of the spleen in rats. Inadequate human data. Reports of workers exposed to aniline in the dye industry developing bladder cancer are attributed to carcinogenic impurities present in the aniline and not to aniline itself.

AR300400

ANTHRACENE

($C_6H_4(CH)_2C_6H_4$, Component of coal tar pitch volatiles)

INDUSTRIAL USES: Anthracene is used as an important source of dyestuffs, a component of smoke screens, and an element in organic semi-conductor research. Coal tar is the base for roofing and pavement.

EXPOSURE LIMITS: TLV: 0.2 mg/m³, A1 Carcinogen
PEL: 0.2 mg/m³
IDLH: 700 mg/m³

PHYSICAL DATA:

Description:	Black or dark brown amorphous residue
Solubility:	Soluble in alcohol, ether, methanol, benzene, chloroform, carbon disulfide, carbon tetrachloride, and toluene
Incompatibilities:	Fluorine
Boiling Point:	647.6°F
Melting Point:	424.4°F
Vapor Pressure:	1 mm Hg @ 145°C
Specific Gravity:	1.25
Ionization Potential:	Not Available
Flammability:	Flammable
Flash Point:	250°F
LEL:	0.6%
UEL:	Not Available
Respirator Cartridge	
Breakthrough Time:	When breathing becomes labored
HNu Sensitivity:	Not Established
OVA Sensitivity:	Not Established

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Chronic exposure causes lung and kidney damage
	Ingestion:	None reported
	External Contact:	Produces dermatitis, burning, and edema. Skin often becomes photosensitive.

Carcinogenic Effects: D; Not classifiable as to human carcinogenicity. No human data available and inadequate data from animal bioassays.

AR300401

BARIUM
(Ba)

INDUSTRIAL USES: Barium is used as a carrier for radium, as a standard in spectrometry, and as a "getter" in electronic tubes.

EXPOSURE LIMITS: TLV: 0.5 mg/m³ TWA
PEL: 0.5 mg/m³ TWA
IDLH: 1100 mg/m³

PHYSICAL DATA:

Description:	Silvery-white, malleable metal
Solubility:	Miscible in alcohol
Incompatibilities:	Acids and oxidizers
Boiling Point:	2732°F
Melting Point:	1310°F
Vapor Pressure:	N/A
Specific Gravity:	3.6
Ionization Potential:	N/A
Flammability:	Flammable at room temperature in powder form; Store under inert gas, petroleum, or other oxygen-free liquid
Flash Point:	N/A
LEL:	N/A
UEL:	N/A
Respiratory Cartridge	
Breakthrough Time:	When breathing becomes labored
HNu Sensitivity:	N/A
OVA Sensitivity:	N/A

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces upper respiratory irritation
	Ingestion:	Produces gastroenteritis, muscle spasms, slow pulse, and extra systoles (contractions) of the heart
	External Contact:	Produces skin and eye irritation, and skin burns
Carcinogenic Effects:	None	

AR300402

BENZENE
(C₆H₆, Benzol)

INDUSTRIAL USES: Benzene is used for the manufacture of ethylbenzene, cyclohexane (for nylon), dodecylbenzene (for detergents), phenol, chlorobenzene, and as a solvent. Benzene is a constituent of gasoline (~ 1%).

EXPOSURE LIMITS: TLV: 10 ppm TWA
PEL: 1 ppm TWA, 5 ppm STEL
IDLH: 3000 ppm, Carcinogen

PHYSICAL DATA:

Description:	Colorless to light yellow, mobile liquid with an aromatic odor
Solubility:	Soluble in alcohol, ether, acetone, acetic acid, carbon tetrachloride, carbon disulfide, and water
Incompatibilities:	Strong oxidizers, many fluorides and perchlorates, and nitric acid
Boiling Point:	176.2°F
Melting Point:	41.9°F
Vapor Pressure:	75 mm Hg @ 20°C
Vapor Density:	0.8790
Ionization Potential:	9.24 eV
Flammability:	Class IB flammable liquid (**Dangerous fire risk**)
Flash Point:	12.0°F
LEL:	1.3%
UEL:	7.9%
Respirator Cartridge Breakthrough Time:	73 minutes @ 1000 ppm
HNu Sensitivity:	100% with a 10.2 eV lamp
OVA Sensitivity:	150%

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces irritation of the eyes, nose, and respiratory system, headache, and nausea
	Ingestion:	Produces a staggered posture, fatigue, and anorexia
	External Contact:	Produces dermatitis and bone marrow depression

Carcinogenic Effects:	OSHA -	Regulated Carcinogen
	EPA -	Human Carcinogen

AR300403

CARBON TETRACHLORIDE
(CCl₄, Tetrachloromethane, Perchloromethane)

INDUSTRIAL USES: Carbon Tetrachloride was used as a cleaning agent for clothing, a solvent and a destructive insect exterminator. It has mostly been replaced by less toxic solvents.

EXPOSURE LIMITS: TLV: 5 ppm TWA, Skin, Suspected Human Carcinogen
PEL: 2 ppm TWA
IDLH: 300 ppm

PHYSICAL DATA:

Description:	Colorless liquid with an ether-like odor
Solubility:	Slightly miscible in water; Miscible with alcohol, benzene, chloroform, ether, carbon disulfide, petr ether, and oils
Incompatibilities:	Sodium, potassium, magnesium, fluorine, and aluminum
Boiling Point:	170°F
Melting Point:	N/A
Vapor Pressure:	91 mm Hg @ 20°C
Vapor Density:	1.59
Ionization Potential:	11.47 eV
Flammability:	Nonflammable liquid
Flash Point:	N/A
LEL:	N/A
UEL:	N/A
Respirator Cartridge Breakthrough Time:	77 minutes @ 1000 ppm
HNu Sensitivity:	90% with an 11.7 eV lamp
OVA Sensitivity:	10%

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces depression of the Central Nervous System, nausea, and vomiting
	Ingestion:	Produces renal, liver, and kidney damage
	External Contact:	Produces a skin irritation
Carcinogenic Effects:	B2; Probable human carcinogen. Carcinogenicity in rats, mice, and hamsters. Inadequate human data.	

AR300404

CHLOROFORM
(CHCl₃, Trichloromethane, Methenyl Chloride)

INDUSTRIAL USES: Chloroform is used as a solvent for fats, oils, rubber, alkaloids, waxes, and resins, as a cleaning agent, as a constituent in fire extinguishers, and as a manufacturing element in the rubber industry.

EXPOSURE LIMITS: TLV: 10 ppm TWA, Suspected Human Carcinogen
PEL: 2 ppm TWA
IDLH: 1000 ppm

PHYSICAL DATA:

Description:	Colorless liquid with a pleasant, sweet odor
Solubility:	Miscible with alcohol, benzene, ether, petr ether, carbon tetrachloride, carbon disulfide, and oils
Incompatibilities:	Aluminum or magnesium powder, sodium, potassium, and strong caustics
Boiling Point:	143°F
Melting Point:	N/A
Vapor Pressure:	160 mm Hg @ 20°C
Vapor Density:	1.48
Ionization Potential:	11.42 eV
Flammability:	Nonflammable liquid
Flash Point:	N/A
LEL:	N/A
UEL:	N/A
Respirator Cartridge	
Breakthrough Time:	33 minutes @ 1000 ppm
HNu Sensitivity:	60% with an 11.7 eV lamp
OVA Sensitivity:	65%

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces dizziness, mental dullness, nausea, and disorientation
	Ingestion:	Produces headache and fatigue
	External Contact:	Produces irritation of the eyes and skin

Carcinogenic Effects: B2; Probable human carcinogen. Chloroform has been tested in eight strains of mice, two strains of rats and in beagle dogs. Increased incidence of several tumor types in rats and three strains of mice. Inadequate human data.

AR300405

CHROMIUM

(Chromium Metals, Divalent Chromium, Trivalent Chromium)

INDUSTRIAL USES: Chromium is used in the manufacture of chrome-steel or chrome-nickel-steel alloys, in the process of increasing the resistance and durability of metals, in the process of chromeplating other metals, as a tracer in various blood diseases, and as a determinant of blood volume.

EXPOSURE LIMITS:
TLV: 0.5 mg/m³ TWA
PEL: 0.5 mg/m³ TWA
IDLH: N/A

PHYSICAL DATA:

Description:	Hard, bluish-white, brittle metal
Solubility:	Miscible with hydrochloric acid and sulfuric acid
Incompatibilities:	Water, alkalis, hydrogen peroxide, and Nitric acid
Boiling Point:	4788°F
Melting Point:	3452°F
Vapor Pressure:	0 mm Hg @ 20°C
Specific Gravity:	7.14
Ionization Potential:	N/A
Flammability:	Nonflammable solid in bulk form (**Finely divided dust burns rapidly if heated in a flame**)
Flash Point:	N/A
LEL:	N/A
UEL:	N/A
Respirator Cartridge	
Breakthrough Time:	When breathing becomes labored
HNu Sensitivity:	N/A
OVA Sensitivity:	N/A

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces histologic fibrosis of the lungs, and irritation of the respiratory passages(possible ulceration)
	Ingestion::	Produces severe irritation of the gastrointestinal tract, circulatory shock, and renal damage
	External Contact:	Produces irritation of the skin
Carcinogenic Effects:	None	

AR300406

1,2-DICHLOROBENZENE
(C₆H₄Cl₂, o-Dichlorobenzene)

INDUSTRIAL USES: 1,2-Dichlorobenzene is used in the manufacture of 3,4-Dichloroaniline and certain dyes, as a solvent for organic materials, as a fumigant and insecticide, and as industrial odor control.

EXPOSURE LIMITS:
TLV: 50 ppm Ceil, Skin
PEL: 50 ppm Ceil
IDLH: 1000 ppm

PHYSICAL DATA:

Description:	Colorless to pale yellow liquid with a pleasant, aromatic odor
Solubility:	Miscible in ethanol, benzene, and diethyl ether
Incompatibilities:	Strong oxidizers, aluminum, acids, acid fumes, and chlorides
Boiling Point:	356.9°F
Melting Point:	0.32°F
Vapor Pressure:	1.15 mm Hg @ 20°C
Vapor Density:	1.28
Ionization Potential:	9.06 eV
Flammability:	Combustible liquid
Flash Point:	150°F
LEL:	2.2%
UEL:	9.2%
Respirator Cartridge Breakthrough Time:	109 minutes @ 1000 ppm
HNu Sensitivity:	N/A
OVA Sensitivity:	50%

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces irritation of the eyes and nose
	Ingestion:	Produces liver and kidney damage
	External Contact:	Produces skin blisters

Carcinogenic Effects: None

AR300407

1,4-DICHLOROBENZENE
(C₆H₄Cl₂, p-Dichlorobenzene, Dichloride, PDCB)

INDUSTRIAL USES: 1,4-Dichlorobenzene is used as a moth repellent, insecticide, and germicide, as a constituent in the manufacture of dyes and pharmaceuticals, and as a soil fumigant.

EXPOSURE LIMITS: TLV: 75 ppm TWA, 110 ppm STEL
PEL: 75 ppm TWA
IDLH: 1000 ppm

PHYSICAL DATA:

Description:	White solid with a mothball-like odor
Solubility:	Miscible in alcohol, benzene, ether, chloroform, and carbon disulfide
Incompatibilities:	Oxidizers
Boiling Point:	345°F
Melting Point:	128°F
Vapor Pressure:	0.4 mm Hg @ 77°F
Specific Gravity:	1.25
Ionization Potential:	8.98 eV
Flammability:	Combustible solid
Flash Point:	150°F
LEL:	N/A
UEL:	N/A
Respirator Cartridge Breakthrough Time:	109 minutes @ 1000 ppm
HNu Sensitivity:	N/A
OVA Sensitivity:	N/A

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces headache, eye irritation, and profuse rhinitis
	Ingestion:	Produces anorexia, nausea, and vomiting
	External Contact:	Produces low-weight and jaundice
Carcinogenic Effects:	None	

AR300408

m-DICHLOROBENZENE
(C₆H₄Cl₂, 1,3-Dichlorobenzene)

INDUSTRIAL USES:

EXPOSURE LIMITS: TLV:
PEL:
IDLH:

PHYSICAL DATA:

Description:
Solubility: Miscible in alcohol and ether
Incompatibilities:
Boiling Point: 173°F
Melting Point: -24.7°F
Vapor Pressure:
Vapor Density:
Ionization Potential:
Flammability:
Flash Point: N/A
LEL: N/A
UEL: N/A
Respirator Cartridge
Breakthrough Time:
HNu Sensitivity:
OVA Sensitivity:

HUMAN TOXICITY:

Systemic Effects: Inhalation:
Ingestion:
External Contact:

Carcinogenic Effects: None

AR300409

DI-N-BUTYLPHTHALATE
($C_6H_4(COOC_4H_9)_2$, DBP, Dibutylphthalate)

INDUSTRIAL USES: This compound is used as a plasticizer in the manufacture of PVC.

EXPOSURE LIMITS:

TLV:	5 mg/m ³ ppm TWA
PEL:	5 mg/m ³ TWA
IDLH:	9300 mg/m ³

PHYSICAL DATA:

Description:	Colorless to faint yellow oily liquid with aromatic odor
Solubility:	13 mg/l in water
Incompatibilities:	Nitrates, strong oxidizers, alkalis/acids, liquid chlorine
Boiling Point:	644°F
Melting Point:	N/A
Vapor Pressure:	<0.01 mm Hg @ 20°C
Vapor Density:	11.38 g/L @ 25 C
Ionization Potential:	N/A
Flammability:	Class IIIB Combustible Liquid
Flash Point:	315 F
LEL:	N/A
UEL:	N/A
Respirator Cartridge	
Breakthrough Time:	
HNu Sensitivity:	
OVA Sensitivity:	

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Irritates upper respiratory tract
	Ingestion:	Produces nausea
	External Contact:	No adverse effects noted

Carcinogenic Effects: Not listed as a carcinogen by NTP, IARC, or OSHA.

AR300410

2,4-DINITROTOLUENE
($C_6H_3CH_3(NO_2)_2$, 2,4-DNT)

INDUSTRIAL USES:

EXPOSURE LIMITS:	TLV:	1.5 mg/m ³ TWA
	PEL:	1.5 mg/m ³ TWA
	IDLH:	200 mg/m ³ (Ca)

PHYSICAL DATA:

Description:	Orange yellow crystalline solid
Solubility:	270 mg/l in water
Incompatibilities:	Strong oxidizers, caustics, metals such as tin and zinc
Boiling Point:	572°F
Melting Point:	°F
Vapor Pressure:	0.0051mm Hg @ 20°C
Vapor Density:	N/A
Ionization Potential:	N/A
Flammability:	Combustible solid, difficult to ignite
Flash Point:	404 F
LEL:	N/A
UEL:	N/A
Respirator Cartridge	
Breakthrough Time:	
HNu Sensitivity:	
OVA Sensitivity:	

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces anoxia and anemia
	External Contact:	Produces jaundice

Carcinogenic Effects: Potential human carcinogen.

DI-N-OCTYLPHTHALATE

(C₂₄H₃₈O₄, Dioctylphthalate)

INDUSTRIAL USES: This compound is used as a plasticizer in the manufacture of PVC.

EXPOSURE LIMITS: TLV:
PEL:
IDLH:

PHYSICAL DATA:

Description:	Colorless viscous liquid with a slight odor
Solubility:	3 mg/l in water
Incompatibilities:	
Boiling Point:	386°F
Melting Point:	-30°F
Vapor Pressure:	0.00014 mm Hg @ 20°C
Vapor Density:	16 g/l @ 25 C
Ionization Potential:	N/A
Flammability:	
Flash Point:	218.3
LEL:	N/A
UEL:	N/A
Respirator Cartridge	
Breakthrough Time:	
HNu Sensitivity:	
OVA Sensitivity:	

HUMAN TOXICITY:

Systemic Effects:	Inhalation:
	Ingestion:
	External Contact:
Carcinogenic Effects:	None

AR300412

DIPHENYL
(C₆H₅C₆H₅, Biphenyl)

INDUSTRIAL USES: Biphenyl is used as a heat transfer liquid, and is used in the manufacture of benzidine.

EXPOSURE LIMITS:

TLV:	0.2 ppm
PEL:	1mg/m ³
IDLH:	300 mg/m ³

PHYSICAL DATA:

Description:	Colorless to pale yellow solid with pleasant odor
Solubility:	Insoluble in water, soluble in benzene and ether
Incompatibilities:	Strong oxidizers
Boiling Point:	489 F
Melting Point:	156 F
Vapor Pressure:	0.06 mm Hg
Vapor Density:	
Ionization Potential:	7.95eV
Flammability:	Combustible Liquid
Flash Point:	235°F
LEL:	0.6%
UEL:	5.8%
Respirator Cartridge	
Breakthrough Time:	
HNu Sensitivity:	
OVA Sensitivity:	

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces irritation of the eyes and throat
	Ingestion:	Produces nausea, liver damage

Carcinogenic Effects: None

AR300413

ETHANOLAMINE

($\text{HOCH}_2\text{CH}_2\text{NH}_2$, Monoethanolamine, 2-Aminoethanol, Colamine)

INDUSTRIAL USES: Ethanolamine is used for scrubbing acid gases (CO_2 and H_2S), especially in the synthesis of ammonia, as a constituent in nonionic detergents used in drycleaning, and as an ingredient in the manufacture of pharmaceuticals.

EXPOSURE LIMITS:

TLV:	3 ppm TWA, 6 ppm STEL
PEL:	3 ppm TWA, 6 ppm STEL
IDLH:	1000 ppm

PHYSICAL DATA:

Description:	Colorless liquid with a mild ammonia-like odor
Solubility:	Miscible with water, methanol, and acetone
Incompatibilities:	Strong acids and oxidizers
Boiling Point:	339°F
Melting Point:	50.9°F
Vapor Pressure:	0.48 mm Hg @ 20°C
Vapor Density:	1.02
Ionization Potential:	8.96 eV
Flammability:	Class IIIA combustible liquid
Flash Point:	185°F
LEL:	3%
UEL:	23.5%
Respirator Cartridge Breakthrough Time:	N/A
HNu Sensitivity:	N/A
OVA Sensitivity:	N/A

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces respiratory dysfunction
	Ingestion:	Produces internal irritation and lethargy
	External Contact:	Produces skin and eye irritation

Carcinogenic Effects: None

AR300414

FORMALDEHYDE

(HCHO, oxomethane, oxymethylene, formic aldehyde)

INDUSTRIAL USES: Formaldehyde is used as a fertilizer disinfectant, an embalming fluid, and in the manufacture of many other compounds.

EXPOSURE LIMITS: TLV: 1 ppm TWA, 2 ppm STEL, Suspected Human Carcinogen
PEL: 1 ppm TWA, 2 ppm STEL
IDLH: 30 ppm

PHYSICAL DATA:

Description:	Colorless gas with a pungent, suffocating odor
Solubility:	Miscible in water, alcohol, and ether
Incompatibilities:	Strong oxidizers, alkalis, acids, phenol, and urea
Boiling Point:	-3.1°F
Melting Point:	-133.6°F
Vapor Pressure:	10 mm Hg @ 20°C
Vapor Density:	1.067
Ionization Potential:	10.88 eV
Flammability:	Combustible liquid (**moderate fire risk**)
Flash Point:	140°F
LEL:	7%
UEL:	73%
Respirator Cartridge Breakthrough Time:	Not Established
HNu Sensitivity:	1.1% with an 11.7 eV lamp
OVA Sensitivity:	Undetectable with this instrument

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces irritation of the eyes, nose, and throat (@ 2-5 ppm), becomes unpleasant (@ 5-10 ppm), and is intolerable (@ levels in excess of 25 ppm). Tissue damage is likely at levels of 25-50 ppm. Rapid and complete recovery is attainable.
	Ingestion:	Produces burning in the nasal area, coughing, bronchial spasms, and pulmonary irritation
	External Contact:	Produces dermatitis

Carcinogenic Effects: Carcinogenic through external contact

LEAD
(Pb)

INDUSTRIAL USES: Lead is used in construction material for tank linings and piping, in pigments for paints, in storage batteries, and in ceramics and plastics.

EXPOSURE LIMITS: TLV: 0.15 mg/m³ TWA
PEL: 0.05 mg/m³ TWA
IDLH: 700 mg/m³

PHYSICAL DATA:

Description:	Heavy, blue-grey, soft, malleable metal
Solubility:	Miscible in nitric acid
Incompatibilities:	Hydrogen peroxide, strong oxidizers, acids, and water
Boiling Point:	3164°F
Melting Point:	621°F
Vapor Pressure:	0 mm Hg @ 20°C (Approx)
Specific Gravity:	11.34
Ionization Potential:	N/A
Flammability:	Noncombustible solid
Flash Point:	N/A
LEL:	N/A
UEL:	N/A
Respirator Cartridge	
Breakthrough Time:	When breathing becomes labored
HNu Sensitivity:	N/A
OVA Sensitivity:	N/A

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces weakness and insomnia
	Ingestion:	Produces facial pallor, anorexia, low weight, and malnutrition
	External Contact:	Produces gingival lead line, tremors, encephalopathy, and eye irritation
Carcinogenic Effects:	None	

AR300416

MERCURY, INORGANIC (Hg)

INDUSTRIAL USES: Mercury is used as a catalyst, in electrical apparatus, thermometers, barometers, and mercury vapor lamps.

EXPOSURE LIMITS: TLV: 0.05 mg/m³ TWA, Skin
PEL: 0.05 mg/m³ TWA, Skin
IDLH: 28 mg/m³

PHYSICAL DATA:

Description:	Silvery, heavy, mobile, odorless liquid
Solubility:	Miscible in boiling sulfuric and nitric acids; insoluble in water
Incompatibilities:	Acetylene, ammonia, chlorine dioxide, azides, calcium, sodium carbide, lithium, rubidium, and copper
Boiling Point:	674°F
Melting Point:	N/A
Vapor Pressure:	0.0012 mm Hg @ 20°C
Vapor Density:	13.6
Ionization Potential:	N/A
Flammability:	Noncombustible liquid
Flash Point:	N/A
LEL:	N/A
UEL:	N/A
Respirator Cartridge Breakthrough Time:	No approved cartridges
HNu Sensitivity:	N/A
OVA Sensitivity:	N/A

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces coughing and chest pain
	Ingestion:	No adverse effects mentioned
	External Contact:	Produces tremors, insomnia, irritability, indecision, headache, fatigue, and weakness
Carcinogenic Effects:	None	

AR300417

METHYLENE CHLORIDE
(CH₂Cl₂, Dichloromethane, Methylene Dichloride)

INDUSTRIAL USES: Methylene Chloride is used in solvents for cellulose acetate, and in degreasing and cleaning fluids.

EXPOSURE LIMITS: TLV: 50 ppm TWA
PEL: 500 ppm TWA, 1000 ppm Ceil, 2000 ppm Peak
IDLH: 5000 ppm

PHYSICAL DATA:

Description:	Colorless liquid with a chloroform-like odor
Solubility:	Miscible in water, alcohol, ether, and DMF
Incompatibilities:	Strong oxidizers, caustics, aluminum, magnesium, potassium, sodium, and nitric acid
Boiling Point:	104°F
Melting point:	N/A
Vapor Pressure:	350 mm Hg @ 20°C
Vapor Density:	1.33
Ionization Potential:	11.32 eV
Flammability:	N/A
Flash Point:	N/A
LEL:	14%
UEL:	22%
Respirator Cartridge Breakthrough Time:	10 minutes @ 1000 ppm (**Cartridge respirators are not recommended for this material due to its poor warning properties**)
HNu Sensitivity:	94% with an 11.7 eV lamp
OVA Sensitivity:	100%

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces fatigue, weakness, sleepiness, and light-headedness
	Ingestion:	Produces numb limbs, nausea, and tingling in the extremities
	External Contact:	Produces eye and skin irritation
Carcinogenic Effects:	EPA -	Probable Human Carcinogen

AR300418

α -METHYLCYCLOHEXANONE
(CH₃C₆H₉O, 2-methylcyclohexanone)

INDUSTRIAL USES: Methylcyclohexanone is used as a solvent.

EXPOSURE LIMITS:

TLV:	50 ppm TWA, 75 ppm STELhrough external contact with the skinhrough external contact with the skin
PEL:	50 ppm TWA, 75 ppm STEL
IDLH:	2500 ppm

PHYSICAL DATA:

Description:	Colorless liquid with a peppermint odor
Solubility:	
Incompatibilities:	Strong oxidizers
Boiling Point:	325°F
Melting Point:	N/A
Vapor Pressure:	1 mm Hg @ 20°C
Vapor Density:	
Ionization Potential:	N/A
Flammability:	Class II Combustible Liquid
Flash Point:	118°F
LEL:	N/A
UEL:	N/A
Respirator Cartridge Breakthrough Time:	
HNu Sensitivity:	
OVA Sensitivity:	

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Narcotic in animals.
	Ingestion:	No adverse effects mentioned
	External Contact:	Eyes/mucous membranes effected.

Carcinogenic Effects: Not listed as a carcinogen by NTP, IARC, or OSHA.

MONOCHLOROBENZENE
(C₆H₅Cl, Chlorobenzene, Benzene Chloride, MCB)

INDUSTRIAL USES: This compound is used in the manufacture of aniline, phenol, and as a heat transfer medium.

EXPOSURE LIMITS:

TLV:	10 ppm TWA, Skin
PEL:	75 ppm TWA, Skin
IDLH:	2400 ppm

PHYSICAL DATA:

Description:	Colorless liquid, almond-like odor
Solubility:	insoluble in water, soluble in benzene, chloroform, ether
Incompatibilities:	Strong oxidizers
Boiling Point:	270°F
Melting Point:	-45°F
Vapor Pressure:	9 mm Hg @ 20°C
Vapor Density:	4.60 g/L @25 C
Ionization Potential:	9.07 eV
Flammability:	Class IC Flammable Liquid
Flash Point:	85 F
LEL:	1.3%
UEL:	9.6%
Respirator Cartridge	
Breakthrough Time:	
HNu Sensitivity:	
OVA Sensitivity:	

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Irritates eyes and mucous membranes in nose and throat
	Ingestion:	Produces drowsiness and incoherence

Carcinogenic Effects:	None

AR300420

METHYLENE DIANILINE
(C₁₂H₁₀N₂, MDA, 4,4Diaminodiphenylmethane)

INDUSTRIAL USES: Methylene Dianiline is used as a curing agent for urethane elastomers, and as an intermediate in the manufacture of polyurethanes.

EXPOSURE LIMITS: TLV: 0.1 ppm TWA
PEL:
IDLH:

PHYSICAL DATA:

Description:	
Solubility:	Miscible in alcohol, ether, and benzene
Incompatibilities:	Not reported
Boiling Point:	231°C @ 11mm
Melting Point:	93 C
Vapor Pressure:	
Vapor Density:	
Ionization Potential:	
Flammability:	
Flash Point:	
LEL:	
UEL:	
Respirator Cartridge	
Breakthrough Time:	
HNu Sensitivity:	
OVA Sensitivity:	

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	
	Ingestion:	No adverse effects mentioned
	External Contact:	Produces jaundice/weakness

Carcinogenic Effects: None

AR300421

NAPHTHALENE
(C₁₀H₈, White Tar, Naphthalin, Moth Flake)

INDUSTRIAL USES: Naphthalene is used in the manufacture of moth repellant, synthetic resins, celluloid smokeless powder, lubricants, and motor fuels.

EXPOSURE LIMITS: TLV: 10 ppm TWA, 15 ppm STEL
PEL: 10 ppm TWA, 15 ppm STEL
IDLH: 500 ppm

PHYSICAL DATA:

Description:	Colorless to brown solid with a mothball-like odor
Solubility:	Miscible in ether, hydronaphthalenes, and fixed and volatile oils
Incompatibilities:	Strong oxidizers and chromic anhydride
Boiling Point:	424°F
Melting Point:	176°F
Vapor Pressure:	0.08 mm Hg @ 20°C
Specific Gravity:	1.16
Ionization Potential:	8.12 eV
Flammability:	Combustible solid
Flash Point:	174°F
LEL:	0.9%
UEL:	5.9%
Respirator Cartridge	
Breakthrough Time:	When breathing becomes labored
HNu Sensitivity:	N/A
OVA Sensitivity:	N/A

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces headache, loss of appetite, and nausea
	Ingestion:	Produces nausea, vomiting, and abdominal pain
	External Contact:	Produces profuse sweating, dermatitis, and renal shutdown

Carcinogenic Effects: None

AR300422

PHOSGENE

(COCl₂, Carbonyl chloride, carbon, oxychloride, chloroformyl chloride)

INDUSTRIAL USES: Intermediate in production of Toluene Diisocyanate

EXPOSURE LIMITS: TLV: 0.1 ppm
PEL: 0.1 ppm
IDLH: 2 ppm

PHYSICAL DATA:

Description: Colorless gas with a suffocating odor like musty hay.
Solubility: Slight
Incompatibilities: Moisture, reacts slowly in water to form hydrochloric acid and carbon dioxide
Boiling Point: 47 F
Melting Point:
Vapor Pressure: >1 atm
Vapor Density:
Ionization Potential: 11.55 eV
Flammability: Nonflammable gas
Flash Point: NA
LEL: NA
UEL: NA
Respirator Cart
Breakthrough Time:

HUMAN TOXICITY:

Systemic Effects: Inhalation: Highly Toxic; Initial signs of overexposure include burning sensation in the throat, eyes, tightness of the chest, difficulty breathing and cyanosis.
Ingestion: Pulmonary edema
External Contact: Irritation, burns to skin and eye
Carcinogenic Effects: Not known to be carcinogenic.

AR300423

o-TOLUDINE

(CH₃C₆H₄NH₂, 2-methylbenzamine, 2-aminotoluene, 2-methylaniline)

INDUSTRIAL USES: This compound is used in the manufacture of various dyes, and as an intermediate in the manufacture of other chemicals.

EXPOSURE LIMITS:

TLV:	2 ppm TWA, Skin
PEL:	5 ppm TWA, Skin
IDLH:	100 ppm (Ca)

PHYSICAL DATA:

Description:	Colorless to pale yellow liquid with aromatic, aniline-like odor
Solubility:	16 mg/l in water
Incompatibilities:	Oxidizers, nitric acid
Boiling Point:	392°F
Melting Point:	107.2°F
Vapor Pressure:	0.1 mm Hg @ 20°C
Vapor Density:	4.38 g/L @ 25 C
Ionization Potential:	7.44 eV
Flammability:	Class IIIA Combustible Liquid
Flash Point:	185 F
LEL:	N/A
UEL:	N/A
Respirator Cartridge	
Breakthrough Time:	
HNu Sensitivity:	
OVA Sensitivity:	

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces anoxia/headaches
	Ingestion:	Produces hematuria
	External Contact:	Produces weakness/dizziness

Carcinogenic Effects: B2; Possible human carcinogen. Insufficient human data.

AR300424

TOLUENE
(C₆H₅CH₃, Toluol, Methylbenzene, Phenylmethane)

INDUSTRIAL USES: Toluene is used in the manufacture of benzoic acid, benzaldehyde, explosives, and dyes, as a solvent for paints, lacquers, gums, and resins, and as a gasoline additive.

EXPOSURE LIMITS: TLV: 50 ppm TWA, 150 ppm STEL
PEL: 100 ppm TWA, 150 ppm STEL
IDLH: 2000 ppm

PHYSICAL DATA:

Description:	Colorless liquid with a sweet, pungent benzene-like odor
Solubility:	Miscible in water, alcohol, chloroform, ether, acetone, glacial acetic acid, and carbon disulfide
Incompatibilities:	Strong oxidizers
Boiling Point:	232°F
Melting Point:	N/A
Vapor Pressure:	22 mm Hg @ 20°C
Vapor Density:	0.87
Ionization Potential:	8.82 eV
Flammability:	Class IB flammable liquid
Flash Point:	40°F
LEL:	1.2%
UEL:	7.1%
Respirator Cartridge Breakthrough Time:	94 minutes @ 1000 ppm
HNu Sensitivity:	100% with a 10.2 eV lamp
OVA Sensitivity:	110%

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces fatigue, weakness, confusion, euphoria, dizziness, and headache
	Ingestion:	Produces dilated pupils, muscle fatigue, and insomnia
	External Contact:	Produces dermatitis
Carcinogenic Effects:	None	

AR300425

2,4-TOLUENEDIAMINE
(CH₃C₆H₃(NH₂)₂, 4-methyl-1,3-benzenediamine, TDA)

INDUSTRIAL USES:

EXPOSURE LIMITS:	TLV:	None
	PEL:	None
	IDLH:	

PHYSICAL DATA:

Description:	Solid
Solubility:	
Incompatibilities:	
Boiling Point:	
Melting point:	99 C
Vapor Pressure:	
Vapor Density:	
Ionization Potential:	
Flammability:	N/A
Flash Point:	N/A
LEL:	
UEL:	
Respirator Cartridge	
Breakthrough Time:	
HNu Sensitivity:	
OVA Sensitivity:	

HUMAN TOXICITY:

Systemic Effects:	Inhalation:
	Ingestion:
	External Contact:

Carcinogenic Effects:	NIOSH	-	Probable Human Carcinogen

AR300426

TOLUENE DIISOCYANATE

(CH₃C₆H₃(NCO)₂, 2,4-Diisocyanatoluene, 2,4-Tolylene Diisocyanate; TDI)

INDUSTRIAL USES: Used in the manufacture of polyurethane foams.

EXPOSURE LIMITS:

TLV:	0.005 ppm TWA, 0.02 ppm STEL
PEL:	0.005 ppm TWA, 0.02 ppm STEL
IDLH:	10 ppm (Ca)

PHYSICAL DATA:

Description:	Colorless to pale yellow solid or liquid (above 71 F) with a sharp, pungent odor
Solubility:	Miscible in ether, acetone, benzene, herosene, olive oil, carbon tetrachloride
Incompatibilities:	Strong oxidizers, water, acids, bases, alcohols
Boiling Point:	484°F
Melting Point:	N/A
Vapor Pressure:	0.01 mm Hg @ 20°C
Vapor Density:	7.12 g/L @ 25 C
Ionization Potential:	N/A
Flammability:	Class IIIB Combustible Liquid
Flash Point:	260°F
LEL:	0.9%
UEL:	9.5%
Respirator Cartridge	
Breakthrough Time:	
HNu Sensitivity:	
OVA Sensitivity:	

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces respiratory irritation
	Ingestion:	Produces cough/chest pain
	External Contact:	Not mentioned

Carcinogenic Effects:

AR300427

VINYL CHLORIDE
(CH₂ = CHCl, Chloroethylene, Chloroethene)

INDUSTRIAL USES: Vinyl Chloride is used in the plastics industry, and as a refrigerant.

EXPOSURE LIMITS: TLV: 5 ppm TWA, **Known Human Carcinogen**
PEL: 1 ppm TWA, 5 ppm Ceil
IDLH: Ca

PHYSICAL DATA:

Description:	Colorless gas or liquid with a pleasant odor
Solubility:	Miscible in alcohol, ether, carbon tetrachloride, benzene, and water
Incompatibilities:	Copper, oxidizers, aluminum, peroxides, iron, and steel
Boiling Point:	7.0°F
Melting Point:	N/A
Vapor Pressure:	2580 mm Hg @ 20°C
Vapor Density:	0.91
Ionization Potential:	10.0 eV
Flammability:	Flammable gas
Flash Point:	-108°F
LEL:	3.6%
UEL:	33.0%
Respirator Cartridge	
Breakthrough Time:	1 hour @ 10 ppm
HNu Sensitivity:	50% with a 10.2 eV lamp
OVA Sensitivity:	35%

HUMAN TOXICITY:

Systemic Effects:	Inhalation:	Produces weakness, abdominal pain, GI bleeding, and cyanosis
	Ingestion:	No adverse effects mentioned
	External Contact:	No adverse effects mentioned

Carcinogenic Effects: Vinyl chloride is a known liver carcinogen

AR300428

APPENDIX H
AIR MONITORING REQUIREMENTS

AR300429

AIR MONITORING REQUIREMENTS

EQUIPMENT

☒ OVA
☐ HNu or TIP II
☐ Combustible Gas Indicator (CGI)
☐ Toxic Gas Monitor
☐ Hydrogen Sulfide
☐ Carbon Monoxide
☐ Other (Specify) _____
☐ Radiation Survey Meter
☒ Detector Tubes
Type(s) Methylene Chloride, Vinyl Chloride
☒ Mini-ram Airborne Dust Monitor
☒ Other Mercury Vapor Analyzer

FREQUENCY OF MONITORING

☒ Continuously (During Intrusive Activities)
☐ Every 15 Minutes
☐ Every 30 Minutes
☒ Every Hour (During Non-Intrusive Activities)
☐ Other _____

AR300430

APPENDIX I
AUGUST 4, 1995 LETTER TO EPA OUTLINING USE OF PHOSGENE
AT OLIN AREA

AR300431



P.O. BOX 248, 1186 LOWER RIVER ROAD NW, CHARLESTON, TN 37310

Phone: (615) 336-4000

August 4, 1995

Mr. Eugene P. Wingert
Remedial Project Manager
U.S. Environmental Protection Agency (3HW41)
841 Chestnut Building
Philadelphia, PA 19107

RE: Phosgene Issues
Olin Area of the Hanlin-Allied-Olin Site, Moundsville, WV
EPA Docket No. III-94-29-DC

Dear Mr. Wingert:

As discussed during our meeting on June 28, 1995, (EPA, Olin, and Rust), Olin and Rust have re-examined the phosgene issues. For reference, phosgene was discussed in the draft EE/CA Work Plan of December 22, 1994, EPA comments to the Work Plan (March 31 and June 14, 1995), Olin's May 1 and June 28, 1995, responses, and our June 28 meeting.

We have researched the history of phosgene usage in the Olin Area, examined phosgene's physicochemical properties, discussed sampling and analytical procedures with two analytical laboratories, and searched the available toxicological information. Our findings indicate:

- ☐ Phosgene was used only at former Buildings 53, 63, and 66.
- ☐ There were no reportable quantity phosgene releases during the Olin production years (1981-1984).
- ☐ During the production years, liquid phosgene was stored at the Olin Area in a refrigerated, above-ground storage tank to maintain its liquid phase.
- ☐ The horizontal, above ground phosgene storage tank, piping, and reactors were removed during the decommissioning (1985-1989).
- ☐ Phosgene has not been produced at the Olin Area since 1984.

- ☐ Phosgene is a gas above 47 °F and requires cooling below this temperature to convert to a liquid phase.
- ☐ In the presence of water, phosgene readily hydrolyzes to carbon dioxide and hydrogen chloride, which in the presence of water, further converts to hydrochloric acid.
- ☐ Liquid phosgene hydrolytically decomposes with half-lives on the order of minutes.
- ☐ PACE Laboratories, Inc. and Centre Analytical Laboratories, Inc. suggested using either an airtight container during sample collection, preparation, and analysis (not practicable) or a soil-gas technique (which would not relate the mass of phosgene to a mass of soil).
- ☐ No analytical method is available to determine phosgene soil concentration.
- ☐ Phosgene is not a standard laboratory analyte and would require a method development to determine soil-gas concentrations.
- ☐ OSHA's threshold limit value (TLV) for phosgene in air is 0.1 ppm.
- ☐ Draeger tube (or equivalent) detection limit ranges from 0.02 - 0.05 ppm.
- ☐ Risk-based values for phosgene in soil are non-existent (e.g., Health Effects Assessment Summary Tables (HEAST), EPA540/R-94/020, USEPA, March 1994).
- ☐ As agreed to with the EPA, phosgene will be analyzed in the breathing zone during soil borehole installation in the vicinity of former Buildings 53, 63, and 66 using Draeger tubes (or equivalent).

To summarize, phosgene was utilized in only three former buildings at the facility. There were no reportable quantity releases of liquid or gaseous phosgene during Olin's production period. All tanks, lines and reactors containing phosgene were above ground. Because of phosgene's highly reactive and unstable physical characteristics, any minor (less than the recordable quantity) phosgene gas releases that may have occurred in the above ground system would have immediately vented to the atmosphere. Any minor liquid phosgene releases during the winter months would have hydrolyzed to carbon dioxide and hydrogen chloride in a matter of minutes. During the summer months, any potential release of liquid phosgene would vaporize almost immediately. These factors, both in the fact that the structures containing phosgene were above ground and

Mr. Eugene P. Wingert
August 4, 1995
Page 3

phosgene's physical characteristic, greatly reduce the possibility of a minor gas or liquid phosgene release impacting soil or groundwater.

In the unlikely event that liquid phosgene has not hydrolyzed to its degradation components over the past 11 years, the physicochemical natures indicate that phosgene will not adsorb to the soil matrices, but would reside in the interstices as soil-gas. Both laboratories surveyed indicated that soil sampling would be extremely difficult due to phosgene's very reactive and unstable physicochemical properties. As a result, we believe it is technically impracticable to obtain an air tight soil sample for phosgene analysis. Even if it was possible to obtain such a soil sample, the laboratories surveyed indicated that an analytical method to relate mass of phosgene per mass of soil can not be developed. Moreover, there are no toxicological parameters to compare phosgene soil-gas concentrations to mass of phosgene per mass of soil. In other words, there is no technical method to determine phosgene soil concentration or toxicology data to compare such data to.

The preceding indicates that it highly unlikely that phosgene is present at the site and that an analytical method to determine phosgene concentrations in soil does not exist. However, these factors do not lessen Olin's concern with unlikely, but potential, phosgene exposure to the individuals performing the EE/CA investigation. Olin Chemical Corporation safely and successfully produces phosgene at a number of active facilities and are experts in phosgene handling and employee safety procedures. Lengthy discussions with our Lake Charles, Louisiana facility an active producer of phosgene, and our New Haven, Connecticut facility has provided us with new and very helpful information.

As you know, phosgene gas is toxic at low concentrations and exposure lengths. OSHA's permissible expose limit (PEL) and the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV) for a phosgene is 0.1 ppm. This PEL and TLV is an 8 hour, time-weighted average concentration. However, Olin takes further precautions to monitor and protect its employees against acute exposures. In the unlikely event, phosgene is present at the phosgene area of the site, short-term or acute exposure is what would be expected. Draeger tubes (or equivalent) are adequate to semi-quantitatively determine phosgene gas concentrations, but do not measure the magnitude of exposure over time. Therefore, in addition to the Draeger tubes already proposed, we propose to institute a modified version of the Lake Charles facility's phosgene employee protection policy during the field investigation.

The Lake Charles' phosgene dosimeter badge usage policy requires employees with the potential of phosgene exposure to wear phosgene dosimeter badges at all times. We propose to institute a modified version of the Lake Charles policy to meet the needs of personnel during field activities near the former phosgene area. Each person working near Buildings 53, 63, and 66 will be required to comply with the enclosed "Olin Area -- Phosgene Dosimeter Badge Usage Policy." Each badge will also be changed, evaluated, and results recorded on a daily basis. Exposure criteria

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will not be modified. Anyone with a phosgene dosage greater than 20 ppm-minute (as explained below), will require medical surveillance for 24 hours. This proposal will provide continuous detection for phosgene and will also protect each individual conducting the EE/CA investigation from potential, but extremely unlikely, exposure to phosgene gas. A phosgene material safety data sheet is also enclosed.

As indicated in the enclosed dosimeter badge usage policy, phosgene exposure levels are indicated by a color change in the dosimeter badge from white (non-detected) to red (>180 ppm-minute). To determine phosgene dosage using the dosimeter badge reading, the dosimeter badge is placed in a cutout section of the dose estimator. The bottom color wheel is rotated until the intensity of color matches the badge (hue may vary; only intensity of color is matched). Once the color intensities are matched, the dosage can be read directly from the color wheel. The dosimeter badge is capable of detecting 5 dosage levels less than the trigger level of 20 ppm-minute. The unit "ppm-minute" indicates that, as the badge is continually exposed to phosgene, the badge continues to darken in intensity. However, once a dose is greater than 20 ppm-minute, indicated by a color change from white to pink, medical evaluation is required. Estimated phosgene concentration can be determined by dividing the dosage by the estimated exposure time. For example, if an individual's dosimeter badge changed from nondetected (white) to level 5 (pink, indicating a 20 ppm-minute exposure), and their exposure period is approximately 20 minutes, the phosgene concentration is estimated at 1 ppm. Averaging this acute exposure over 8 hours (as OSHA's PEL and ACGIH's TLV) results in a PEL and TLV of 0.1 ppm. This indicates that the PEL and TLV have been met and is why medical surveillance is required.

Our Lake Charles industrial hygienist has also provided additional information regarding acute phosgene exposure. Since phosgene symptoms can occur in a delayed manner, anyone exposed to greater than a 20 ppm-minute dose requires medical surveillance. Olin's industrial hygienist further indicates that a phosgene dose of up to 50 ppm-minute can cause several side effects, including: itchy throat, burning eyes, heavy chest and other symptoms. Exposures as high as 100 ppm-minute are very serious and can be life threatening. Phosgene exposure at dosages higher than 180 ppm-minute are extremely dangerous and are often life threatening. However, the unlikely incidental phosgene exposure from soil-gas in phosgene area of the site is not expected (or realistic) to exceed the trigger level of 20 ppm-minute.

As indicated in our draft EE/CA Work Plan, and for the reasons summarized above, Olin concludes that it is highly unlikely that phosgene is even present in either its gas or liquid phases at the Olin Area. Furthermore, soil sampling for phosgene is technically impracticable and there are no toxicology data for soil concentrations. However, Draeger tubes have been proposed to quantitatively evaluate potential soil-gas concentration. The only remaining factor regarding phosgene is the remote possibility of acute phosgene exposure to individuals performing the

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EE/CA. Phosgene dosimeter badges are proposed to provide continuous protection for personnel working in the former phosgene area against PEL and TLV exceedences.

Olin believes these measures exceed all expectations for protecting the health and safety of individuals performing the EE/CA near the phosgene area of the site. However, if there are additional questions regarding phosgene's physicochemical nature or toxicology, I can arrange for a conference call with our Lake Charles or New Haven facilities. Please call me at (615) 336-4576 if you wish to schedule this conference call.

Sincerely,
OLIN CORPORATION



Richard W. McClure, PG, REM
Senior Project Coordinator

Enclosures (2)

cc: David L. Cummings, Olin*
Tom O'Brien, Olin*
Drennon Strawbridge, Olin*
Laura Tew, Olin - Lake Charles*
Dr. Steven J. Barbee, Olin - New Haven*

Jennifer Hubbard, EPA - Region III
Kathy Kiestler, Olin - Lake Charles
Robert Higgins, Olin - Moundsville
Jeff Jackson, Rust

* - Without enclosures

AR300436

**TITLE: Phosgene Badge Usage Policy
Allied-Hanlin-Olin Site
Olin Area, Moundsville, WV**

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EFFECTIVE DATE: 08/31/95

NEXT REVIEW DATE: 08/31/97

APPROVED BY: Kathy Kiestler

POSITION TITLE: Industrial Hygienist, Olin - Lake Charles, Louisiana

1.0 PURPOSE:

To provide a means of assessing exposure to employees, contractors, and visitors working in areas where phosgene may be present.

To provide medical personnel with dose information to aid in evaluation and treatment.

To provide the Moundsville Engineering Evaluation/Cost Analysis (EE/CA) Site Team and Olin management with a tool which may be utilized to locate and correct potential hazards.

2.0 SCOPE:

This procedure is applicable to personnel performing subsurface investigations in the former phosgene processing area (Buildings 53, 63, and 66) during execution of the EE/CA investigation.

3.0 RESPONSIBILITY:

The Project Manager, Field Team Leader and Site Safety Officer, as defined in the EE/CA Work Plan (Section 7.0, Health and Safety Plan), are responsible for ensuring the compliance of this procedure.

4.0 PROCEDURE:

4.1 Background

The GMD phosgene badge and Phosgene Usage Policy have been successfully used in the Lake Charles facility since 1979. The Olin Area - Phosgene Usage Policy is a modified version of the Lake Charles' Phosgene Usage Policy. Modification to the Lake Charles policy were instituted to protect field personnel during execution of the EE/CA investigation at the Allied-Hanlin-Olin site.

The phosgene badge employs a chemically impregnated tape which changes color when exposed to phosgene. The badge has an "Indicator" Window and a "Control" Window configuration. The "Indicator Window" allows phosgene to diffuse onto the tape, unrestricted. The "Control" Window is covered by a barrier strip which slows down diffusion, but also protects the badge from sunlight, water, and dirt. Because of this, the badge is read using a color wheel

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with two different scales, one for the "Control" window, the other for the lighter intensity "Indicator" window.

The badge reads in units of ppm-min. This means, as the badge is continuously exposed to phosgene, it continues to darken in intensity. If the exact duration of exposure is known, the reading in ppm-min. may be divided by the total number of minutes to arrive at ppm (unit of concentration). But knowing the duration of exposure is not really necessary. Because we speak of dose in units of ppm-min, the duration of exposure is not critical.

Phosgene badges turn pink when exposed to phosgene. Individuals who are color blind to pink must have someone else assess their badge. High concentrations of hydrogen chloride bleaches the pink color back to white. High concentrations ($\frac{1}{2}$) of phosgene can cause a previously blood red badge to revert back to white. Evidence of this can be seen around the periphery of the plastic seal which retains the red color probably wicked there by diffusion across the paper. Cigarette smoke discolors the badge to a yellow tint. "Old" phosgene badges also show a yellowish tint. Water renders the badge useless, so it's important to keep it in a dry place.

4.2 Obtaining Phosgene Badges

- 4.2.1 Phosgene badges have a 3-month expiration date on the badges, so overstocking is uneconomical. The Project Manager should contact the Project Coordinator if extra badges are required. The Project Coordinator will arrange for additional shipments.
- 4.2.2 Badges are distributed by the Site Safety Officer.. Personnel involved in subsurface investigations in the former phosgene area (Buildings 53, 63, and 66) require phosgene badges.
- 4.2.3 Badges are issued as part of the field sign-in procedure during subsurface investigations in the former phosgene area.
- 4.2.4 The Site Safety Officer has the responsibility to explain the usage of the badge to those unfamiliar with it.

4.3 Use of a Phosgene Badge

- 4.3.1 At the beginning of each work shift OBTAIN a new phosgene badge.

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TITLE: Phosgene Badge Usage Policy
Allied-Hanlin-Olin Site
Olin Area, Moundsville, WV

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- 4.3.2 PULL the barrier strip at the bottom of the badge, EXPOSING the paper tape. WRITE your name and today's date on the badge.
- 4.3.3 Contractors WRITE company name also.
- 4.3.4 REMOVE the adhesive tab on the back of the badge and STICK the badge under your hard hat brim.
- 4.3.5 This protects the badge and is close to your nose.
- 4.3.6 If you NOTICE an unusual odor check your badge for pink color. At the end of your work shift, CHECK your badge for pink color.
- 4.3.7 REPORT any pink color to the Site Safety Officer or the Field Team Leader IMMEDIATELY.
- 4.3.8 If you SUSPECT phosgene exposure and DISCOVER your badge is missing, REPORT to the Site Safety Officer. The Site Safety Officer will arrange for transfer to the local medical facility for observation. ANY pink color is reason for investigation, but does not necessarily indicate overexposure.
- 4.3.9 TURN your badge in to the Site Safety Officer..
- 4.3.10 Pink color is matched to dose by the following procedure:

4.4 Use of a Phosgene Dose Estimator:

- 4.4.1 LEAVE the control window barrier strip intact and READ the indicator window unless it is unreadable. Dose Estimators are located at field office.
- 4.4.2 The Field Team Leader and Site Safety Officer have additional ones if needed.
- 4.4.3 The badge is PLACED into the cutout section of the dose estimator. The BOTTOM color wheel is rotated until the INTENSITY of the color matches the badge (*hues may vary; only INTENSITY of color is matched*). Note the number where it says "Read number here". This number corresponds to dose at the

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Olin Area, Moundsville, WV

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bottom of the dose estimator. A match of "5" corresponds to 19 ppm-min. Anyone showing color darker than this (> 20 ppm-min) must REPORT to the LOCAL MEDICAL FACILITY for evaluation.

- 4.4.4 All phosgene badges showing ANY exposure will be recorded by operations in log books in the field office. The log contains the following items:

- 4.4.4.1 date
- 4.4.4.2 time
- 4.4.4.3 name
- 4.4.4.4 company name
- 4.4.4.5 badge reading in ppm-min

- 4.4.5 When the log is full it will be sent to the Project Manager for retention and a new one will be started.

- 4.4.6 If the reading of the phosgene badge is questionable, the Field Team Leader and/or the Project Manager may be CONSULTED to help READ the badge.

- 4.4.7 All exposures greater than 20 ppm-min must REPORT to the LOCAL MEDICAL FACILITY for 24 hour observation.

- 4.4.8 If an individual KNOWS his badge incorrectly estimated his exposure (accidentally worn on the outside of a respirator, badge used to check for leaks, etc...) he should STATE this and ATTACH an explanation to the badge when it is TURNED in.

- 4.4.9 Phosgene badges do "fade out" over time. This fade is particularly noticeable at lower dose levels, but is not significant when the badge is read immediately.

- 4.4.10 Only ONE phosgene badge should be WORN per shift. After an exposure below 20 ppm-min, additional badges may be used along side the first, to give visual proof of subsequent exposures, should they occur. In the case of another badge being worn, and exposed, the two readings should be ADDED to arrive at the total dose.

- 4.4.11 This information must be COMMUNICATED to Medical personnel. It is imperative that those giving treatment know the cumulative dose of the individual.

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TITLE: Phosgene Badge Usage Policy
Allied-Hanlin-Olin Site
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- 4.4.12 The Project Manager must contact the Project Coordinator and must INVESTIGATE any exposure prior to ALLOWING work to continue in the area.

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**MATERIAL
SAFETY DATA****OCEAN NETWORK EMERGENCY PHONE 1-800-OLIN-911**

THIS MATERIAL SAFETY DATA SHEET (MSDS) HAS BEEN PREPARED IN COMPLIANCE WITH THE FEDERAL OSHA HAZARD COMMUNICATION STANDARD, 29 CFR 1910.1200. THIS PRODUCT MAY BE CONSIDERED TO BE A HAZARDOUS CHEMICAL UNDER THAT STANDARD. (REFER TO THE OSHA CLASSIFICATION IN SEC. I.) THIS INFORMATION IS REQUIRED TO BE DISCLOSED FOR SAFETY IN THE WORKPLACE. THE EXPOSURE TO THE COMMUNITY, IF ANY, IS QUITE DIFFERENT.

I. PRODUCT IDENTIFICATION

REVISION NO : 3
REVISION DATE : 5/05/95
PRODUCT CODE : CIE500007
FILE NUMBER : CIE00857.0001
PRODUCT NAME: PHOSGENE

SYNONYMS: Carbonyl chloride

CHEMICAL FAMILY: OLIN INTERMEDIATE

FORMULA: Cl_2CO

USE DESCRIPTION: Chemical reagent

OSHA HAZARD CLASSIFICATION: Water reactive, lung toxin, skin and eye hazard, corrosive, highly toxic

II. COMPONENT DATA**PRODUCT COMPOSITION**

CAS or CHEMICAL NAME: Carbonyl chloride (phosgene)

CAS NUMBER: 75-44-5

PERCENTAGE RANGE: 100%

HAZARDOUS PER 29 CFR 1910.1200: Yes

EXPOSURE STANDARDS:

	OSHA (PEL)	ACGIH (TLV)
	ppm	ppm
	mg/cubic-meter	mg/cubic-meter
TWA:	0.1	0.1
CEILING:	None	None
STEL:	None	None

III. PRECAUTIONS FOR SAFE HANDLING AND STORAGE

DO NOT TAKE INTERNALLY. DO NOT INHALE MIST OR VAPOR. AVOID CONTACT WITH SKIN, EYES AND CLOTHING. UPON CONTACT WITH SKIN OR EYES, WASH OFF WITH WATER.

STORAGE CONDITIONS:

STORE IN A COOL, DRY, WELL VENTILATED PLACE.

DO NOT STORE AT TEMPERATURES ABOVE: 55 Deg.C (130 Deg.F)

OTHER: Avoid contact with water or moisture. Reacts to form carbon dioxide and hydrogen chloride.

PRODUCT STABILITY AND COMPATIBILITY

SHELF LIFE LIMITATIONS: Not Known

INCOMPATIBLE MATERIALS FOR STORAGE OR TRANSPORT: Not Known

IV. PHYSICAL DATA

APPEARANCE: Yellow liquid or colorless gas

FREEZING POINT: -84 Deg.C (-180 Deg.F)

BOILING POINT: 9 Deg.C (46.8 Deg.F)

DECOMPOSITION TEMPERATURE: No Data

SPECIFIC GRAVITY: 1.38

BULK DENSITY: 1.38 (g/cc)

pH @ 25 DEG.C: Acidic

VAPOR PRESSURE @ 25 DEG.C: 1.73 atm @ 21.1 Deg.C

SOLUBILITY IN WATER: Reacts with water

VOLATILES, PERCENT BY VOLUME: 100%

EVAPORATION RATE: No Data

VAPOR DENSITY: 3.4 (Air = 1)

MOLECULAR WEIGHT: 98 g/mole

ODOR: Sharp and pungent

COEFFICIENT OF OIL/WATER DISTRIBUTION: Not Applicable

V. PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS**PERSONAL PROTECTION FOR ROUTINE USE OF PRODUCT:****RESPIRATORY PROTECTION:**

Wear a NIOSH/MSHA approved respirator if any exposure occurs.

VENTILATION:

Use local exhaust ventilation to maintain levels to below the TLV.

SKIN AND EYE PROTECTIVE EQUIPMENT:

Wear gloves, boots, apron and a face shield with safety glasses.

A full impermeable suit is recommended if exposure is possible to large portion of body.

OTHER: Eye wash station and safety shower should be provided in the immediate work area.

EQUIPMENT SPECIFICATIONS (WHEN APPLICABLE):

RESPIRATOR TYPE: NIOSH/MSHA approved positive-pressure supplied-air respirator

PROTECTIVE CLOTHING TYPE (This includes: gloves, boots, apron, protective suit): Neoprene, viton

**MATERIAL
SAFETY DATA****VI. FIRE AND EXPLOSION HAZARD INFORMATION****FLAMMABILITY DATA:**

EXPLOSIVE: No
FLAMMABLE: No
COMBUSTIBLE: No
PYROPHORIC: No
FLASH POINT: Not Flammable
AUTOIGNITION TEMPERATURE: No Data
FLAMMABLE LIMITS AT NORMAL ATMOSPHERIC TEMPERATURE AND PRESSURE (PERCENT VOLUME IN AIR): LEL - No Data UEL - No Data

NFPA RATINGS:

Health: 4
Flammability: 0
Reactivity: 0

HMIS RATINGS:

Health: 4
Flammability: 0
Reactivity: 1

EXTINGUISHING MEDIA:

Not Applicable-Choose extinguishing media suitable for surrounding materials.

FIRE FIGHTING TECHNIQUES AND COMMENTS:

Use water to cool containers exposed to fire.
Water reactive material; do not spray with water.

USE NIOSH/MSHA APPROVED POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS WHEN THIS MATERIAL IS INVOLVED IN A FIRE.

VII. REACTIVITY INFORMATION**CONDITIONS UNDER WHICH THIS PRODUCT MAY BE UNSTABLE:**

TEMPERATURES ABOVE: Stable under normal conditions
MECHANICAL SHOCK OR IMPACT: No
ELECTRICAL (STATIC) DISCHARGE: No
HAZARDOUS POLYMERIZATION: Will not occur
INCOMPATIBLE MATERIALS: Water, ammonia, amines, alcohol, phenol, aluminum or sodium metal, and hydrogen gas

HAZARDOUS DECOMPOSITION PRODUCTS: Carbon dioxide and hydrogen chloride gas form reaction with water.

SUMMARY OF REACTIVITY:

EXPLOSIVE:	No
OXIDIZER:	No
PYROPHORIC:	No
ORGANIC PEROXIDE:	No
WATER REACTIVE:	Yes

VIII. FIRST AID

EYES:

Immediately flush with large amounts of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Call a physician at once.

SKIN:

Immediately flush with water for at least 15 minutes. Call a physician. If clothing comes in contact with the product, the clothing should be removed immediately and should be laundered before re-use.

INGESTION:

Immediately drink large quantities of water. DO NOT induce vomiting. Call a physician at once. DO NOT give anything by mouth if the person is unconscious or if having convulsions.

INHALATION:

If person experiences nausea, headache or dizziness, person should stop work immediately and move to fresh air until these symptoms disappear. If breathing is difficult, administer oxygen, keep the person warm and at rest. Call a physician. In the event that an individual inhales enough product to lose consciousness, person should be moved to fresh air at once and a physician should be called immediately. If breathing has stopped, artificial respiration should be given immediately. In all cases, ensure adequate ventilation and provide respiratory protection before the person returns to work.

OTHER: Inhalation of this product can result in the formation of life-threatening pulmonary edema. This can occur in a delayed fashion up to 24 hours after exposure.

**MATERIAL
SAFETY DATA****IX. TOXICOLOGY AND HEALTH INFORMATION****ROUTES OF ABSORPTION**

Dermal, eye contact, inhalation, ingestion.

WARNING STATEMENTS AND WARNING PROPERTIES

HIGHLY TOXIC. MAY BE FATAL IF INHALED. CAUSES SEVERE RESPIRATORY IRRITATION. HARMFUL IF EXPOSED TO SKIN OR EYES, MAY CAUSE BURNS. HARMFUL IF INGESTED.

HUMAN THRESHOLD RESPONSE DATA

ODOR THRESHOLD: 0.5 ppm

IRRITATION THRESHOLD: In the range of 3-4 ppm. The odor and irritant properties of phosgene do not provide sufficient warning of hazardous conditions.

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH: 2 ppm

SIGNS, SYMPTOMS, AND EFFECTS OF EXPOSURE**INHALATION****ACUTE:**

Phosgene is a highly toxic chemical. Inhalation of this material is severely irritating to the nose, mouth, throat, and respiratory tract. Acute exposure may cause respiratory and circulatory failure. Initial signs of overexposure include a burning sensation in the throat, eyes, tightness of the chest, difficulty breathing and cyanosis. Pulmonary edema may develop and can result in shortness of breath, wheezing, choking, chest pain, impairment of lung function, pneumonia and death. Nervous system effects may also be seen including headache, dizziness, blurred vision, mental confusion and muscular twitching. Nausea and vomiting may also occur. These effects may be delayed in onset and may not be seen for 2-48 hours following exposure.

CHRONIC:

Chronic inhalation may cause permanent lung damage including emphysema and fibrosis.

SKIN**ACUTE:**

Liquid phosgene can produce severe irritation and/or burns to the skin on contact. This irritation is characterized by redness, swelling, and scab formation. Prolonged skin exposure may cause destruction of the dermis with ulceration.

CHRONIC:

Effects from chronic exposure would be similar to those from single exposure except for effects secondary to tissue destruction.

EYE

Exposure to vapors causes a scratchy sensation of the eyes and may cause photophobia, lachrymation and conjunctivitis. Direct contact with liquid phosgene can cause burns resulting in impairment of vision and corneal damage.

INGESTION**ACUTE:**

In the gaseous state ingestion of phosgene is unlikely, however, accidental ingestion can occur in the liquid state. There is a possibility that pulmonary edema can result from this route of exposure.

CHRONIC:

There is no available data on chronic ingestion of phosgene.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Respiratory, cardiovascular, skin or eye disorders

INTERACTIONS WITH OTHER CHEMICALS WHICH ENHANCE TOXICITY

None known or reported

ANIMAL TOXICOLOGY**ACUTE TOXICITY**

Inhalation LC 50: 1400 mg/m³/30 min (rat)

Inhalation LC 10: 360 mg/m³/30 min (human)

Inhalation LC 50: 3200 mg/m³ (human)

Dermal LD 50: No available data

Oral LD 50: No available data

Irritation: Causes burns to eyes and skin and severe respiratory irritation.

ACUTE TARGET ORGAN TOXICITY

Exposure to this product can result in severe irritation and/or burns to eyes, mucous membranes, respiratory tract, and skin.

**MATERIAL
SAFETY DATA****CHRONIC TARGET ORGAN TOXICITY**

Repeated exposure may cause irreversible changes to the lung resulting in emphysema or fibrosis.

REPRODUCTIVE AND DEVELOPMENTAL TOXICITY

There are no known or reported effects on reproductive function or fetal development.

CARCINOGENICITY

This product is not known or reported to be carcinogenic by any reference source including IARC, OSHA, NTP, or EPA.

MUTAGENICITY

This product is not known or reported to be mutagenic.

AQUATIC TOXICITY

No available data

X. TRANSPORTATION INFORMATION

NOT APPLICABLE - INTERMEDIATE NOT SHIPPED

XI. SPILL AND LEAKAGE PROCEDURES

FOR ALL SPILL AND LEAK ACCIDENTS, CONTACT:

OCEAN at the telephone number that appears on the first page of this Material Safety Data Sheet.

CONSULT PLANT PROCEDURES IN THE EVENT OF A SPILL OR LEAK.

PERSONAL PROTECTION FOR EMERGENCY SPILL AND FIRE-FIGHTING SITUATIONS:

Response to this material requires the use of a full encapsulated suit and self-contained breathing apparatus (SCBA).

Compatible materials for response to this material are neoprene, viton and saranex

Protection concerns must also address the potential of the physical characteristic of this product as poison by inhalation and corrosive

XII. WASTE DISPOSAL

CARE MUST BE TAKEN TO PREVENT ENVIRONMENTAL CONTAMINATION FROM THE USE OF THIS MATERIAL. THE USER OF THIS MATERIAL HAS THE RESPONSIBILITY TO DISPOSE OF UNUSED MATERIAL, RESIDUES AND CONTAINERS IN COMPLIANCE WITH ALL RELEVANT LOCAL, STATE AND FEDERAL LAWS AND REGULATIONS REGARDING TREATMENT, STORAGE AND DISPOSAL FOR HAZARDOUS AND NONHAZARDOUS WASTES.

XIII. ADDITIONAL REGULATORY STATUS INFORMATION**TOXIC SUBSTANCES CONTROL ACT:**

This substance is listed on the Toxic Substances Control Act inventory.

XIV. ADDITIONAL INFORMATION

MSDS STATUS: Revision to Section IX, Toxicology Information

THE INFORMATION PROVIDED ON THIS MSDS IS THE BEST ESTIMATE OF TECHNICALLY QUALIFIED INDIVIDUALS BUT MAY NOT BE BASED ON DIRECT TOXICOLOGY TESTING OR EXPERIENCE IN EMERGENCY SITUATIONS. IT MUST BE USED BY OR UNDER THE DIRECT SUPERVISION OF TECHNICALLY QUALIFIED INDIVIDUALS (AS DEFINED IN 40 CFR 710.2). CONSULT PLANT PROCEDURES IN THE EVENT OF A SPILL OR LEAK FOR HANDLING AND ENVIRONMENTAL INFORMATION.

XV. MAJOR REFERENCES

1. Bretherick, L., Handbook of Reactive Chemical Hazards, 3rd Ed., Boston, MA: Butterworths, 1985.
2. Hazardline, Occupational Health Services Inc., New York, NY.
3. Lewis, R. and D. Sweet, Eds., Registry of Toxic Effects of Chemical Substances, 1985-1986, Washington, DC: U.S. Government Printing Office, 1987.
4. NIOSH Pocket Guide to Chemical Hazards. Washington, DC: U.S. Government Printing Office, 1985.

AR300449

**MATERIAL
SAFETY DATA**

THE INFORMATION IN THIS MATERIAL SAFETY DATA SHEET SHOULD BE PROVIDED TO ALL WHO WILL USE, HANDLE, STORE, TRANSPORT, OR OTHERWISE BE EXPOSED TO THIS PRODUCT. THIS INFORMATION HAS BEEN PREPARED FOR THE GUIDANCE OF PLANT ENGINEERING, OPERATIONS AND MANAGEMENT AND FOR PERSONS WORKING WITH OR HANDLING THIS PRODUCT. OLIN BELIEVES THIS INFORMATION TO BE RELIABLE AND UP TO DATE AS OF THE DATE OF PUBLICATION, BUT MAKES NO WARRANTY THAT IT IS. ADDITIONALLY, IF THIS MATERIAL SAFETY DATA SHEET IS MORE THAN THREE YEARS OLD, YOU SHOULD CONTACT OLIN AT THE PHONE NUMBER LISTED BELOW TO MAKE CERTAIN THAT THIS SHEET IS CURRENT.

OLIN MSDS CONTROL GROUP
Olin Corporation
120 Long Ridge Road
Stamford, CT 06904
Phone Number: (203) 356-3449

OLIN CORPORATION SUBSIDIARIES AND AFFILIATED ENTITIES: ASAHI-OLIN LTD., BRIDGEPORT BRASS CORPORATION, INDY ELECTRONICS, INC., OLIN CHLORATE CORPORATION, OLIN FABRICATED METAL PRODUCTS INC., OLIN HUNT SPECIALTY PRODUCTS INC., OLIN ELECTRONICS TECHNOLOGY, OLIN MESA CORP., OLIN SPECIALTY METALS CORPORATION, PACIFIC ELECTRO DYNAMICS, INC., PHYSICS INTERNATIONAL COMPANY, ROCKET RESEARCH COMPANY, OCG MICROELECTRONIC MATERIALS, INC.

APPENDIX J
PERSONAL PROTECTIVE EQUIPMENT

AR300451

PERSONAL PROTECTIVE EQUIPMENT

FULL BODY PROTECTION

☒ Tyvek
☐ KleenGuard
☐ Polyethylene coated Tyvek
☐ Saran coated Tyvek
☐ Other _____

HEAD PROTECTION

☒ Safety Hard Hat
☐ Hard Hat Liner
☐ Splash/Rain Hood

EYES AND FACE PROTECTION

☐ Face Shield
☒ Safety Glasses
☒ Goggles (during wet/splash conditions)

HEARING PROTECTION

☒ Ear Plugs
☐ Ear Muffs
☐ Both Plugs and Muffs

HAND PROTECTION

☒ Nitrile Gloves
☐ Neoprene Gloves
☒ Vinyl - PVC Gloves
☐ Viton Gloves
☐ Silver Shield Gloves
☒ Leather Work Gloves

FOOT PROTECTION

☒ Regular Leather Work boots
☐ Plain
☒ Steel-Toe
☐ Insulated
☒ Neoprene Overshoe

AR300452

☒ Neoprene Boot
 ☐ Plain
 ☒ Steel-Toe
____ PVC Boot
 ☐ Plain
 ☐ Steel-Toe
____ Butyl Rubber Boot
 ☐ Plain
 ☐ Steel-Toe
____ Other (Specify) _____

GENERAL

____ Safety Harness
____ Lifeline
____ Cooling Jacket
____ Life Jacket
____ ☒ Eyewash Kit(s)
____ ☒ Fire Extinguisher
____ Botsball Thermometer
____ ☒ First Aid Kit(s)/Bloodborne Pathogen Kit(s)
____ Disposal Bags

AR300452A

EPA REGION III
SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOC ID 164658
PAGE # 300453

IMAGERY COVER SHEET
UNSCANNABLE ITEM

SITE NAME Hanlin-Allied-Olin

OPERABLE UNIT 00

ADMINISTRATIVE RECORDS- SECTION III VOLUME

REPORT OR DOCUMENT TITLE Engineering Evaluation / Cost
Analysis work plan

DATE OF DOCUMENT 1-5-96

DESCRIPTION OF IMAGERY Former Building / Sewer

locations, Existing monitoring wells, & proposed soil sampling
locations.

NUMBER AND TYPE OF IMAGERY ITEM(S) 1 oversized map

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IMAGERY COVER SHEET
UNSCANNABLE ITEM

SITE NAME <u>Hanlin-Allied-Olin</u>
OPERABLE UNIT <u>CO</u>
ADMINISTRATIVE RECORDS- SECTION <u>III</u> VOLUME _____

REPORT OR DOCUMENT TITLE <u>Engineering Evaluation / Cost Analysis work plan</u>
DATE OF DOCUMENT <u>1-5-96</u>
DESCRIPTION OF IMAGERY <u>1978 Concentrations of Key Organic Compounds in Groundwater (Prior to Olin Acquisition)</u>
NUMBER AND TYPE OF IMAGERY ITEM(S) <u>1 oversized map</u>

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IMAGERY COVER SHEET
UNSCANNABLE ITEM

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OPERABLE UNIT 00

ADMINISTRATIVE RECORDS- SECTION III VOLUME

REPORT OR DOCUMENT TITLE Engineering Evaluation / Cost
Analysis work plan

DATE OF DOCUMENT 1-5-96

DESCRIPTION OF IMAGERY 1982 Concentrations of Key Organic
Compounds in Groundwater (At Time of Olin Acquisition)

NUMBER AND TYPE OF IMAGERY ITEM(S) 1 oversized map

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IMAGERY COVER SHEET
UNSCANNABLE ITEM

SITE NAME <u>Hanlin - Allied-Olin</u>
OPERABLE UNIT <u>00</u>
ADMINISTRATIVE RECORDS- SECTION <u>III</u> VOLUME _____

REPORT OR DOCUMENT TITLE <u>Engineering Evaluation / Cost Analysis work plan</u>
DATE OF DOCUMENT <u>1-5-96</u>
DESCRIPTION OF IMAGERY <u>Current Surface Topography, Existing Building Foundations, Existing Monitoring Wells, & proposed soil sampling locations.</u>
NUMBER AND TYPE OF IMAGERY ITEM(S) <u>1 oversized map</u>