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FINAL
FIELD OPERATIONS PLAN

WHITMOYER LABORATORIES SITE
JACKSON TOWNSHIP
LEBANON COUNTY, PENNSYLVANIA

JUNE 1988
W.A. NO. 200-3L09

300388

EBASCO SERVICES INCORPORATED
One Oxford Valley, Suite 414, 2300 Lincoln Highway - East, Langhorne, PA 19047-1829, (215) 752-0212

June 10, 1988
RM/III/88-260
Response Required

Mr. Jeffrey Pike
Environmental Protection Agency
Region III
841 Chestnut Street
Philadelphia, PA 19107

Subject: REM III PROGRAM - EPA CONTRACT NO. 68-01-7250
WORK ASSIGNMENT NO. 200-3L09
WHITMOYER LABORATORIES SITE RI/FS, JACKSON TWP., PENNSYLVANIA
FINAL FIELD OPERATIONS PLAN

Dear Mr. Pike:

Enclosed are twelve (12) copies (11 bound and 1 unbound) of the Final Field Operations Plan (FOP) for the Whitmoyer Laboratories Site RI/FS. The FOP consists of the Site Management Plan (SMP), the Field Sampling and Analysis Plan (FSAP), and the Health and Safety Plan (HASP). Comments submitted by EPA Region III staff and PADER have been incorporated.

If you have any questions or comments regarding this document, please feel free to contact me or our Site Manager, Mr. George J Latulippe at (412) 788-1080.

Very truly yours,

Richard C Evans, P.E.
Regional Manager, Region III

RCE/GJL/drp

Enclosures

cc: S Del Re - EPA, Region III (w/o attachment)
P Krantz - EPA, Central Regional Laboratory
M Yates - ZPMO
S Missailidis - ZPMO
M Amdurer - ZPMO
L Johnson - NUS
G Latulippe - NUS
File: Whitmoyer Laboratories Site (1$17/563)
Daily

JUNE 1988

FINAL
FIELD OPERATIONS PLAN

WHITMOYER LABORATORIES SITE
JACKSON TOWNSHIP
LEBANON COUNTY, PENNSYLVANIA

EPA WORK ASSIGNMENT NUMBER 200-3L09
UNDER
CONTRACT NUMBER 68-01-7250

PREPARED BY:
NUS CORPORATION
PITTSBURGH, PENNSYLVANIA

APPROVED BY:
EBASCO SERVICES INCORPORATED
LANGHORNE, PENNSYLVANIA

PREPARED BY:

GEORGE J LATULIPPE
SITE MANAGER
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APPROVED BY:

RICHARD C EVANS, P.E.
REGIONAL MANAGER, REGION III
EBASCO SERVICES INCORPORATED

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SECTION II	FIELD SAMPLING AND ANALYSIS PLAN
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SECTION I

FINAL
SITE MANAGEMENT PLAN

WHITMOYER LABORATORIES SITE RI/FS
JACKSON TOWNSHIP, PENNSYLVANIA

JUNE 1988
W.A. NO. 200-3L09

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1.0 SITE CONTROL

1.1 SITE ACCESS

The Whitmoyer Laboratories Site covers a 22-acre area which is secured by a chain-link fence. Entrance to the site is made possible by a gate (with lock) along Fairlane Avenue. Once inside the fenced-in area, paved roads provide access throughout most of the site area. However, caution is recommended while traveling by vehicle throughout the site because an active food warehouse is operating in one of the buildings, and equipment salvaging occurs periodically at the site. A watchman has been employed at the site in the past to provide site access.

Approximately one-third of the field activities will be conducted outside of the fenced-in area (monitoring well construction/installation/sampling, soil, surface water/sediment sampling, and residential well sampling). Access to sampling locations is not anticipated to be a problem.

Site access will be arranged by the Site Manager and EPA prior to initiating the remedial investigation (RI) field activities. Table 1-1 identifies the various property owners that will be affected by the field activities.

No REM III personnel shall enter properties without first making their presence known to the property owners. Anticipated field dates will be given to the appropriate land owners by EPA prior to field mobilization. Additionally, homeowners who will have their residential wells sampled will be contacted by EPA to obtain site access and arrange a suitable time for collecting the well sample.

In addition to notifying the property owners, no REM III Team member will enter the site until: (1) written or verbal authorization is received from the property owner(s), (2) at least 24-hour notice is given to the property owner(s) before initiation of field activities, and (3) each field team member possesses personal identification in the form of a driver's license, company identification card, or a suitable substitute.

In gaining site access, no REM III Team member will sign or acknowledge any documents unless approved by the Site Manager. The Site Manager will contact the Ebasco Regional Manager (RM) and EPA RPM prior to signing any document presented to a REM III Team member by a property owner.

1.2 SITE SECURITY/CONTROL

All removable equipment will be returned to the command post and secured at the end of each work day. Any equipment (i.e., drilling rig) left on site will be secured to the extent possible to prevent unauthorized removal or vandalism. Any unfinished wells will be covered or capped in such a manner as to prevent tampering. Finished wells will be locked.

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TABLE 1-1

PROPERTY OWNERS - SITE ACCESS
WHITMOYER LABORATORIES SITE

Property Owner(s)	Location	Activity
Whitmoyer Laboratories, Inc.	Whitmoyer Laboratories Site, Fairlane Avenue	Monitoring well installation, soil, groundwater, surface water and sediment sampling, soil gas investigation
Buckeye Pipeline Co.	Western Portion of the site	Test pitting/soil sampling
Grumbine, Harold	Land immediately north and south of the site	Monitoring well installation/sampling, soil boring/sampling
Sterling Drug	Land immediately east of site	Monitoring well installation/sampling, soil boring/sampling
Wenger's Farm Machinery	Land immediately northeast of site	Soil boring/sampling, monitoring well installation/sampling
Lloyd Kreider	Land west of site	Soil boring/sampling
Stella Kreider	Land west of site	Soil boring/sampling, residential well sampling
P.J. Valves, Inc.	Land south of site	Monitoring well installation/sampling
Ross's Place	Land west of site	Monitoring well installation/sampling
Mr. Hurst	Land west of Race St.	Monitoring well installation/sampling
Jacob Mays	Land east of Myerstown	Monitoring well installation/sampling
Unidentified*	Land near Millardsville	Monitoring well installation/sampling
7 Unidentified Residences*	Site vicinity	Residential well sampling

* Exact well location will be chosen after the fracture trace analysis is complete.

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1.3 FIELD OFFICE/COMMAND POST

A field-office trailer will be mobilized on site prior to the initiation of any field activities. The office trailer will serve as a central command post through the duration of the field investigation, providing communications, shelter, office space, sanitary facilities, and space for equipment storage and sample handling. Permission is expect to be granted by Whitmoyer Laboratories, Inc., or the current owner, if different, to mobilize the field trailer onto their property. The field trailer will be stationed near the entrance gate of the site. A key to unlock the entrance gate will be given to the appropriate field team leaders.

The property owners will be responsible for providing access to government officials, potentially responsible party (PRP) representatives, and other site visitors. All site visitors will be told of health and safety concerns when they arrive on site. PRP representatives have expressed an interest in overseeing some portions of fieldwork and possibly splitting samples. All arrangements to split samples, share data, etc., must be worked out between the PRPs and EPA. REM III personnel will follow EPA instructions on these matters.

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2.0 SITE OPERATIONS

The following subsections outline the organization of the field teams, the responsibilities of key personnel, and the schedule for performance of the RI field work.

2.1 ORGANIZATION

The overall project organization and responsibilities of key management personnel are discussed in Section 6.0 of the RI/FS Work Plan. The organizational chart presented in Section 6.0 is reproduced as Figure 2-1 for easy reference.

The field work will be performed by four teams as follows:

Team No. 1 - Responsible for monitoring well construction/installation, development, and aquifer testing. Team No. 1 will be comprised of three site geologists.

Team No. 2 - Responsible for the surface and subsurface soil investigation, which will involve borehole augering, monitoring, and soil sampling at the site and surrounding properties. Test pit excavation will also be performed by this team. The team will consist of a geologist (Team Leader) and one technician.

Team No. 3 - Responsible for sampling monitoring and residential wells, including sample preservation. This team is also responsible for all sampling (exclusive of asbestos) in buildings, as well as drums and tanks. This team will consist of a Sampling Team Leader (STL) and three field technicians.

Team No. 4 - Responsible for obtaining all surface water sediment, and aquatic biota samples. A specialized team is desired for the surface water and sediment investigation, since it involves collection of aquatic biota samples. This team will consist of a Sampling Team Leader and three field technicians.

Team No. 5 - Responsible for assessing the buildings for presence of asbestos materials and collecting asbestos samples. This team will consist of a Sampling Team Leader and one field technician.

It is anticipated that two or more teams and as many as four or five teams could be on site at the same time; however, each team will function independently. Due to the complexity of operations and the number of sampling teams working on site at the same time, a Field Operations Leader (FOL) with no sampling

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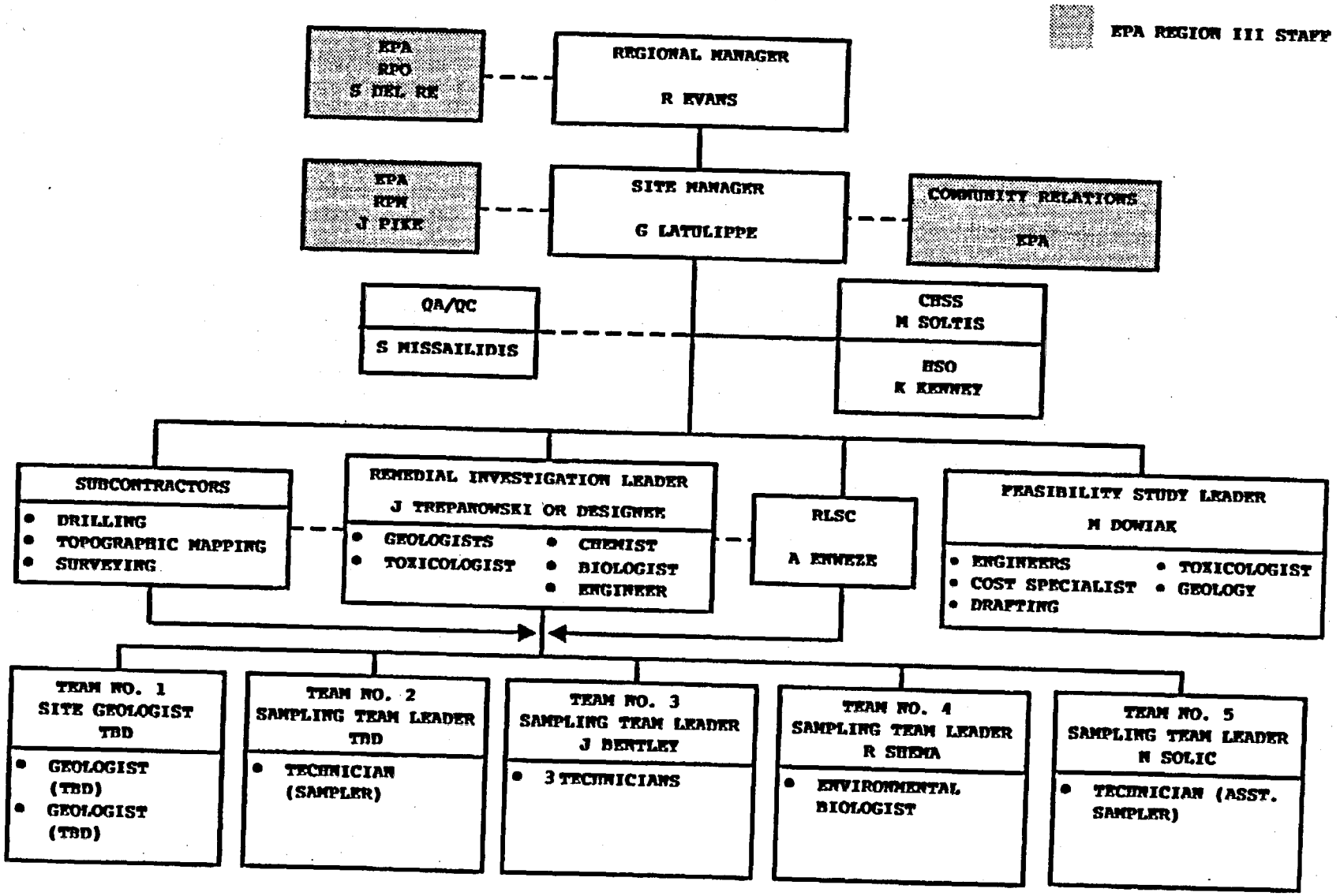
FIGURE 2-1
PROJECT ORGANIZATION
WHITMOYER LABORATORIES SITE



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responsibilities will be stationed at the site. All Team Leaders will report to the RI Task Manager and FOL on a daily basis and interact with the Health and Safety Officer (HSO) as needed.

2.2 RESPONSIBILITIES OF KEY PERSONNEL

Key personnel for field operations are identified in Figure 2-1. Telephone numbers for the key participants are given in the Health and Safety Plan (HASP). Their specific responsibilities are discussed below.

- Sampling Team Leader (STL) and Site Geologist. The STL and Site Geologist (or designees) are responsible for all day-to-day aspects of the Whitmoyer Laboratories Site RI field work. Their responsibilities include:

  - Assuring that all field team members are familiar with the Field Sampling and Analysis Plan (FSAP) and the Health and Safety Plan (HASP).

  - Assuring that all field team members have completed health and safety training.

  - Reporting to the RI Task Manager and FOL on a regular basis regarding the status of all field work and any problems encountered.

  - Completing Field Change Requests, as necessary, for approval by the Site Manager.

  - Coordinating the activities of all field teams.

- Health and Safety Officer (HSO). The HSO reports to the Company Health and Safety Supervisor (CHSS) and indirectly to the Site Geologist, Sampling Team Leader, and Site Manager. Details of the HSO's responsibilities are presented in the HASP and include:

  - Controlling specific health and safety related field operations such as personnel decontamination, monitoring of worker heat or cold stress, distribution of safety equipment, etc.

  - Assuring that field team personnel comply with all procedures established by the HASP.

  - Identifying assistant HSOs or HSO designees.

  - Terminating work if an imminent safety hazard, emergency situation, or other potentially dangerous situation is encountered.

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- Regional Laboratory Sample Coordinator (RLSC). The RLSC is responsible for the following:

  - Scheduling laboratory service through SMO and other vendors.

  - Tracking samples and coordinating with EPA Central Regional Laboratory (CRL).

  - Scheduling data validation.

  - Identifying laboratory analytical methods and laboratory QC.

2.3 SCHEDULE

The schedule for the Whitmoyer Laboratories Site RI field activities is presented in Section 6.3 of the RI/FS Work Plan. Key target dates are:

Activity	Anticipated Dates	
	Start	End
Mobilization*	06/20/88	07/11/88
Drum and Tank Sampling	07/11/88	08/22/88
Building Sampling	08/22/88	10/17/88
Drilling and Monitoring Well Construction	07/11/88	09/19/88
Soil/Waste Investigation	07/18/88	09/06/88
Groundwater Sampling (REM III monitoring wells)	09/19/88	11/07/88
Groundwater Sampling (residential wells)	09/19/88	11/07/88
Surface Water and Sediment Sampling	07/11/88	10/17/88
Aquatic Survey/Wetland Delineation	10/03/88	10/24/88
Demobilization	11/07/88	11/14/88

*Includes obtaining site access.

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SECTION II

FINAL
FIELD SAMPLING AND ANALYSIS PLAN

WHITMOYER LABORATORIES SITE RI/FS
JACKSON TOWNSHIP, PENNSYLVANIA

JUNE 1988
W.A. NO. 200-3L09

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1.0 INTRODUCTION

This Field Sampling and Analysis Plan (FSAP) for the Whitmoyer Laboratories Site, Jackson Township, Pennsylvania, is an integral part of the Remedial Investigation/Feasibility Study (RI/FS) Work Plan. Whereas the work plan develops the RI/FS objectives and scope, and defines what activities will occur, the FSAP concentrates on how the various activities will be performed. Additionally, the FSAP identifies the sampling and analytical objectives, detailed sampling procedures, and the Quality Assurance/Quality Control (QA/QC) requirements for sample collection, handling, and shipping. In the interest of continuity, some of the information from the Work Plan is repeated in this document. The emphasis, however, is to avoid repetition by the liberal use of references to the Work Plan.

1.1 SITE DESCRIPTION AND HISTORY

The Whitmoyer Laboratories Site is located on approximately 22 acres in Jackson Township, Lebanon County, Pennsylvania, about 1 mile southwest of the borough of Myerstown (see Figure 1-1). The site lies between the Union Canal of Tulpehocken Creek and the Conrail (Reading) Railroad. Fairfield Avenue forms the site's eastern boundary, while Creamery Street adjoins the site to the west.

Land surrounding the site is predominantly farmland, with scattered farmhouses. A Sterling Drug factory is located 2,000 feet east of the site, while PJ Valves, a manufacturing plant, is located about 1,500 feet to the south. A large active limestone quarry, locally referred to as the Calcite Quarry, is located approximately 1.5 miles west of the site.

Tulpehocken Creek flows adjacent to the site. The Union Canal branches from Tulpehocken Creek just west of the site and rejoins the creek near the site's eastern boundary. Tulpehocken Creek joins the Schuylkill River near Reading, Pennsylvania. The Schuylkill River flows into the Delaware River, which eventually empties into the Atlantic Ocean. Tulpehocken Creek (and the Schuylkill River) serve as drinking water supplies and irrigation sources downstream of the site.

The earliest activity at the site occurred in the early 1900s, when an oil pipeline was constructed across the site. Onsite storage tanks were also part of the pipeline's operations. This activity probably was performed by Tuscarora Oil Company or a predecessor.

In September, 1934, C W Whitmoyer formed Whitmoyer Laboratories, Inc. (WLI), by merging his operations with another animal pharmaceutical company. WLI filed to do business in Pennsylvania in the following months. Little documentation of WLI operations prior to 1957 exists. Aerial photography

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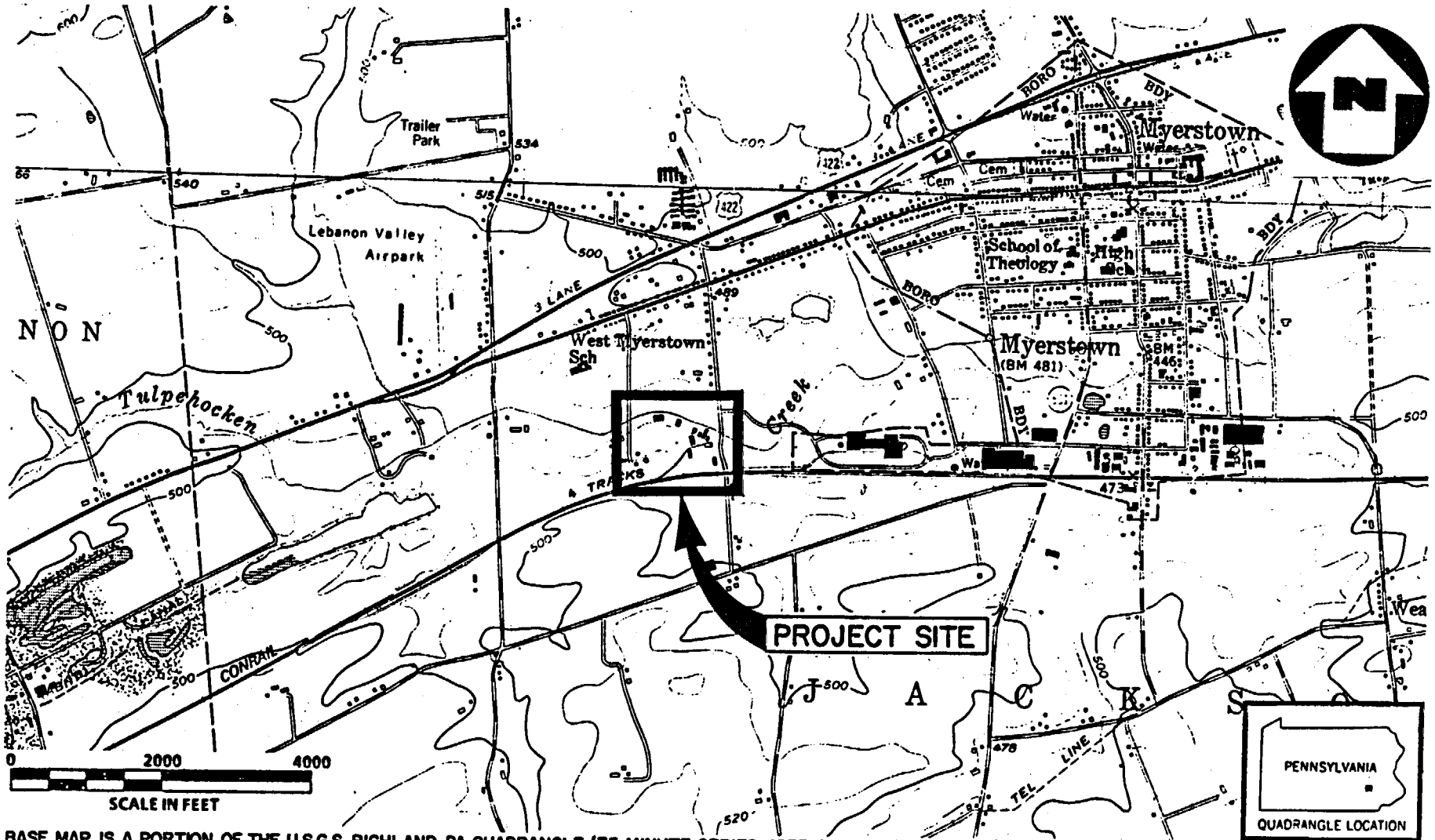

BASE MAP IS A PORTION OF THE U.S.G.S. RICHLAND, PA QUADRANGLE (7.5 MINUTE SERIES, 1955, PHOTOREVISED 1969). CONTOUR INTERVAL 20'.

FIGURE 1-1

LOCATION MAP

WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

SCALE: 1" = 2000'

NUS CORPORATION

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indicates that some production was occurring, but no records regarding feedstocks, products, and/or quantities were identified.

Aerial photography from 1951 indicates that some unspecified activity was occurring at the site. At this time Buildings 1-5 (see Figure 1-2) had been constructed, as were the tanks located to the south of Buildings 4 and 5. Additionally, mounded material, a probable pit, and possible drums were identified. Construction work along the pipeline had recently occurred, and a rail spur to the site was being constructed. The 2 large dikes which were later utilized as lagoons were also evident.

In 1957 the production of organic arsenicals (veterinary pharmaceuticals) reportedly commenced at the site. Two primary products, arsanilic acid and carbarsone (p-ureidobenzenearsonic acid), were manufactured. The primary organic chemical used was aniline. Coal tar dip, piperazine, sulfa products, biodin, and ethylenediamine dihydroiodide (EDDI) were also produced in 1964. Wastewater from all of these processes was routed to an unlined lagoon which was constructed inside of the easternmost dike previously emplaced around an oil storage tank. The lagoon was constructed directly on top of bedrock.

Lime was added to the process wastewater to precipitate arsenic. The arsenic precipitate consisted of calcium arsenate, calcium arsenite, and organically-bound arsenic. Estimates of the quantity of arsenic placed in the unlined lagoon range as high as 4,000,000 pounds or more. The lagoon occupied the same area as the consolidated lagoons shown on Figure 1-2.

In 1964 WLI was bought by and became a wholly owned subsidiary of Rohm & Haas (R&H). In late 1964 the arsenic pollution problem caused by wastewater disposal in the unlined lagoon was first noted. An investigation was conducted by R&H and significant soil, surface-water, and groundwater contamination was identified.

Surface water at the site assayed at 40-60 mg/l arsenic. Approximately 1,900 to 3,200 pounds of arsenic per day were leaving the site in surface water. Arsenic contamination was traced from Tulpehocken Creek/Union Canal as far as the Schuylkill River-Delaware River confluence in Philadelphia.

Groundwater arsenic contamination reached 10,000 mg/l on site. More than 30 residential wells in the vicinity of the site were found to be contaminated with high levels of arsenic. At least two individuals were reportedly hospitalized with chronic arsenic poisoning from ingestion of their well water. The area of groundwater pollution was approximately 1 mile wide by 6 miles long, radiating in all directions from the site.

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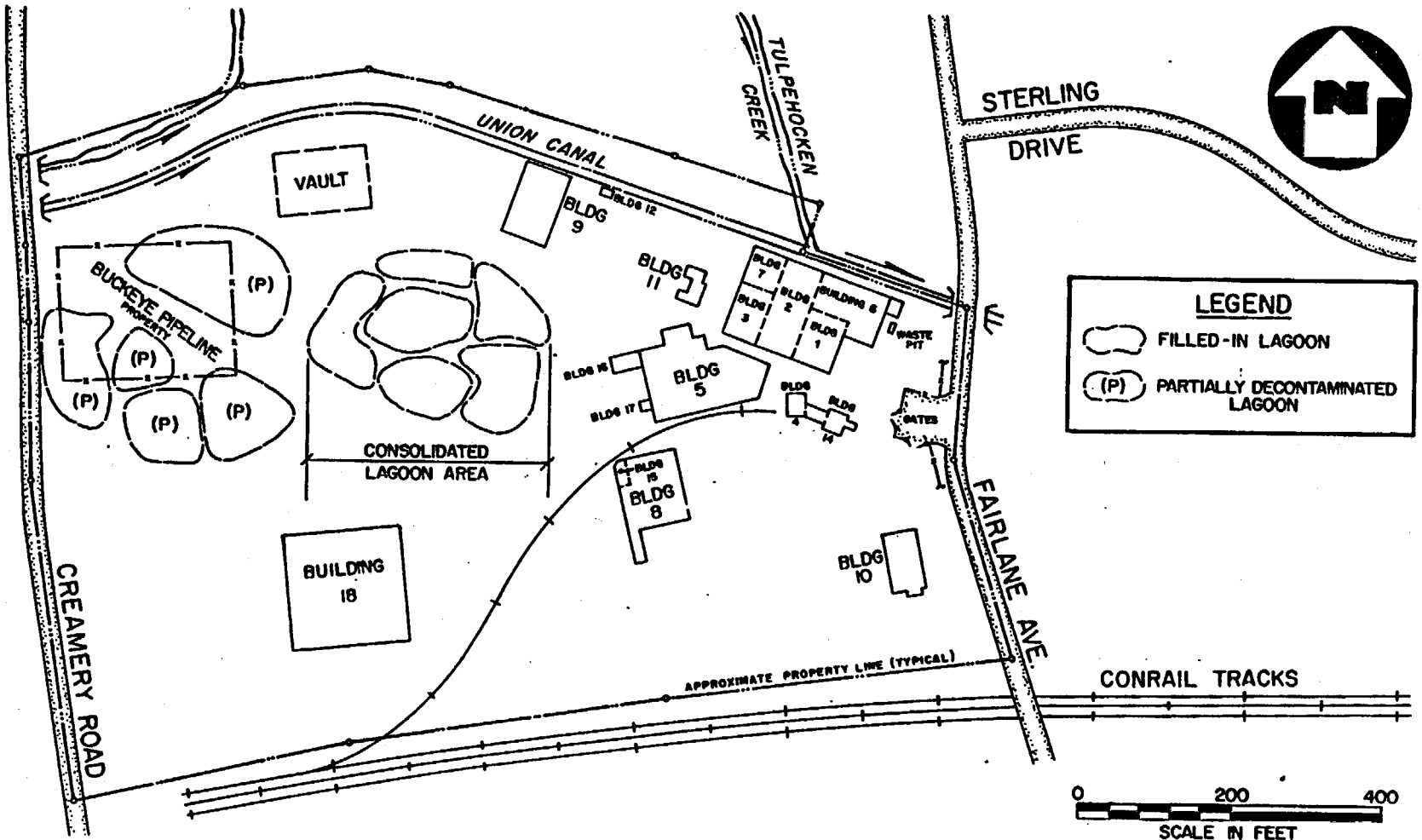

SOURCE: GENERAL LAYOUT DRAWING, PREPAREDNESS, PREVENTION & CONTINGENCY PLAN, DEC. 22, 1982.

FIGURE 1-2

GENERAL ARRANGEMENT
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

NUS CORPORATION

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Once this contamination was identified, a three-phased remediation effort was initiated. This effort consisted of:

- Termination of process wastewater disposal in the lagoon and excavation of lagoon sludges and other hot spots.
- Groundwater pumping and treatment.
- Supply of bottled water to nearby residents with contaminated wells.

At the same time (late 1964), R&H temporarily ceased operations, waiting until they believed contamination problems had been sufficiently addressed before resuming production. In the spring of 1965 production of organic arsenicals and other chemicals at the Whitmoyer plant was resumed on a no-arsenic-discharge basis. Treated arsenic wastes were trucked to Paulsboro, New Jersey, and dumped in the ocean.

A concrete vault measuring 123 feet long by 83 feet wide and 12 feet deep was constructed to accept the lagoon sludges and other contaminated material. The walls (and possibly the floor) were coated with a bitumastic sealant. An estimated 3.75 - 4.0 million pounds of arsenic were placed in the vault.

Two separate scattered piles of diamino diphenyl arsonic acid (DDAA), which is a waste product, were being held on the property for later arsenic recovery. These piles, which weighed about 2.0 million pounds, were also excavated and drummed as part of the cleanup effort. The drums were temporarily stored off site in a barn until 1968. This material was reportedly recycled later. About 250 drums of contaminated soil underlying the DDAA stockpile were deposited in the vault.

As part of the cleanup, 1,455 drums probably containing aniline still bottoms which had been deposited at the nearby Schaefferstown Quarry were removed from the quarry back to the site. These drums were reportedly placed in the vault.

The extraction and treatment of contaminated groundwater was initiated concurrently with the excavation project, i.e., in December 1964. Initially 4 previously abandoned wells were used to extract the contaminated groundwater. Weekly yields of arsenic peaked at 11,000 pounds early in the project, and quickly fell to 4,500 to 5,000 pounds by April 1965. Three additional extraction wells were brought onstream in June 1965 to bring the extraction rate up to 70 gpm, but arsenic yields continued to gradually decrease. Seven additional recovery wells were drilled and activated by the end of 1966, increasing the extraction rate to 140 gpm. While these additional wells increased arsenic production in the near term, the well yields eventually decreased again, to a level of 500 to 700 pounds per week by April 1968. The cumulative amount of arsenic extracted in the groundwater by the end of 1968 was 400,000 pounds. No comparable figures for aniline or other contaminants are

available, as these were not contaminants of concern at that time and were not measured.

The extracted water was treated with ferric sulfate and flocculant to precipitate ferric arsenate. The ferric arsenate was allowed to precipitate in the existing lagoons, which had been compartmentalized into eight lagoons and refurbished. Additional lagoons were also constructed to provide added settling capacity. Some of these lagoons were lined with 6 inches of topsoil, while others were lined with 6 to 8 inches of clay. When completed, the lagoons covered approximately 2.5 acres.

With the exception of the thin liner, no effort was made to keep the treated wastewater from re-entering groundwater. In fact, infiltration was encouraged so that greater pumping rates could be achieved without necessitating a discharge to the sewer or surface water. During the pump and treat program an estimated 3 pounds of arsenic per day was re-entering groundwater via infiltration from the lagoons.

Due to the cost of groundwater treatment, the desire to expand the cone of depression of the pumping network (by limiting reinfiltration), the desire to minimize the accumulation of arsenic precipitate, and the lower concentration of groundwater being pumped, R&H petitioned and received permission to discharge extracted groundwater directly to Tulpehocken Creek in December 1968. Direct discharge commenced shortly thereafter. This discharge was temporarily halted in April 1969 but reinitiated the following September.

In 1970 a program of overstressing was attempted to assist flushing of contaminants from the subsurface. This program consisted of ponding Union Canal water on the lagoons, municipal water near well No. 3, and spent cooling water (in a trench) near well No. 7, and allowing these waters to infiltrate to the subsurface. As arsenic yields did not significantly increase with this approach, it was abandoned shortly thereafter.

In March 1971, because of public and regulatory opposition to continued untreated discharge of contaminated groundwater to Tulpehocken Creek and R&H's reticence to resume groundwater treatment, R&H ceased operation of their pumping wells. Reportedly 50,000 pounds of arsenic was extracted and discharged to Tulpehocken Creek from December 1968 until pumping was halted. The discharge rate was as high as 250,000 gpd during this period.

Adding the 50,000 pounds of arsenic removed from December 1968 until the March 1971 end of pumping to the amount removed from December 1964 through December 1968 gives a total of 450,000 pounds of arsenic removed from groundwater during the extraction program.

In 1965 R&H also conducted an augering and coring program to evaluate the arsenic concentration of subsurface soil and rock. As expected, with arsenic's affinity for soil adsorption, the lower layers of the soil mantle (which were in contact with groundwater) had accumulated significant amounts of arsenic (the available 1965 analytical results for the soil directly above bedrock averaged 1,500 mg/kg). Most of this accumulation had occurred around and along the contact surface between the soil mantle and the underlying rock formations. The majority of this contamination is reportedly localized within the plant boundaries. The soil's arsenic accumulations were later confirmed during a 1973 United States Geological Survey (USGS) study. A USGS conclusion was that the majority of the arsenic in the soil in 1965 had remained there through the pump and treat program.

In 1970 R&H amended their process for producing arsanilic acid. At this time, perchloroethylene (PCE) was introduced as a process chemical at the plant.

In March 1971 public opposition to ocean dumping of the plant wastes caused R&H to abandon this disposal method. Since R&H had no way of disposing its waste solutions, production of arsanilic acid and carbarsone was temporarily suspended. In 1972, R&H introduced a process whereby they evaporated (boiled) the waste solutions, followed by centrifuging and drumming the remaining waste for landfill disposal off site. When this was approved, production commenced once again.

During the week of May 17, 1976, the USEPA Annapolis Field Office, with assistance from PADER, conducted an investigation of the Myerstown Sewage Treatment Plant. The primary study objective was to determine the pollutants and their sources that were interfering with the plant's operations and causing the plant's discharge limitations for arsenic and other criteria to be exceeded. Six industrial sewer discharges, including WLI's, were sampled. An arsenic materials balance indicated that nearly 94 percent of the arsenic load reaching the plant was not attributable to the industrial discharges. It was concluded that contaminant infiltration through cracked sewer lines was the probable source.

Following this conclusion, WLI conducted additional studies and discovered several infiltration points on their property. Most, if not all, of these leaks were repaired.

In late 1976 and 1977, R&H consolidated the lagoon sludges. Sludge containing 200,000 pounds of arsenic was excavated from the westernmost lagoons (1, 2, 3, 4, 13, 14, and 15) and placed in the easternmost lagoons (5 through 12 - see Figure 1-3). The consolidation raised the receiving lagoons' height from 5 to 8 feet on average.

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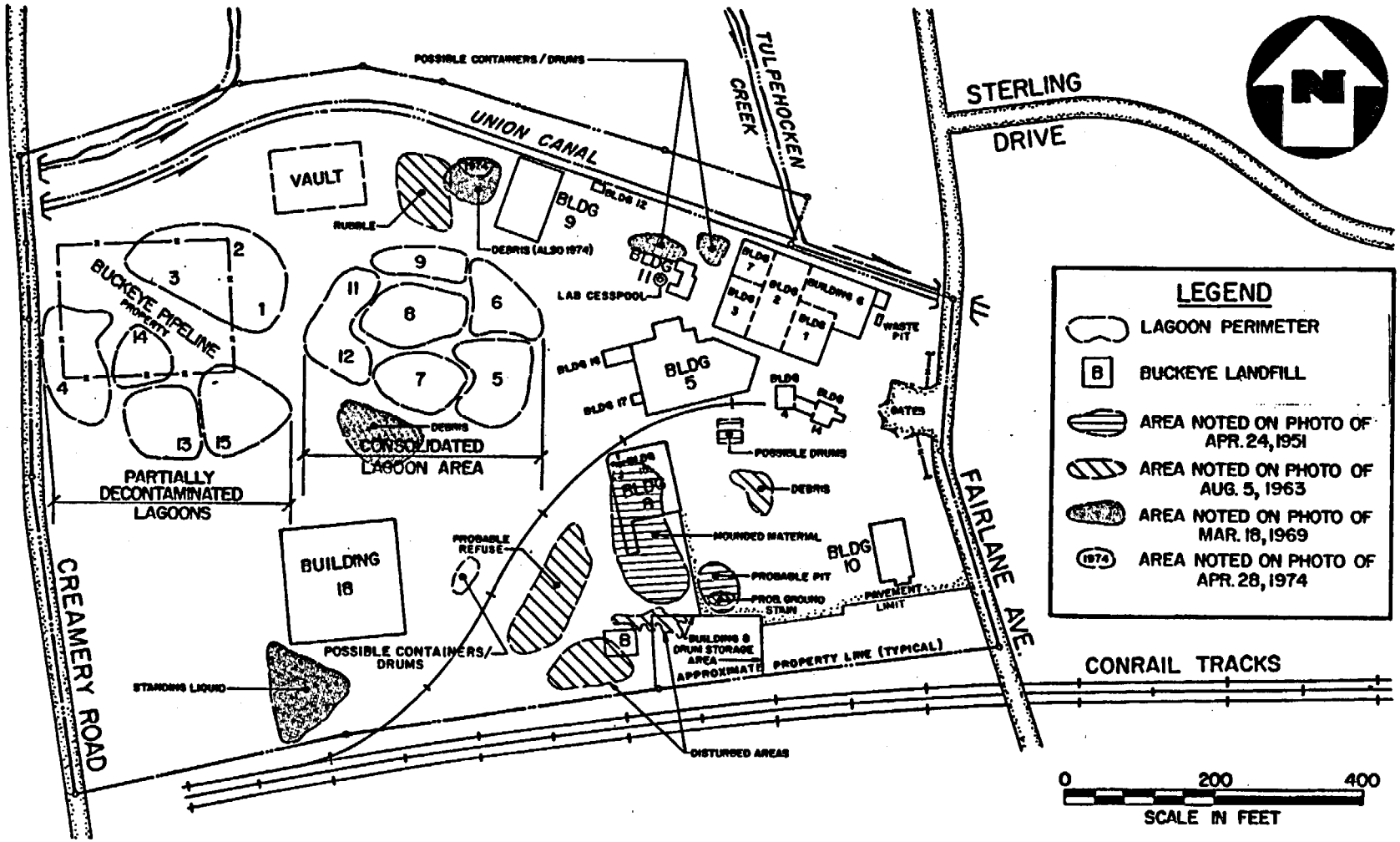

FIGURE 1-3

APPROXIMATE LOCATION OF POTENTIAL SOURCE AREAS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

NUS CORPORATION

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Due to the crevices in the bottoms of the abandoned lagoons, complete removal of the sludge was impossible. To restrict movement of the remaining material, R&H reportedly placed a 1/4- to 1/2-inch-thick layer of bentonite over the excavated lagoons. The clay was wetted and covered with 1.5 to 2 feet of earth. Following cover placement, the earth was seeded to prevent erosion.

No records revealing the nature of the cover material used for the consolidated lagoons were identified. This area is well vegetated.

In the mid-70s WLI was required to get an air permit for their discharge of contaminants from their evaporation wastewater treatment process. Contaminants of concern for which WLI monitored included arsenic and aniline (some of the arsenic products, e.g., alkyl arsines, were volatile).

In the summer of 1978, a portion of the stack emissions condensed and dropped out in the nearby farmers' fields. This fallout damaged one farmer's corn crop planted directly east of the site. Investigating PADER representatives believed arsenic was the contaminant which damaged the corn. Cattle were reportedly attracted to the fallout areas because of the high salt content.

In 1978 Beecham Laboratories of Clifton, New Jersey, purchased WLI from R&H. The plant managerial staff remained essentially intact.

In 1979 Buckeye Oil Company repaired a section of pipeline running through the site. In the course of these repairs, underground excavations uncovered a burial ground containing old rusted metal and deteriorated fiber drums which contained arsenical waste products. It was reported that this area was used as a small dumping ground and covered over around 1958 or 1959. The burial area, which was approximately 30 feet by 40 feet and about 7 feet deep, was excavated and disposed off site.

On May 14, 1982, Beecham sold WLI to Stafford Laboratories, Inc., of Phoenix, Arizona. Again the plant managerial staff remained essentially intact.

In July to November 1982, concern about arsenic and organic contaminants leaving the property was raised, and a small pumping program using existing well No. 7 was initiated. Water was pumped from this well into a specially heated truck and evaporated. From program inception to completion, aniline concentrations decreased, but arsenic and PCE concentrations did not. Since the arsenic and PCE concentrations did not decline, the program was halted in November.

On February 9, 1984, EPA's Technical Assistance Team (TAT) conducted an assessment of the Whitmoyer Laboratories Site.

Samples for arsenic were collected from Tulpehocken Creek both upstream and downstream of the site, from Union Canal on the site property, from onsite well Nos. 4 and 7, and from a nearby residential well. Elevated levels of arsenic were detected in the downgradient surface water and sediment and onsite monitor well samples.

During the TAT investigation, organic vapors were detected by a photoionization detector. To confirm organic contamination, TAT again sampled on February 17, 1984. During this sampling event, samples were again collected from Well Nos. 4 and 7 and also from liquid and sediment present in a borehole located adjacent to the vault. The samples were analyzed for aniline, volatiles, and base/neutral/acid extractable compounds. Elevated levels of organics were detected in all of these samples.

In January 1984 WLI developed a process to produce chlorohexidine. Production reportedly commenced shortly thereafter.

Stafford Laboratories filed for bankruptcy in the summer of 1984.

On May 17, 1985, WLI submitted a revised RCRA Hazardous Waste Treatment and Storage Closure Plan to PADER. This closure plan only related to the then-current hazardous waste activities. Following implementation of the plan, WLI was no longer to treat and store hazardous waste, except within the 90-day storage limit for a RCRA hazardous waste generator, i.e., wastewater evaporation was to be discontinued. At the same time WLI sought a RCRA hazardous waste generator status. This closure plan was reportedly signed in 1985. It is unclear when waste evaporation actually ceased at the site.

The closure plan called for all containerized waste to be shipped off site to a permitted treatment, storage, or disposal (TSD) facility at closure. Additionally, all liquid wastes stored in tanks, sludge remaining in the bottoms of tanks, waste generated during decontamination of the WLI plant, and contaminated soil identified during decontamination were to be transported off site to a TSD facility.

In 1985 and 1987 the PADER Bureau of Environmental Control sampled nearby residential wells for volatile organics and arsenic. Elevated levels of arsenic, PCE, trichloroethylene (TCE), 1,1-dichloroethylene, 1,1-dichloroethane, trans-1,2-dichloroethene, cis-1,2-dichloroethylene, 1,1,1-trichloroethane, and toluene were detected.

The WLI plant reportedly last operated in January of 1987. These operations were said to be only of a limited scale. It is unclear what portion of the closure plan has been implemented to date. Laboratory wastes and approximately 600 full drums have been observed on site, as of January, 1988. Some of the wastewater tanks on site are reportedly full (leaks from tank piping have also been observed).

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In February 1987 USEPA's Environmental Response Team (ERT) sampled two bodies of water of interest, the Myerstown Pond and the Lakeside Quarry east of Myerstown, for arsenic. The water samples contained arsenic in concentrations lower than the present Primary Drinking Water Standard (50 µg/l). A sediment sample from the Lakeside Quarry was also collected. This sample contained a relatively small quantity of arsenic.

In July 1987 USEPA's TAT sampled offsite surface and subsurface soil, soil from the banks of Union Canal, the lagoon sludge material, the vault contents, and surface water and sediment from Union Canal and Tulpehocken Creek for arsenic. Elevated levels were detected in the lagoon, vault, offsite soils, and downgradient surface water and sediment samples.

Also, in July 1987, the TAT conducted ground-penetrating radar (GPR) and magnetometer surveys of the lagoon areas to determine the lagoons' volumetric extent and if buried drums were present in the lagoons.

On November 4 and 5, 1987, USEPA's TAT sampled 24 offsite residential and industrial wells for VOAs and arsenic. Elevated levels of arsenic, PCE, TCE, 1,1-dichloroethane, and 1,1,1-trichloroethane were detected in several of the wells.

Based on the USEPA TAT's February 1984 samples, the Whitmoyer Laboratories Site was proposed for the National Priority List (NPL) in October 1984. The site was finalized on this list in June 1986, and is currently ranked 244th on the list.

The USEPA is presently effecting an emergency response at the site to hook up citizens with contaminated residential wells to the Myerstown municipal water supply. This response is expected to be completed in 1988.

The site borders Tulpehocken Creek, approximately 37 stream miles upstream of the confluence with the Schuylkill River and about 16 stream miles upstream of Blue Marsh Lake. Myerstown is the first downstream community, at a distance of approximately 3/4 mile.

The headwaters of the section of Tulpehocken Creek originate approximately 3 miles to the northwest. The creek is formed by springs and runoff from Blue Mountain.

The Tulpehocken Creek drainage basin covers 211 square miles and is 33.5 miles long, with an average bed gradient of 0.0015 ft/ft. The average annual creek flow at the Blue Marsh dam site was calculated at 253 cfs, with the maximum flood flow being 16,100 cubic feet per second (cfs) on June 22, 1972, and the minimum flow being 22 cfs on September 12, 1966. The general direction of stream flow near the site follows the east-northeast strike of the carbonate bedrock.

There are several ponds and quarries in and around Myerstown which are fed by groundwater. Included in this list are the Myerstown Pond, a 2-acre community lake, the Lakeside Quarry on the east end of Myerstown, two smaller quarries on the Wenger property near Race Street in Myerstown, and a quarry west of the Kreider property and the site.

The Whitmoyer Laboratories Site is located within the Lebanon Valley, part of the Great Valley portion of the Valley and Ridge Physiographic Province. The valley is a topographic expression of the underlying relatively easily eroded carbonate bedrock units. The site is underlain by carbonate bedrock of the Ontelaunee Formation, the youngest member of the Ordovician Age Beekmantown Group. A thin mantle of clayey residual soil overlies bedrock in the site vicinity. Depths to bedrock in the site vicinity are expected to range from 0-18 feet, based on available boring logs. The depth to bedrock is expected to be greatest in the vicinity of Tulpehocken Creek and the Union Canal.

The Ontelaunee Formation is described in regional literature as a light to dark gray dolomite, which weathers to a dark grayish brown. Regular parallel banding is characteristic of this formation, as is the presence of stylolites. The Ontelaunee Formation strikes N60°E to N80°E predominantly, with an overall dip to the SE of approximately 30°. In the Myerstown area, this formation is approximately 500 feet thick.

Approximately 1,500 feet north of the site area, the Annville and Myerstown Limestones outcrop along a narrow east-northeast trending band. These units, which underlie much of the town of Myerstown, physically underlie the Ontelaunee Formation but are stratigraphically younger. The reversed position of these beds with respect to the Ontelaunee Formation is an indication that the bedrock units in the site area represent the overturned (older beds overlie younger beds) south limb of a recumbent synclinorium. The Annville Limestone is described as a thick-bedded, light blue to pink-gray, crystalline, high-calcium limestone, with gray mottling and banding at the base. The unit weathers to white in outcrops.

Further north, the Hershey Formation outcrops. This unit is described as a dark-gray, argillaceous limestone approximately 450 feet thick. The town of Myerstown is reported to obtain its municipal groundwater supplies from this formation.

A few hundred feet south of the Whitmoyer Laboratories Site, the Epler Formation outcrops. This unit, part of the Beekmantown Group (along with the Ontelaunee Formation), has a variable lithology, including limestone, dolomite, and chert. The Epler Formation is stratigraphically older but physically overlies the Ontelaunee Formation, and is approximately 1,000 feet thick in the local area.

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The carbonate bedrock units underlying the Lebanon Valley form the major aquifer in the area. The various formations present, although differing somewhat in water-yielding capacity, are considered to form a single, large, heterogeneous, unconfined aquifer. The porosity of the carbonate aquifer is almost entirely secondary, with fractures enlarged through solution channeling forming the primary groundwater storage zones and migration pathways.

Of the formations present in the local area surrounding the site, the Ontelaunee Formation, which underlies the site, is considered to be the highest yielding unit on an overall basis. The Hershey and Epler Formations are regarded as relatively low-yielding formations, while the overall yields of the Annville and Myerstown Formations cannot be categorized due to a lack of well data for these units. One-half of all wells completed in the carbonate bedrock units of the Lebanon Valley have specific capacities of 5.2 gallons per minute per foot of drawdown (gpm/ft dd) or less, which roughly corresponds to a transmissivity of 8,000 gallons per day per foot (gpd/ft) or less. This data includes both wells installed in the formations surrounding the site and wells in other carbonate bedrock units in the area, and thus may be significantly different from local conditions in the site area. According to domestic well logs, the principal water-bearing zone within the carbonate rocks occurs from 70-80 feet below ground surface. Twenty-five percent of all water-bearing zones (fractures) encountered were found at depths of less than 62 feet, another 25 percent were found within the depth interval 62-80 feet, 25 percent of all water-bearing zones were found at depths ranging from 80-145 feet, 15 percent were found at depths ranging from 145-230 feet, with the remaining 10 percent encountered at depths exceeding 230 feet (Meisler, 1963). Boring logs from site-related monitoring wells indicate that most fractures encountered were found at depths of 35 feet or less, with possible secondary groupings of fractures in depth ranges of 50-60 and 75-100 feet.

Recharge to groundwater in the carbonate rock units is principally through precipitation infiltration, with additional recharge due to groundwater migration from adjacent rock units and occasional surface water recharge, during extended dry periods. Geochemically, groundwater is of the calcium-bicarbonate type, and is typically hard.

A detailed description of the site features, geology, hydrogeology, history and previous investigations is provided in Section 2.0 of the RI/FS Work Plan.

1.2 OVERVIEW OF RI/FS FIELD ACTIVITIES

Various field investigations will be conducted to collect data to meet the RI/FS objectives. Provided below is a brief description of these investigations. A detailed description of

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each investigation can be found in Section 4.3 of the RI/FS Work Plan.

Hydrogeologic Investigation

- Evaluate existing wells to determine whether they can be included in the groundwater monitoring effort.
- Perform a fracture trace analysis to assist in well location.
- Install 52 (47 new and an estimated 5 rehabilitated existing wells) monitoring wells to determine and assess the presence or absence of groundwater contamination in the underlying aquifer.
- Perform in-situ aquifer testing on newly-installed REM III wells.
- Sample the 52 REM III wells and analyze the samples for Target Compound List (TCL) volatile organics (VOA), base/neutral and acid extractable (BNAEs) organics, Target Analyte List (TAL) metals, and selected water chemistry parameters. Selected wells will be analyzed for pesticides/PCBs and cyanide.
- Water level monitoring.

Residential Well Investigation

- Collect groundwater samples from eight residential wells.
- The proposed analytical parameters are identical to those identified in the hydrogeologic investigation.

Surface Water and Sediment Investigation

- Collect surface water samples twice from 14 locations in Tulpehocken Creek and once from 6 nearby lakes.
- Analyze all of the surface water samples for arsenic, iron, aniline, and selected water chemistry parameters. Analyze samples from three locations for TCL, VOAs, BNAEs, and TAL metals.
- Conduct an aquatic biota survey of the surface water bodies.
- Collect sediment samples once from the surface water sample locations. Analyze all samples for iron, arsenic, aniline and selected indicator parameters. Analyze samples from three locations for TCL, VOAs, BNAEs and TAL metals.

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Soil/Waste Investigation

- Excavate to bedrock through and adjacent to waste disposal areas using soil boring and/or waste pitting techniques, and sample for subsurface profiling and chemical analysis.

- Collect two or three samples per excavation. Samples should be collected from the top 3 inches and the soil-bedrock interface; one other sample will be collected if the soil is greater than 6 feet deep.

- Analyze all samples for arsenic and iron. Selected samples will also be analyzed for TCL, VOAs and BNAEs, TCLP metals, TAL metals, pesticides/PCBs, and cyanide, as well as cation exchange capacity and oxidation-reduction potential.

Buildings Investigation

- Collect 156 wipe samples from building and equipment surfaces. Analyze all wipe samples for arsenic and selected samples for TCL BNAEs.

- Collect 50 samples from residual liquids remaining in process piping. Analyze piping samples for TAL metals, BTU content, ash content, chlorine content, ignitability, reactivity, and compatability parameters.

- Collect 7 samples of roof runoff during a rain event. Analyze all samples for arsenic and two selected samples for TCL BNAEs and aniline.

- Collect 10 samples of suspected asbestos materials and analyze for asbestos.

- Analyze laboratory wastes for compatibility in the field. Combine compatible wastes into drums. Sample an estimated 100 drums following waste combination to evaluate disposal options.

Drum and Tank Investigation

- Collect 150 aliquots from drums being stored on site. Categorize aliquots in the field, based on compatibility and disposal parameters. Analyze one sample from each category (estimated at 30) for the same parameters as the piping samples. Analyze solids samples for TCLP metals also. Analyze samples with unknown organic content with a GC/IR scan to determine the primary organic constituents.

- Collect 10 samples of liquids and sludges in tanks on site. Analyze for same parameters as piping samples.

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2.0 DATA QUALITY OBJECTIVES AND PARCC PARAMETERS

The RI/FS Work Plan for the Whitmoyer Laboratories Site contains a summary of available site information, defines the data gaps and the RI/FS objectives, and identifies the types of data necessary to complete the RI/FS. The RI/FS objectives are summarized below:

- Characterize the nature and extent of contamination in various environmental media (groundwater, surface water, sediment, surface and subsurface soil, air, and biota).
- Characterize the waste materials remaining on site in the vault, lagoons, the process buildings, drums, tanks, and suspected subsurface waste disposal areas.
- Assess the actual and potential public health and environmental risks from the contaminated media and wastes at the site. This will include an assessment of contaminant migration potential to the Union Canal, Tulpehocken Creek, and other area surface water bodies.
- Screen and evaluate potential remedial action alternatives for the site, including a no-action scenario.

Section 3.0 and Tables 3-3 and 3-5 of the Work Plan outlined the data requirements to meet the RI/FS objectives. Sections 3.0 and 4.0 of the Work Plan discuss the data collection activities and methodologies of sample procurement and analysis for each waste type and media.

This section outlines the data quality objectives with respect to ensuring that the appropriate data are obtained to meet the RI/FS objectives. Data quality objectives (DQOs) were established to ensure that the appropriate data are obtained to meet the RI/FS objectives, and that the data collected are of sufficient quality for their intended use.

Table 2-1 summarizes the sampling and analysis program for the Whitmoyer Laboratories Site. Table 2-1 includes a prioritization of the risk assessment, modeling, and engineering data uses. Analytical methods were selected to meet the data objectives because their precision, accuracy, and detection limits are suitable for the intended data use(s). Table 2-2 summarizes sample container requirements, holding times, and preservation methods.

Generally, the sampling and analysis program presented on Table 2-1, utilizes routine CLP or REM III analytical protocol. A small percentage of the arsenic samples are analyzed by non-CLP methods. As described in the Whitmoyer Work Plan, arsenic contamination at the Whitmoyer Laboratories Site occurs in the organic and inorganic form. References such as Standard Methods for the Examination of Water and Wastewater (1985)

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TABLE 2-1

SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA

Matrix - Onsite Groundwater (Round 1)

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use[a] Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method[b]	Target Detection Limit
30	2	2	2	4	40	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	CRDL(b)
30	2	2	2	--	36	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	CRDL(b)
30	2	2	2	--	36	1,2,3,4,5	IV	TAL Inorganics (filtered)	CLP-RAS	CLP Protocol	CRDL(b)
30	2	2	2	--	36	1,2,3,4,5	IV	Total Arsenic (unfiltered)	CLP-RAS	CLP Protocol	CRDL(b)
4	1	1	1	--	7	1,2,3,4,5	III	Total Arsenic (filtered)	CLP-SAS	SM 303E prep. 5.d	2 µg/l
4	1	1	1	--	7	1,2,3,4,5	IV	Cyanide	CLP-RAS	CLP Protocol	CRDL(b)
4	1	1	1	--	7	1,2,3,4,5	IV	TCL Pesticides/PCBs	CLP-RAS	CLP Protocol	CRDL(b)
30	2	--	--	--	32	1,4,5	III	Common Anions[d]	REM III-SAS	EPA 300.0	(u)
30	2	--	--	--	32	1,4,5	III	Alkalinity	REM III-RAS	EPA 130.1	10 mg/l
30	2	--	--	--	32	1,3,4,5	III	COD	REM III-SAS	EPA 410.1	5 mg/l
30	2	--	--	--	32	1,3,4,5	III	BOD_5	REM III-SAS	SM 507	1 mg/l
30	2	--	--	--	32	1,3,4,5	III	TOC	REM III-SAS	EPA 415.1	1 mg/l
30	2	--	--	--	32	1,4,5	I	Eh, pH, Temperature, Specific Conductance, Dissolved Oxygen	Field Analysis	Primary Specific Ion Electrode	(v)

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Onsite

TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE TWO

Matrix - Onsite Groundwater (Round 2)

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Target Detection Limit
60	3	3	3	--	69	1,2,3,4,5	IV	Total Arsenic (filtered & unfiltered)	CLP-SAS	CLP Protocol	CRDL(b)
30	2	2	2	--	36	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	CRDL(b)
30	2	2	2	4	40	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	CRDL(b)
30	2	--	--	--	32	1,3,4,5	III	COD	REM III-SAS	EPA 410.1	5 mg/l
~~30~~ 9	2	--	--	--	32	1,3,4,5	III	BOD_5	REM III-SAS	SM 507	1 mg/l
30	2	--	--	--	32	1,3,4,5	III	TOC	REM III-SAS	EPA 415.1	1 mg/l
30	2	--	--	--	32	1,4,5	I	Eh, pH, Temperature, Specific Conductance, Dissolved Oxygen	Field Analysis	Primary Specific Ion Electrode	NA

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TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE THREE

Matrix - Offsite Groundwater (Round 1)

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use[a] Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method[b]	Target Detection Limit
22	2	2	2	3	31	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	CRDL(b)
8	1	1	1	1	12	1,2,3,4,5	V	TCL Volatiles[c]	CLP-SAS	EPA 601/602	0.5-1 µg/l
30	2	2	2	--	36	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	CRDL(b)
30	2	2	2	--	36	1,2,3,4,5	IV	TAL Inorganics (filtered)	CLP-RAS	CLP Protocol	CRDL(b)
34(t)	2	2	2	--	40	1,2,3,4,5	IV	Total Arsenic (unfiltered)	CLP-RAS	CLP Protocol	CRDL(b)
30	2	--	--	--	32	1,4,5	III	Common Anions[d]	REM III-SAS	EPA 300.0	(u)
30	2	--	--	--	32	1,4,5	III	Alkalinity	REM III-RAS	EPA 130.1	10 mg/l
30	2	--	--	--	32	1,3,4,5	III	COD	REM III-SAS	EPA 410.1	5 mg/l
30	2	--	--	--	32	1,3,4,5	III	BOD_5	REM III-SAS	SM 507	1 mg/l
30	2	--	--	--	32	1,3,4,5	III	TOC	REM III-SAS	EPA 415.1	1 mg/l
30	2	--	--	--	32	1,4,5	I	Dissolved Oxygen, Eh, pH, Specific Conductance,	Field Analysis	Primary Specific Ion Electrode	(v)

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TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE FOUR

Matrix - Offsite Groundwater (Round 2)

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Target Detection Limit
30	2	2	2	--	36	1,2,3,4,5	IV	Total Arsenic	CLP-SAS	CLP Protocol	CRDL(b)
22	2	2	2	3	31	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	CRDL(b)
8	1	1	1	1	12	1,2,3,4,5	V	TCL Volatiles(c)	CLP-SAS	EPA 601/602	0.2 µg/l
30	2	2	2	--	36	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	CRDL(b)
30	2	--	--	--	32	1,3,4,5	III	COD	REM III-SAS	EPA 410.1	5 mg/l
30	2	--	--	--	32	1,3,4,5	III	BOD_5	REM III-SAS	SM 507	1 mg/l
30	2	--	--	--	32	1,3,4,5	III	TOC	REM III-SAS	EPA 415.1	1 mg/l
30	2	--	--	--	32	1,4,5	I	Dissolved Oxygen, Eh, pH, Specific Conductance	Field Analysis	Primary Specific Ion Electrode	(v)

Matrix - Vault Waste (g)

4	1	1	--	1	7	1,3,4	V	TCL Volatiles	CLP-SAS	CLP Protocol(h)	CRDL(b)
4	1	1	--	--	6	1,3,4	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol(h)	CRDL(b)
4	1	1	--	--	6	1,3,4	V	TAL Inorganics	CLP-SAS	CLP Protocol(h)	CRDL(b)
2	1	1	--	--	4	1,3,4	V	TCL Pesticides/PCBs	CLP-SAS	CLP Protocol(h)	CRDL(b)
2	1	1	--	--	4	1,3,4	V	Cyanide	CLP-SAS	CLP Protocol(h)	CRDL(b)
4	--	--	--	--	4	1,3,4	III	TCLP (Metals)	CLP-SAS	(i)	NA

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TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE FIVE

Matrix - Vault Perimeter Soils

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Target Detection Limit
2	1	1	--	1	5	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	CRDL(b)
2	1	1	--	--	4	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Pro-tocol	CRDL(b)
2	1	1	--	--	4	1,2,3,4,5	IV	TAL Inorganics	CLP-RAS	CLP Protocol	CRDL(b)
6	1	1	--	--	8	1,2,3,4,5	IV	Total Arsenic/Iron	CLP-SAS	CLP Protocol	CRDL(b)
2	--	--	--	--	2	1,2,3,4,5	III	TCLP (Metals)	CLP-SAS	(i)	NA

Matrix - Vault Tracer

29	2	2	--	--	33	1,2,3,4,5	III	Lithium	REM III-SAS	CLP Protocol	10 ug/l

Matrix - Sludge From Consolidated Lagoons

8	1	1	--	2	12	1,3,4	V	TCL Volatiles	CLP-SAS	CLP Protocol(h)	CRDL(b)
8	1	1	--	--	10	1,3,4	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol(h)	CRDL(b)
6	1	1	--	--	8	1,3,4	V	TCL Pesticides/PCBs	CLP-SAS	CLP Protocol(h)	CRDL(b)
8	1	1	--	--	10	1,3,4	V	TAL Inorganics	CLP-SAS	CLP Protocol(h)	CRDL(b)
6	1	1	--	--	8	1,3,4	V	Cyanide	CLP-SAS	CLP Protocol(h)	CRDL(b)
16	1	1	--	--	18	1,3,4	V	Iron, Arsenic	CLP-SAS	CLP Protocol	CRDL(b)
16	1	1	--	--	18	1,3,4	V	Aniline	CLP-SAS	CLP Protocol	CRDL(b)
8	--	--	--	--	8	1,3,4	III	TCLP (Metals only)	CLP-SAS	(i)	NA
6	1	--	--	--	7	1,3,4	III	pH, Eh	REM III SAS	EPA Protocol	NA

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TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE SIX

Matrix - Lagoon Sludge or Sludge/Soil Mixtures

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Target Detection Limit
4(k)	--	--	--	--	4(k)	4,1	III	Unit Weight	REM III-SAS	ASTM D 2216-80	NA
4(k)	--	--	--	--	4(k)	4,1	III	Natural Water Content	REM III-SAS	ASTM D 2216-80	NA
4(k)	--	--	--	--	4(k)	4,1	III	One-Dimensional Consolidation	REM III-SAS	ASTM D 2435-80	NA
4(k)	--	--	--	--	4(k)	4,1	III	Unconfined Compressive Strength	REM III-SAS	ASTM D 2166-66	NA
4(k)	--	--	--	--	4(k)	4,1	III	Grain Size	REM III-SAS	ASTM D 422-63	NA
4(k)	--	--	--	--	4(k)	4,1	III	Specific Gravity	REM III-SAS	ASTM D 854-83	NA
4(n)	--	--	--	--	4(n)	4,1	III	Grain Size	REM III-SAS	ASTM D 422-63	NA
4(n)	--	--	--	--	4(n)	4,1	III	Specific Gravity	REM III-SAS	ASTM D 854-83	NA
4(n)	--	--	--	--	4(n)	4,1	III	Natural Water Content	REM III-SAS	ASTM D 2216-80	NA
4(n)	--	--	--	--	4(n)	4,1	III	Atterberg Limits	REM III-SAS	ASTM D 4318-84	NA

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TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE SEVEN

Matrix - Lagoon Cap

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Target Detection Limit
4(k)	--	--	--	--	4(k)	4,1	III	Unit Weight	REM III-SAS	ASTM D 2216-80	NA
4(k)	--	--	--	--	4(k)	4,1	III	Natural Water Content	REM III-SAS	ASTM D 2216-80	NA
4(k)	--	--	--	--	4(k)	4,1	III	Grain Size	REM III-SAS	ASTM D 422-63	NA
4(k)	--	--	--	--	4(k)	4,1	III	Specific Gravity	REM III-SAS	ASTM D 854-83	NA
4(k)	--	--	--	--	4(k)	4,1	III	Triaxial Permeability	REM III-SAS	SW846-9100	NA
4(k)	--	--	--	--	4(k)	4,1	III	Atterberg Limits	REM III-SAS	ASTM D 4318-84	NA
4(k)	--	--	--	--	4(k)	4,1	III	Density	Field Analysis	Nuclear Densometer ASTM D 2922-81	NA
4(l)	--	--	--	--	4(l)	4,1	III	Atterberg Limits	REM III-SAS	ASTM D 4318-84	NA
4(l)	--	--	--	--	4(l)	4,1	III	Grain Size	REM III-SAS	ASTM D 422-63	NA
4(l)	--	--	--	--	4(l)	4,1	III	Specific Gravity	REM III-SAS	ASTM D 854-83	NA
4(l)	--	--	--	--	4(l)	4,1	III	Triaxial Permeability	REM III-SAS	SW846-9100	NA

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TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE EIGHT

Matrix - Lagoon Liner

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Target Detection Limit
4(k)	--	--	--	--	4(k)	4,1	III	Unit Weight	REM III-SAS	ASTM D 2216-80	NA
4(k)	--	--	--	--	4(k)	4,1	III	Natural Water Content	REM III-SAS	ASTM D 2216-80	NA
4(k)	--	--	--	--	4(k)	4,1	III	Grain Size	REM III-SAS	ASTM D 422-63	NA
4(k)	--	--	--	--	4(k)	4,1	III	Specific Gravity	REM III-SAS	854-83	NA
4(k)	--	--	--	--	4(k)	4,1	III	Triaxial Permeability	REM III-SAS	SW846-9100	NA
4(n)	--	--	--	--	4(n)	4,1	III	Grain Size	REM III-SAS	ASTM D 422-63	NA
4(n)	--	--	--	--	4(n)	4,1	III	Natural Water Content	REM III-SAS	ASTM D 2216-80	NA
4(n)	--	--	--	--	4(n)	4,1	III	Specific Gravity	REM III-SAS	ASTM D 854-83	NA

Matrix - Groundwater: Lagoon Lysimeters (1st and 2nd Rounds)

8	2	2	2	--	14	1,2,3,4,5	IV	Total Arsenic	CLP-SAS	CLP Protocol	CRDL(b)
8	--	--	--	--	8	1,3,4,5	I	pH	Field Analysis	pH paper	NA

Matrix - Lagoon Perimeter Soils

3	1	1		1	6	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	CRDL(b)
3	1	1		--	5	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	CRDL(b)
3	1	1		--	5	1,2,3,4,5	IV	TAL Inorganics	CLP-RAS	CLP Protocol	CRDL(b)
10	1	1		--	12	1,2,3,4,5	IV	Iron, Arsenic	CLP-SAS	CLP Protocol	CRDL(b)
3	--	--	--	--	3	1,2,3,4,5	III	TCLP (Metals)	CLP-SAS	(i)	NA

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TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE NINE

Matrix - Excavated Lagoon Soil and Sludge(o)

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Target Detection Limit
6	1	1		1	9	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	CRDL(b)
6	1	1		--	8	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	CRDL(b)
6	1	1		--	8	1,2,3,4,5	IV	TAL Inorganics	CLP-RAS	CLP Protocol	CRDL(b)
20	2	2		--	24	1,2,3,4,5	IV	Arsenic, Iron	CLP-SAS	CLP Protocol	CRDL(b)
6	--	--	--	--	6	1,2,3,4,5	III	TCLP (Metals)	CLP-SAS	(i)	NA

Matrix - Process Buildings: Building and Equipment Wipe Samples

156	8	8	8	--	180	1,2,3,4	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	CRDL(b)
156	8	8	8	--	180	1,2,3,4	IV	Total Arsenic	CLP-SAS	CLP Protocol	CRDL(b)

Matrix - Roof Drainage

2	1	1	1	--	5	1,2,3,4	V	TCL B/N/A-E and Aniline	CLP-RAS	CLP Protocol	CRDL(b)
7	1	1	1	--	10	1,2,3,4	IV	Total Arsenic	CLP-SAS	CLP Protocol	CRDL(b)

Matrix - Asbestos

10	1			--	11	1,2,3,4	III	Asbestos	REM III-SAS	EPA-600/ MA-82-020 (Dec. 1982)	<1 percent(w)

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TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE TEN

Matrix - Air (f)

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Target Detection Limit
10	1	1	--	--	12	1,2,3,4,5	III	Aniline	REM III-SAS	NIOSH Method 5310	0.5 ppm(b)
2	1	1	--	--	4	1,2,3,4,5	III	Methyl bromide	REM III-SAS	NIOSH Method 5372	0.5 ppm(b)

Matrix - Process Buildings: Soil(p)

2	1	1	--	1	5	1,2,3,4	IV	TCL Volatiles	CLP-RAS	CLP Protocol	CRDL(b)
2	1	1	--	--	4	1,2,3,4	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	CRDL(b)
2	1	1	--	--	4	1,2,3,4	IV	TAL Inorganics	CLP-RAS	CLP Protocol	CRDL(b)
6	1	1	--	--	8	1,2,3,4	IV	Total Arsenic, Iron	CLP-SAS	CLP Protocol	CRDL(b)
6	--	--	--	--	6	1,2,3,4	III	Cation Exchange Capacity	REM III-SAS	SW846-9081	1 meq/100g(b)
2	1	1	--	--	4	1,2,3,4,5	IV	Pesticides/PCBs	CLP-RAS	CLP Protocol	CRDL(b)
2	1	1	--	--	4	1,2,3,4,5	IV	Cyanide	CLP-RAS	CLP Protocol	CRDL(b)
2	--	--	--	--	2	1,2,3,4,5	III	TCLP (Metals)	CLP-SAS	(i)	NA

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TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE ELEVEN

Matrix - Laboratory Wastes

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Target Detection Limit
100	5	5	5	--	115	1,3,4	V	TAL Metals	CLP-SAS	CLP Protocol(h)	CRDL(b)
100	--	--	--	--	100	1,3,4	III	BTU Content	REM III-SAS	ASTM 3287-77	NA
100	--	--	--	--	100	1,3,4	III	Ash Content	REM III-SAS	SM 209D	0.1%
100	--	--	--	--	100	1,3,4	IV	Chlorine Content	REM III-SAS	ASTM D808	0.1%
100	--	--	--	--	100	1,3,4	II	GC/IR Scan	REM III-SAS	NUS Method	NA
75	--	--	--	--	75	1,3,4	III	TCLP Metals	CLP-SAS	(i)	NA
100	--	--	--	--	100	1,3,4	III	Ignitability	REM III-SAS	SW 846-1010	NA
100	--	--	--	--	100	1,3,4	III	Reactivity	REM III-SAS	SW 846	NA
100	--	--	--	--	100	1,3,4	I	Compatibility Tests	Field Analysis	Various	NA

Matrix - Wastes in Piping

50	3	3	3		59	1,3,4	V	TAL Metals	CLP-SAS	CLP Protocol(h)	CRDL(b)
50	--	--	--	--	50	1,3,4	III	BTU Content	REM III-SAS	ASTM 3286-77	NA
50	--	--	--	--	50	1,3,4	III	Ash Content	REM III-SAS	SM 209D	0.1%
50	--	--	--	--	50	1,3,4	III	Chlorine Content	REM III-SAS	ASTM D808	0.1%
50	--	--	--	--	50	1,3,4	III	Ignitability	REM III-SAS	SW846-1010	NA
50	--	--	--	--	50	1,3,4	III	Reactivity	REM III-SAS	SW846	NA
50	--	--	--	--	50	1,3,4	I	Compatibility Tests	Field Analysis	Various	NA

TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE TWELVE

Matrix - Wastes in Tanks and Drums

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use[a] Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method[b]	Target Detection Limit
40	--	--	--	--	40	1,3,4	III	BTU Content	REM III-SAS	ASTM 3287-77	NA
40	--	--	--	--	40	1,3,4	III	Ash Content	REM III-SAS	SM 209D	0.1%
40	--	--	--	--	40	1,3,4	III	Chlorine Content	REM III-SAS	ASTM D808	0.1%
20	--	--	--	--	20	1,3,4	II	GC/IR Scan	REM III-SAS	MUS Method	NA
40	2	2	2	--	46	1,3,4	V	TAL Metals	CLP-SAS	CLP Protocol[h]	CRDL(b)
40	--	--	--	--	40	1,3,4	III	Ignitability	REM III-SAS	SW846-1010	NA
40	--	--	--	--	40	1,3,4	III	Reactivity	REM III-SAS	SW846	NA
30	--	--	--	--	30	1,3,4	V	PCB's	CLP-SAS	CLP Protocol[h]	CRDL(b)
160	--	--	--	--	160	1,3,4	I	Compatibility Tests	Field Analysis	Various	NA
20	--	--	--	--	20	1,2,3,4,5	III	TCLP	CLP-SAS	(i)	NA

Matrix - Waste Pit Soils and Sludges

2	1	1	--	1	5	1,3,4	IV	TCL Volatiles	CLP-RAS	CLP Protocol	CRDL(b)
2	1	1	--	--	4	1,3,4	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	CRDL(b)
8	1	1	--	--	10	1,3,4	IV	Total Arsenic, Iron	CLP-SAS	CLP Protocol	CRDL(b)
2	1	1	--	--	4	1,3,4	IV	TAL Metals	CLP-RAS	CLP Protocol	CRDL(b)
8	1	1	--	--	10	1,3,4	V	Aniline	CLP-SAS	CLP Protocol	CRDL(b)
2	--	--	--	--	2	1,3,4	III	TCLP (Metals only)	CLP-SAS	(i)	NA

TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE THIRTEEN

Matrix - Offsite Soils (Attenuation Capacity)

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Target Detection Limit
40	2	2	2	--	46(s)	4,3	IV	Total Arsenic	CLP-SAS	CLP Protocol	CRDL(b)
40	2	2	2	--	46(s)	4,3	V	Aniline	CLP-SAS	CLP Protocol	CRDL(b)
40	2	2	2	2	48(s)	4,3	IV	Tetrachloroethene	CLP-SAS	CLP Protocol	CRDL(b)
40	2	2	2	--	46	4,3	IV	Total Arsenic	CLP-SAS	CLP Protocol	CRDL(b)
40	2	2	2	--	46	4,3	V	Aniline	CLP-SAS	CLP Protocol	CRDL(b)
40	2	2	2	2	48	4,3	IV	Tetrachloroethene	CLP-SAS	CLP Protocol	CRDL(b)
5	1	--	--	--	6	4,3	III	Iron	REM III-SAS	CLP Protocol	100 mg/kg(b)
5	1	--	--	--	6	4,3	III	TOC	REM III-SAS	CASWS P3-65	NA
5	1	--	--	--	6	4,3	III	CEC	REM III-SAS	SW846-9081	1 meq/100g(b)
5	1	--	--	--	6	4,3	III	Grain Size	REM III-SAS	ASTM D422-63	NA

Matrix - Photographic Anomalies: Soils

9	1	1	--	3	14	1,3,4	IV	TCL Volatiles	CLP-RAS	CLP Protocol	CRDL(b)
9	1	1	--	--	11	1,3,4	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	CRDL(b)
9	1	1	--	--	11	1,3,4	IV	TAL Inorganics	CLP-RAS	CLP Protocol	CRDL(b)
36	2	2	--	--	40	1,3,4	V	Aniline	CLP-SAS	CLP Protocol	CRDL(b)
36	2	2	--	--	40	1,3,4	IV	Total Arsenic	CLP-SAS	CLP Protocol	CRDL(b)
9	--	--	--	--	9	1,3,4	III	TCLP (Metals only)	CLP-SAS	(i)	NA

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TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE FOURTEEN

Matrix - Onsite Soils

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use[a] Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method[b]	Target Detection Limit
9	1	1	--	2	13	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	CRDL(b)
9	1	1	--	--	11	1,2,3,4,5	V	TCL B/N/A-E and Anilines	CLP-SAS	CLP Protocol	CRDL(b)
9	1	1	--	--	11	1,2,3,4,5	IV	TAL Inorganics	CLP-RAS	CLP Protocol	CRDL(b)
36	2	2	--	--	40	1,2,3,4,5	IV	Total Arsenic, Iron	CLP-SAS	CLP Protocol	CRDL(b)
9	--	--	--	--	9	1,2,3,4,5	III	TCLP (Metals only)	CLP-SAS	(i)	NA

Matrix - Offsite Soils

11	1	1	--	2	15	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	CRDL(b)
11	1	1	--	--	13	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	CRDL(b)
11	1	1	--	--	13	1,2,3,4,5	IV	TAL Inorganics	CLP-RAS	CLP Protocol	CRDL(b)
62(t)	4	4	--	--	70	1,2,3,4,5	IV	Iron, Arsenic	CLP-SAS	CLP Protocol	CRDL(b)
11	--	--	--	--	11	1,2,3,4,5	III	TCLP (Metals only)	CLP-SAS	(i)	NA

Matrix - 1951 Pit Soils

2	1	1	--	1	5	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	CRDL(b)
2	1	1	--	--	4	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	CRDL(b)
2	1	1	--	--	4	1,2,3,4,5	IV	TAL Metals	CLP-RAS	CLP Protocol	CRDL(b)
6	1	1	--	--	8	1,2,3,4,5	IV	Iron, Arsenic	CLP-SAS	CLP Protocol	CRDL(b)
6	1	1	--	--	8	1,2,3,4,5	V	Aniline	CLP-SAS	CLP Protocol	CRDL(b)
2	--	--	--	--	2	1,2,3,4,5	III	TCLP (Metals only)	CLP-SAS	(i)	NA

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TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE FIFTEEN

Matrix - DDAA Storage Areas

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Target Detection Limit
2	1	1	--	1	5	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	CRDL(b)
2	1	1	--	--	4	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	CRDL(b)
2	1	1	--	--	4	1,2,3,4,5	IV	TAL Metals	CLP-RAS	CLP Protocol	CRDL(b)
8	1	1	--	--	10	1,2,3,4,5	IV	Iron, Arsenic	CLP-SAS	CLP Protocol	CRDL(b)
8	1	1	--	--	10	1,2,3,4,5	V	Aniline	CLP-SAS	CLP Protocol	CRDL(b)
2	--	--	--	--	2	1,2,3,4,5	III	TCLP (Metals only)	CLP-SAS	(i)	NA

Matrix - Drum Storage Areas Soils

5	1	1	--	2	9	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	CRDL(b)
5	1	1	--	--	7	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	CRDL(b)
20	1	1	--	--	22	1,2,3,4,5	V	Aniline	CLP-SAS	CLP Protocol	CRDL(b)
20	1	1	--	--	22	1,2,3,4,5	IV	Total Arsenic, Iron	CLP-SAS	CLP Protocol	CRDL(b)
5	--	--	--	--	5	1,2,3,4,5	III	TCLP	CLP-SAS	(i)	NA
5	1	1	--	--	7	1,2,3,4,5	IV	TAL Metals	CLP-RAS	CLP Protocol	CRDL(b)

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TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE SIXTEEN

Matrix - Surface Water(x)

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Target Detection Limit
3	1	1	1	1	7	1,2,3,4,5	V	TCL Volatiles	CLP-SAS	EPA 601/602	CRDL(b)
3	1	1	1	--	6	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	CRDL(b)
3	1	1	1	--	6	1,2,3,4,5	IV	TAL Metals	CLP-RAS	CLP Protocol	CRDL(b)
31	2	2	2	--	37	1,2,3,4,5	IV	Total Arsenic, Iron (unfiltered)	CLP-SAS	CLP Protocol	CRDL(b)
28	2	2	2	--	34	1,2,3,4,5	IV	Iron, Arsenic (filtered)	CLP-SAS	CLP Protocol	CRDL(b)
31	2	2	2	--	37	1,2,3,4,5	V	Aniline	CLP-SAS	CLP Protocol	CRDL(b)
34	2	--	--	--	36	1,4,5	III	Hardness	REM III-SAS	EPA 310.1	=10 mg/l
34	2	--	--	--	36	1,5,4	III	Suspended Solids	REM III-SAS	EPA 160.2	1.0 mg/l
34	--	--	--	--	34	1,4,5	I	pH, Eh, Temperature, Specific Conductance, Dissolved Oxygen	Field Analysis	Primary Specific Ion Electrode	(v)
28	2	2	2	--	34	1,4,5	III	Nitrate/Nitrite	REM III-SAS	EPA 300.0	0.013 mg/l(b)
34	2	--	--	--	36	1,4,5	III	Alkalinity	REM III-SAS	EM 130.1	10 mg/l
30	2	2	2	--	36	1,2,3,4,5	IV	Arsenic (unfiltered)	CLP-SAS	CLP Protocol	CRDL(b)

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TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE SEVENTEEN

Matrix - Sediments

No. of Samples	No. of Dup's	No. of Field Blanks	No. of Bottle Blanks	No. of Trip Blanks	Total No. of Samples	Data Use(a) Objectives	Analy. Option	Analysis	Source of Analysis	Analytical Method(b)	Target Detection Limit
3	1	1	--	1	6	1,2,3,4,5	IV	TCL Volatiles	CLP-RAS	CLP Protocol	CRDL(b)
3	1	1	--	--	5	1,2,3,4,5	V	TCL B/N/A-E and Aniline	CLP-SAS	CLP Protocol	CRDL(b)
3	1	1	--	--	5	1,2,3,4,5	IV	TAL Metals	CLP-RAS	CLP Protocol	CRDL(b)
17	1	1	--	--	19	1,2,3,4,5	IV	Total Arsenic, Iron	CLP-SAS	CLP Protocol	CRDL(b)
11	1	1	--	--	13	1,2,3,4,5	IV	Aniline	CLP-SAS	CLP Protocol	CRDL(b)
20	--	--	--	--	20	1,4,5	III	pH	REM III-SAS	SW 9045	NA
20	1	--	--	--	21	5,4,1	III	Total Organic Carbon	REM III-RAS	CASWS P3-65	NA
20	--	--	--	--	20	1,2,3,4	III	Grain Size	REM III-SAS	ASTM D 422-63	NA
11	1	1	--	1	14	4,1,2,3,5	IV	PCE	CLP-SAS	CLP Protocol	CRDL(b)
20	--	--	--	--	20	1,4,5	III	Eh	REM III-SAS	ASTM D 1498-76	NA

Matrix - Fish Tissue (Whole Body)*

8	1	--	--	--	9	2,1	V	Arsenic	CLP-SAS	CLP Protocol	CRDL(b)

Matrix - Fish (Edible Tissue)*

8	1	--	--	--	9	2,1	V	Arsenic	CLP-SAS	CLP Protocol	CRDL(b)

* Fish tissues sample assay conducted at 8 locations: 1 upstream location, 4 downstream locations, and 3 downstream lakes.

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TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE EIGHTEEN

(a) Data use list has been prioritized:
   1 Site Characterization
   2 Risk Assessment
   3 Evaluation of Alternatives
   4 Engineering Design of Alternatives
   5 Modeling Input

(b) Analytical sensitivity achieved by the proposed analytical method is acceptable for the data uses and objectives.
(c) Residential wells only.
(d) Includes chloride, fluoride, nitrate-N, nitrite-N, orthophosphate-P, and sulfate.
(e) All CLP analyses for waste samples can be performed with 8-oz. of material. Pack jar in paint can for shipment.
(f) Air samples collected per request of Health and Safety Officer for Whitmoyer Site. Aniline air samples will be collected in Buildings 1, 2, 3, 6, and 7. Methyl bromide, samples will be collected in Building 5.
(g) Three soil borings/2 or 3 samples per boring, as follows: top 3 inches; bottom 1.5 feet; and possibly 1 opportunity sample.
(h) CLP protocol for high level samples. Pack samples in paint cans for shipment.
(i) 51 Federal Register 40572 (to be codified at 40 CFR 268, Part I).
(j) Can be performed with the same thin-wall tube sample.
(k) Actual number of samples will be based on a density of 1 every 2,500 square feet.
(l) Samples to be collected with split barrel sampler, at a density of 1 sample every 2,500 square feet, if thin-wall tube cannot be used. Permeability sample will be prepared to average field density as measured by ASTM D 2922-81 and sent for analysis.
(m) Same sample jar as grain size.
(n) Samples to be collected with split barrel sampler at a density of 1 sample every 2,500 square feet, if thin-wall tube cannot be used.
(o) One test pit per lagoon and 3 test pits around lagoon perimeter/2 or 3 samples per test pit. One sample per every other pit analyzed for TCL, TAL. Other samples analyzed for arsenic and iron only.
(p) Seven borings/2 or 3 samples per boring.
(q) Pack in paint cans for shipment.
(r) Can be analyzed from ignitability sample volume.
(s) Liquid samples.
(t) Includes opportunity sample.
(u) Common anion detection limits: Fluoride (0.005 mg/l); chloride (0.015 mg/l); nitrite (0.004 mg/l); nitrate (0.013 mg/l); O-Phosphate-P (0.06 mg/l).
(v) Dissolved oxygen detection limit is approximately 0.5 mg/l.
(w) Lower detection limit is less than 1 percent.
(x) Includes all 3 sampling rounds.

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TABLE 2-1
SUMMARY OF FIELD SAMPLING AND ANALYSIS PROGRAM
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE NINETEEN

ASTM	American Society for Testing Materials.
CLP	Contract Laboratory Program.
CLP Protocol	Protocols defined in the CLP Statement of Work, latest revision (CLP-RAS: Routine Analytical Services).
CLP-SAS	Special Analytical Services (SAS) requiring specified preparation, analysis or reporting techniques which are available through the CLP. CLP-SAS requires coordination with SMO.
EPA	Methods for Chemical Analysis of Water and Wastes, March 1983.
NA	Not Applicable.
SM	Standard Methods for the Examination of Water and Wastewater, 16th edition.
SW	Test Methods for Evaluating Solid Waste (SW-846), 3rd edition, November 1986.
NIOSH	National Institute of Occupational Safety and Health.
CASWS	Procedure for Handling and Chemical Analysis of Sediment and Water Samples EPA/CE-81-1.
TAL	Target Analytes List (formerly the HSL).
TCL	Target Compound List (formerly the HSL).
TOC	Total Organic Carbon.
REM III-RAS	A REM III Team laboratory will be performing the analysis. The analysis required is one of the 101 tests considered as routine analysis by REM III laboratory. REM III-RAS requires coordination with Ebasco.
REM III-SAS	A REM III Team laboratory will be performing the analysis. The analysis required is NOT one of the 101 tests considered as routine analysis. REM III-SAS requires coordination with Ebasco.
Field Duplicate	A single sample split into two portions and both are submitted blindly to the laboratory. The duplicate set serves as an oversight function in assessing the precision of the overall sampling, handling and analytical program. NOTE: In the EPA DQO guidance document, Field Duplicates are referred to as Replicate Samples.
Bottle Blank	Samples which are obtained by directly pouring analyte-free, deionized water into a sample collection bottle. They serve as an oversight function in assessing the effect of residual contamination in the sample collection bottle.
Trip Blank	Trip blanks are prepared prior to the sampling event in the actual sample containers and are kept with the investigation samples throughout the sampling event. Trip blanks must be submitted with each batch (i.e., daily) of samples submitted for VOA analysis. They are used to monitor the loss (or gain) in the VOA fraction associated with routine sample handling.
Field Blank	Samples which are obtained by running analyte-free deionized water through sample collection equipment (bailer, pump, auger, etc.) after decontamination. These samples are used to monitor the effectiveness of equipment decontamination procedures.

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TABLE 2-2

SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS, PRESERVATION REQUIREMENTS, AND HOLDING TIMES
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA

Matrix	Analysis	Total No. of Samples	Bottle Requirements		Holding Time	Preservation Requirements
			Per Sample	Total		
Onsite Groundwater (Round 1)	TCL Volatiles	40	2, 40-ml glass vials	80	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	36	1, 80-oz. amber glass	36	7 days to extraction; 40 days after	Cool to 4°C
	TAL Inorganics (filtered)	36	1, 1-liter plastic bottle	36	6 months; Hg-28 days	HNO_3 to pH<2; Cool to 4°C
	Total Arsenic (unfiltered)	36	1, 1-liter plastic bottle	36	6 months	HNO_3 to pH<2; Cool to 4°C
	Total Arsenic (filtered)	7	1, 1-liter plastic bottle	7	6 months	HNO_3 to pH<2; Cool to 4°C
	Cyanide	7	1, 1-liter plastic bottle	7	14 days	NaOH to pH>12; Cool to 4°C
	TCL Pesticides/PCBs	7	1, 80-oz. amber glass	7	7 days to extraction; 40 days after	Cool to 4°C
	Common Anions[d]	32	1, 1-liter plastic bottle	32	28 days	Cool to 4°C
	Alkalinity	32	1, 1-liter plastic bottle	32	14 days	Cool to 4°C
	COD, TOC	32	1, 500-ml plastic bottle	32	28 days	H_2SO_4 to pH<2; Cool to 4°C
	BOD	32	1, 1-liter plastic bottle	32	48 hours	Cool to 4°C
	Eh, pH, Temperature, Specific Conductance, Dissolved Oxygen	32	NA	--	NA	NA

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TABLE 2-2
SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS,
PRESERVATION REQUIREMENTS, AND HOLDING TIMES
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE TWO

Matrix	Analysis	Total No. of Samples	Bottle Requirements		Holding Time	Preservation Requirements
			Per Sample	Total		
Onsite Groundwater (Round 2)	Total Arsenic (filtered & unfiltered)	69	1, 1-liter plastic bottle	69	6 months	HNO_3 to pH<2; Cool to 4°C
	TCL B/N/A-E and Aniline	36	1, 80-oz. amber glass	36	7 days to extraction; 40 days after	Cool to 4°C
	TCL Volatiles	40	2, 40-ml. glass vials	80	7 days	Cool to 4°C
	COD, TOC	32	1, 500-ml plastic bottle	32	28 days	H_2SO_4 to pH<2; Cool to 4°C
	BOD	32	1, 1-liter plastic bottle	32	48 hours	Cool to 4°C
	Eh, pH, Temperature, Specific Conductance, Dissolved Oxygen	32	NA	--	NA	NA
Offsite Groundwater (Round 1)	TCL Volatiles	31	2, 40-ml glass vials	62	7 days	Cool to 4°C
	TCL Volatiles(a)	12	2, 40-ml glass vials	24	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	36	1, 80-oz. amber glass	36	7 days to extraction; 40 days after	Cool to 4°C
	TAL Inorganics (filtered)	36	1, 1-liter plastic bottle	36	6 months; Hg-28 days	HNO_3 to pH<2; Cool to 4°C
	Total Arsenic (unfiltered)	40	1, 1-liter plastic bottle	40	6 months	HNO_3 to pH<2; Cool to 4°C
	Common Anions(b)	32	1, 1-liter plastic bottle	32	28 days	Cool to 4°C
	Alkalinity	32	1, 1-liter plastic bottle	32	14 days	Cool to 4°C
	COD, TOC	32	1, 500-ml plastic bottle	32	28 days	H_2SO_4 to pH<2; Cool to 4°C
	BOD	32	1, 1-liter plastic bottle	32	48 hours	Cool to 4°C
	Dissolved Oxygen, Eh, pH, Specific Conductance	32	NA	--	NA	NA

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TABLE 2-2
SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS,
PRESERVATION REQUIREMENTS, AND HOLDING TIMES
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE THREE

Matrix	Analysis	Total No. of Samples	Bottle Requirements		Holding Time	Preservation Requirements
			Per Sample	Total		
Offsite Groundwater (Round 2)	Total Arsenic (filtered)	36	1, 1-liter plastic bottle	36	6 months	HNO_3 to pH<2; Cool to 4°C
	TCL Volatiles	31	2, 40-ml glass vials	62	7 days	Cool to 4°C
	TCL Volatiles(a)	12	2, 40-ml glass vials	24	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	18	1, 80-oz. amber glass	18	7 days to extraction; 40 days after	Cool to 4°C
	COD, TOC	32	1, 500-ml plastic bottle	32	28 days	H_2SO_4 to pH<2; Cool to 4°C
	BOD	32	1, 1-liter plastic bottle	32	48 hours	Cool to 4°C
	Dissolved Oxygen, Eh, pH, Specific Conductance	32	NA	--	NA	NA
Vault Waste	TCL Volatiles	7	(c)	14	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	6	(c)	6	7 days to extraction; 40 days after	Cool to 4°C
	TAL Inorganics	6	(c)	6	6 months; Hg-28 days	Cool to 4°C
	TCL Pesticides/PCBs	4	(c)	4	7 days to extraction; 40 days after	Cool to 4°C
	Cyanide	4	(c)	4	14 days	Cool to 4°C
	TCLP (Metals)	4	1-32 oz. wide-mouth bottle(k)	4	NA	NA
Air	Aniline	12	NA	NA	7 days	Cool to 4°C
	Methyl bromide	4	NA	NA	7 days	Cool to 4°C

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TABLE 2-2
SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS,
PRESERVATION REQUIREMENTS, AND HOLDING TIMES
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE FOUR

Matrix	Analysis	Total No. of Samples	Bottle Requirements		Holding Time	Preservation Requirements
			Per Sample	Total		
Vault Perimeter Soils	TCL Volatiles	5	2, 120-ml wide-mouth glass jars	10	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	4	1, 8-oz. wide-mouth glass jar	4	7 days to extraction; 40 days after	Cool to 4°C
	TAL Inorganics	4	1, 8-oz. wide-mouth glass jar	4	6 months; Hg-28 days	Cool to 4°C
	Total Arsenic/Iron	8	1, 8-oz. wide-mouth glass jar	8	6 months	Cool to 4°C
	TCLP (Metals)	2	1, 32-oz. wide-mouth glass jar	2	NA	NA
Sludge from Consolidated Lagoons	TCL Volatiles	12	(c)	12	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	10	(c)	10	7 days to extraction; 40 days after	Cool to 4°C
	TCL Pesticides/PCBs	8	(c)	8	7 days to extraction; 40 days after	Cool to 4°C
	TAL Inorganics	10	(c)	10	6 months	Cool to 4°C
	Cyanide	8	(c)	8	14 days	Cool to 4°C
	Iron, Arsenic	18	(c)	18	6 months	Cool to 4°C
	Aniline	18	(c)	18	7 days to extraction; 40 days after	Cool to 4°C
	TCLP (Metals only)	8	1, 32-oz. wide-mouth glass jar(k)	8	NA	NA
	pH, Eh	7	1, 8-oz. glass jar(k)	7	NA	NA

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TABLE 2-2
SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS,
PRESERVATION REQUIREMENTS, AND HOLDING TIMES
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE FIVE

Matrix	Analysis	Total No. of Samples	Bottle Requirements		Holding Time	Preservation Requirements
			Per Sample	Total		
Lagoon Sludge or Sludge/Soil Mixtures	Unit Weight	4(e)	1 thin-wall tube(k)	4	NA	NA
	Natural Water Content	4(e)	(d,k)	4(d)	NA	NA
	One-Dimensional Consolidation	4(e)	(d,k)	4(d)	NA	NA
	Unconfined Compressive Strength	4(e)	(d,k)	4(d)	NA	NA
	Grain Size	4(e)	(d,k)	4(d)	NA	NA
	Specific Gravity	4(e)	(d,k)	4(d)	NA	NA
	Grain Size	4(h)	1, 32-oz. wide-mouth glass jar(k)	4	NA	NA
	Specific Gravity	4(h)	(g,k)	4(g)	NA	NA
	Natural Water Content	4(h)	(g,k)	4(g)	NA	NA
	Atterberg Limits	4(h)	(g,k)	4(g)	NA	NA

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TABLE 2-2
SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS,
PRESERVATION REQUIREMENTS, AND HOLDING TIMES
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE SIX

Matrix	Analysis	Total No. of Samples	Bottle Requirements		Holding Time	Preservation Requirements
			Per Sample	Total		
Lagoon Cap	Unit Weight	4(e)	1 thin-wall tube	4	NA	NA
	Natural Water Content	4(e)	(d)	4(d)	NA	NA
	Grain Size	4(e)	(d)	4(d)	NA	NA
	Specific Gravity	4(e)	(d)	4(d)	NA	NA
	Triaxial Permeability	4(e)	(d)	4(d)	NA	NA
	Atterberg Limits	4(e)	(d)	4(d)	NA	NA
	Density	4(e)	NA	NA	NA	NA
	Atterberg Limits	4(f)	1, 32-oz. wide-mouth glass jar	4	NA	NA
	Grain Size	4(f)	(g)	4(g)	NA	NA
	Specific Gravity	4(f)	(g)	4(g)	NA	NA
	Triaxial Permeability	4(f)	1, 32-oz. wide-mouth glass jar	4	NA	NA
Lagoon Liner	Unit Weight	4(e)	1 thin-wall tube(k)	4	NA	NA
	Natural Water Content	4(e)	(d,k)	4(d)	NA	NA
	Grain Size	4(e)	(d,k)	4(d)	NA	NA
	Specific Gravity	4(e)	(d,k)	4(d)	NA	NA
	Triaxial Permeability	4(e)	(d,k)	4(d)	NA	NA
	Grain Size	4(h)	1, 32-oz. wide-mouth glass jar(k)	4	NA	NA
	Natural Water Content	4(h)	(g)	4(g)	NA	NA
	Specific Gravity	4(h)	(g)	4(g)	NA	NA

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TABLE 2-2
SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS,
PRESERVATION REQUIREMENTS, AND HOLDING TIMES
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE SEVEN

Matrix	Analysis	Total No. of Samples	Bottle Requirements		Holding Time	Preservation Requirements
			Per Sample	Total		
Lagoon Lysimeters	Total Arsenic	14	1, 1-liter plastic bottle	14	6 months	HNO_3 to pH<2; Cool to 4°C
	pH	8	NA	NA	NA	NA
Lagoon Perimeter Soils	TCL Volatiles	6	2, 120-ml wide-mouth glass jars	12	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	5	1, 8-oz. wide-mouth glass jar	5	7 days to extraction; 40 days after	Cool to 4°C
	TAL Inorganics	5	1, 8-oz. wide-mouth glass jar	5	6 months; Hg-28 days	Cool to 4°C
	Iron, Arsenic	12	1, 8-oz. wide-mouth glass jar	12	6 months	Cool to 4°C
	TCLP (Metals)	3	1, 32-oz. jar	3	NA	NA
Excavated Lagoon Soil and Sludge(i)	TCL Volatiles	9	2, 120-ml wide-mouth glass jars	18	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	8	1, 8-oz. wide-mouth glass jar	8	7 days to extraction; 40 days after	Cool to 4°C
	TAL Inorganics	8	1, 8-oz. wide-mouth glass jar	8	6 months; Hg-28 days	Cool to 4°C
	Arsenic, Iron	24	1, 8-oz. wide-mouth glass jar	24	6 months	Cool to 4°C
	TCLP (Metals)	6	1, 32-oz. jar	6	NA	NA

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TABLE 2-2
SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS,
PRESERVATION REQUIREMENTS, AND HOLDING TIMES
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE EIGHT

Matrix	Analysis	Total No. of Samples	Bottle Requirements		Holding Time	Preservation Requirements
			Per Sample	Total		
Process Buildings Building and Equipment Wipe Samples	TCL B/N/A-E and Aniline	180	1, 8-oz. wide-mouth glass jar or vial	180	7 days to extraction; 40 days after	Cool to 4°C
	Total Arsenic	180	1, 8-oz. wide-mouth glass jar or vial	180	6 months	Cool to 4°C
Roof Drainage	TCL B/N/A-E and Aniline	5	1, 80-oz. amber glass	5	7 days to extraction; 40 days after	Cool to 4°C
	Total Arsenic	10	1, 1-liter plastic bottle	10	6 months	HNO_3 to pH<2; Cool to 4°C
Asbestos	Asbestos	11	Baggie	11	NA	NA
Process Buildings: Soil(j)	TCL Volatiles	5	2, 120-ml wide-mouth glass jars	10	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	4	1, 8-oz. wide-mouth glass jar	4	7 days to extraction; 40 days after	Cool to 4°C
	TAL Inorganics	4	1, 8-oz. wide-mouth glass jar	4	6 months, Hg-28 days	Cool to 4°C
	Total Arsenic, Iron	8	1, 8-oz. wide-mouth glass jar	14	6 months	Cool to 4°C
	Cation Exchange Capacity	6	1, 16-oz. wide-mouth glass jar	6	NA	Cool to 4°C
	Pesticides/PCBs	4	1, 8-oz. wide-mouth glass jar	4	7 days to extraction; 40 days after	Cool to 4°C
	Cyanide	4	1, 8-oz. wide-mouth glass jar	4	14 days	Cool to 4°C
	TCLP (Metals)	2	1, 32-oz. wide-mouth glass jar	2	NA	NA

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TABLE 2-2
SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS,
PRESERVATION REQUIREMENTS, AND HOLDING TIMES
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE NINE

Matrix	Analysis	Total No. of Samples	Bottle Requirements		Holding Time	Preservation Requirements
			Per Sample	Total		
Wastes in Piping	TAL Metals	59	(c)	62	6 months; Hg-28 days	Cool to 4°C
	BTU Content	50	1, 8-oz. wide-mouth glass jar(k)	50(1)	NA	Cool to 4°C
	Ash Content	50	(1)	50(1)	NA	Cool to 4°C
	Compatibility Tests	50	NA	NA	NA	NA
	Ignitability	50	(1)	50(1)	NA	NA
	Reactivity	50	(1)	50(1)	NA	NA
	Chlorine Content	50	(1)	50(1)	NA	NA
Wastes in Tanks and Drums	TAL Metals	46	(c)	46	6 months; Hg-28 days	Cool to 4°C
	BTU Content	40	1, 8-oz. wide-mouth glass jar(k)	40	NA	Cool to 4°C
	Ash Content	40	(1)	40(1)	NA	Cool to 4°C
	TCLP Metals	20	1, 32-oz. wide-mouth glass jar(k)	20	NA	NA
	Ignitability	40	(1)	40(1)	NA	Cool to 4°C
	Reactivity	40	(1)	40(1)	NA	Cool to 4°C
	Compatibility Tests	160	NA	NA	NA	NA
	Chlorine Content	40	(1)	40(1)	NA	Cool to 4°C
	GC/IR Scan	20	(1)	20(1)	NA	Cool to 4°C

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TABLE 2-2
SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS,
PRESERVATION REQUIREMENTS, AND HOLDING TIMES
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE TEN

Matrix	Analysis	Total No. of Samples	Bottle Requirements		Holding Time	Preservation Requirements
			Per Sample	Total		
Laboratory Wastes	TAL Metals	115	(c)	115	6 months; Hg-28 days	Cool to 4°C
	BTU Content	100	1, 8-oz. wide-mouth glass jar(k)	100	NA	Cool to 4°C
	Ash Content	100	(1)	100(1)	NA	Cool to 4°C
	Chlorine Content	100	(1)	100(1)	NA	Cool to 4°C
	GC/IR Scan	100	(1)	100(1)	NA	Cool to 4°C
	Ignitability	100	(1)	100(1)	NA	NA
	Reactivity	100	(1)	100(1)	NA	NA
	Compatibility Tests	100	NA	NA	NA	NA
	TCLP Metals	75	1, 32-oz. wide-mouth glass jar(k)	75	NA	NA
Waste Pit Soils and Sludges	TCL Volatiles	5	2, 120-ml wide-mouth glass jars	10	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	4	1, 8-oz. wide-mouth glass jar	4	7 days to extraction; 40 days after	Cool to 4°C
	Total Arsenic, Iron	10	1, 8-oz. wide-mouth glass jar	10	6 months	Cool to 4°C
	TAL Metals	4	1, 8-oz. wide-mouth glass jar	4	6 months, Hg-28 days	Cool to 4°C
	Aniline	10	1, 8-oz. wide-mouth glass jar	10	7 days to extraction; 40 days after	Cool to 4°C
	TCLP (Metals only)	2	1, 32-oz. wide-mouth glass jar	2	NA	NA

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TABLE 2-2
SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS,
PRESERVATION REQUIREMENTS, AND HOLDING TIMES
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE ELEVEN

Matrix	Analysis	Total No. of Samples	Bottle Requirements		Holding Time	Preservation Requirements
			Per Sample	Total		
Offsite Soils (Attenuation Capacity)	Total Arsenic	464(m)	1, 80-oz. amber glass jar	26	6 months	Cool to 4°C
	Aniline	46(m)	(q)	26(q)	7 days to extraction; 40 days after	Cool to 4°C
	Tetrachloroethene	48(m)	(q)	26(q)	7 days	Cool to 4°C
	Total Arsenic	46	1, 32-oz. wide-mouth glass jar	26	6 months	Cool to 4°C
	Aniline	46	(q)	26(q)	7 days to extraction; 40 days after	Cool to 4°C
	Tetrachloroethene	48	(q)	(q)	7 days	Cool to 4°C
	Iron	6	1, 8-oz. wide-mouth glass jar	6	6 months	Cool to 4°C
	TOC	6	1, 8-oz. wide-mouth glass jar	6	28 days	Cool to 4°C
	CEC	6	1, 16-oz. wide-mouth glass jar	6	NA	Cool to 4°C
	Grain Size	6	1, 8-oz. wide-mouth glass jar	6	NA	NA

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TABLE 2-2
SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS,
PRESERVATION REQUIREMENTS, AND HOLDING TIMES
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE TWELVE

Matrix	Analysis	Total No. of Samples	Bottle Requirements		Holding Time	Preservation Requirements
			Per Sample	Total		
Photographic Anomalies: Soils	TCL Volatiles	14	2, 120-ml wide-mouth glass jars	28	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	11	1, 8-oz. wide-mouth glass jar	11	7 days to extraction; 40 days after	Cool to 4°C
	TAL Inorganics	11	1, 8-oz. wide-mouth glass jar	11	6 months; Hg-28 days	Cool to 4°C
	Aniline	40	1, 8-oz. wide-mouth glass jar	40	7 days to extraction; 40 days after	Cool to 4°C
	Total Arsenic	40	1, 8-oz. wide-mouth glass jar	40	6 months	Cool to 4°C
	TCLP (Metals only)	9	1, 32-oz. wide-mouth glass jar	9	NA	NA
Onsite Soils	TCL Volatiles	13	2, 120-ml wide-mouth glass jars	26	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	11	1, 8-oz. wide-mouth glass jar	11	7 days to extraction; 40 days after	Cool to 4°C
	TAL Inorganics	11	1, 8-oz. wide-mouth glass jar	11	6 months; Hg-28 days	Cool to 4°C
	Total Arsenic, Iron	40	1, 8-oz. wide-mouth glass jar	40	6 months	Cool to 4°C
	TCLP (Metals only)	9	1, 32-oz. wide-mouth glass jar	9	NA	NA

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TABLE 2-2
SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS,
PRESERVATION REQUIREMENTS, AND HOLDING TIMES
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE THIRTEEN

Matrix	Analysis	Total No. of Samples	Bottle Requirements		Holding Time	Preservation Requirements
			Per Sample	Total		
Offsite Soils	TCL Volatiles	15	2, 120-ml wide-mouth glass jars	30	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	13	1, 8-oz. wide-mouth glass jar	13	7 days to extraction; 40 days after	Cool to 4°C
	TAL Inorganics	13	1, 8-oz. wide-mouth glass jar	13	6 months; Hg-28 days	Cool to 4°C
	Iron, Arsenic	56	1, 8-oz. wide-mouth glass jar	56	6 months	Cool to 4°C
	TCLP (Metals only)	11	1, 32-oz. wide-mouth glass jar	11	NA	NA
1951 Pit Soils	TCL Volatiles	5	2, 120-ml wide-mouth glass jars	10	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	4	1, 8-oz. wide-mouth glass jar	4	7 days to extraction; 40 days after	Cool to 4°C
	TAL Inorganics	4	1, 8-oz. wide-mouth glass jar	4	6 months; Hg-28 days	Cool to 4°C
	Iron, Arsenic	8	1, 8-oz. wide-mouth glass jar	8	6 months	Cool to 4°C
	Aniline	8	1, 8-oz. wide-mouth glass jar	8	7 days to extraction; 40 days after	Cool to 4°C
	TCLP (Metals only)	2	1, 32-oz. wide-mouth glass jar	2	NA	NA

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TABLE 2-2
SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS,
PRESERVATION REQUIREMENTS, AND HOLDING TIMES
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE FOURTEEN

Matrix	Analysis	Total No. of Samples	Bottle Requirements		Holding Time	Preservation Requirements
			Per Sample	Total		
DDAA Storage Areas	TCL Volatiles	5	2, 120-ml wide-mouth glass jars	10	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	4	1, 8-oz. wide-mouth glass jar	4	7 days to extraction; 40 days after	Cool to 4°C
	TAL Inorganics	4	1, 8-oz. wide-mouth glass jar	4	6 months; Hg-28 days	Cool to 4°C
	Iron, Arsenic	10	1, 8-oz. wide-mouth glass jar	10	6 months	Cool to 4°C
	Aniline	10	1, 8-oz. wide-mouth glass jar	10	7 days to extraction; 40 days after	Cool to 4°C
	TCLP (Metals only)	2	1, 32-oz. wide-mouth glass jar	2	NA	NA
Drum Storage Areas Soils	TCL Volatiles	9	2, 120-ml wide-mouth glass jars or 2, 40-ml glass vials	18	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	7	1, 8-oz. wide-mouth glass jar	7	7 days to extraction; 40 days after	Cool to 4°C
	Aniline	22	1, 8-oz. wide-mouth glass jar	22	7 days to extraction; 40 days after	Cool to 4°C
	Total Arsenic, Iron	22	1, 8-oz. wide-mouth glass jar	22	6 months	Cool to 4°C
	TCLP	5	1, 32-oz. wide-mouth glass jar	5	NA	NA
	TAL Inorganics	7	1, 8-oz. wide-mouth glass jar	7	6 months; Hg-28 days	Cool to 4°C

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TABLE 2-2
SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS,
PRESERVATION REQUIREMENTS, AND HOLDING TIMES
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
PAGE FIFTEEN

Matrix	Analysis	Total No. of Samples	Bottle Requirements		Holding Time	Preservation Requirements
			Per Sample	Total		
Surface Water(n)	TCL Volatiles	7	2, 40-ml glass vials	14	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	6	1, 80-oz. amber glass	6	7 days to extraction; 40 days after	Cool to 4°C
	TAL Metals	6	1, 1-liter plastic bottle	6	6 months; Hg-28 days	HNO_3 to pH<2; Cool to 4°C
	Total Arsenic, Iron (unfiltered)	37	1, 1-liter plastic bottle	37	6 months	HNO_3 to pH<2; Cool to 4°C
	Iron, Arsenic (filtered)	34	1, 1-liter plastic bottle	34	6 months	HNO_3 to pH<2; Cool to 4°C
	Aniline	37	1, 80-oz. amber glass	37	7 days to extraction; 40 days after	Cool to 4°C
	Hardness	36	1, 1-liter plastic bottle	36	14 days	Cool to 4°C
	Suspended Solids	36	1, 1-liter plastic bottle	36	NA	NA
	pH, Eh, Temperature, Specific Conductance, Dissolved Oxygen	34	NA	NA	NA	NA
	Nitrate/Nitrite	34	1, 1-liter plastic bottle	34	14 days	Cool to 4°C
	Alkalinity	36	(o)	36(o)	14 days	Cool to 4°C
	Arsenic (unfiltered)	36	1, 1-liter plastic bottle	36	6 months	HNO_3 to pH<2; Cool to 4°C

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TABLE 2-2
SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS,
PRESERVATION REQUIREMENTS, AND HOLDING TIMES
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
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Matrix	Analysis	Total No. of Samples	Bottle Requirements		Holding Time	Preservation Requirements
			Per Sample	Total		
Sediments	TCL Volatiles	6	2, 120-ml wide-mouth glass jars	12	7 days	Cool to 4°C
	TCL B/N/A-E and Aniline	5	1, 8-oz. wide-mouth glass jar	5	7 days to extraction; 40 days after	Cool to 4°C
	TAL Inorganics	5	1, 8-oz. wide-mouth glass jar	5	6 months; Hg-28 days	Cool to 4°C
	Total Arsenic, Iron	19	1, 8-oz. wide-mouth glass jar	19	6 months	Cool to 4°C
	Aniline	13	1, 8-oz. wide-mouth glass jar	13	7 days to extraction	Cool to 4°C
	pH	20	1, 8-oz. wide-mouth glass jar	20	NA	NA
	Total Organic Carbon	21	1, 8-oz. wide-mouth glass jar	21	28 days	Cool to 4°C
	Grain Size	20	1, 8-oz. wide-mouth glass jar	20	NA	NA
	PCE	14	2, 120-ml wide-mouth glass jars	28	7 days	Cool to 4°C
	Eh	20	1, 8-oz. wide-mouth glass jar	20	NA	NA

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TABLE 2-2
SUMMARY OF ANALYSES, BOTTLE REQUIREMENTS,
PRESERVATION REQUIREMENTS, AND HOLDING TIMES
WHITMOYER LABORATORIES SITE, MYERSTOWN, PENNSYLVANIA
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Matrix	Analysis	Total No. of Samples	Bottle Requirements		Holding Time	Preservation Requirements
			Per Sample	Total		
Fish Tissue (whole body)	Arsenic	9	1, 8-oz. glass jar	9	NA	Cool to 4°C
Fish Tissue (edible tissue)	Arsenic	9	1, 8-oz. glass jar	9	NA	Cool to 4°C

ASTM American Society for Testing Materials.
EPA Methods for Chemical Analysis of Water and Wastes, March 1983.
NA Not Applicable.
TAL Target Analytes List (formerly the HSL).
TCL Target Compound List (formerly the HSL).
TOC Total Organic Carbon.

(a) Residential wells only.
(b) Includes chloride, fluoride, nitrate-N, nitrite-N, orthophosphate-P, and sulfate.
(c) All CLP analyses for waste samples can be performed with 8-oz. of material. Pack jar in paint can for shipment.
(d) Can be performed with the same thin-wall tube sample.
(e) Actual number of samples will be based on a density of 1 every 2,500 square feet.
(f) Samples to be collected with split barrel sampler, at a density of 1 sample every 2,500 square feet, if thin-wall tube cannot be used. Permeability sample will be prepared to average field density as measured by ASTM D 2922-81 and sent for analysis.
(g) Same sample jar as grain size.
(h) Samples to be collected with split barrel sampler at a density of 1 sample every 2,500 square feet, if thin-wall tube cannot be used.
(i) One test pit per lagoon/3 test pits around perimeter/2 or 3 samples per test pit. One sample per every other pit analyzed for TCL, TAL. Other samples analyzed for arsenic and iron only.
(j) Seven borings/2 or 3 samples per boring.
(k) Pack in paint cans for shipment.
(l) Same sample bottle as BTU Content.
(m) Liquid samples.
(n) Includes all three rounds.
(o) Same sample bottle as hardness.
(p) Includes opportunity samples.
(q) Same sample jar as arsenic.

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indicate that strong sample digestion procedures may be necessary to detect and quantify strongly bound organic arsenic. While routine CLP sample digestion protocols successfully yield total recoverable arsenic and provide data acceptable for risk assessment purposes, the strong sample digestion suggested by the Standard Methods Method 303E.5.d may yield a truer total arsenic contamination level in the media sampled. The data collected will permit comparison between the Standard Method method and the CLP Method and provide guidance on the selection of analytical methods to be used in treatability studies designed to ultimately meet feasibility study objectives.

In general, a four-step process was used to develop site-specific DQOs; to identify appropriate analytical protocols; and to establish Precision, Accuracy, Representativeness, Comparability, and Completeness (PARCC) requirements for each data set, as follows:

- Compare Applicable or Relevant and Appropriate Requirements (ARARs), risk-based criteria, and data needs for risk assessment, engineering, and modeling purposes to detection limits for available analytical methods.

- Select appropriate methods to allow quantification of parameters at levels sufficiently below ARARs, etc., to minimize the number of critical data points.

- Evaluate the maximum allowable variability (i.e., maximum precision and accuracy range) based on a comparison of the detection limit to ARARs, etc.

- Develop site-specific acceptable variability based on proposed data uses and method-specific precision and accuracy information.

This acceptable variability or precision and accuracy "window," was compared to historical laboratory performance data on a method-by-method basis. This comparison determined whether the standard REM III or Contract Laboratory Program (CLP) framework is sufficient, or whether more stringent precision and accuracy requirements are needed (e.g., additional matrix spikes, etc.).

PARCC parameters were reviewed as part of the DQO process. PARCC parameters are indicators of data quality. The objectives of the RI/FS and the intended use of the data needed to meet the objectives define the PARCC parameters. The following outlines the PARCC goals as they relate to the Whitmoyer Laboratories Site.

- Precision and Accuracy

  Field and laboratory precision and accuracy performance can affect the attainment of project objectives, particularly when compliance with established criteria is based on laboratory analysis of environmental samples.

Such criteria are used in risk assessment and screening of remedial alternatives. Given the uncertainties associated with the estimation of health effects and contaminant transport modeling, the following overall precision and accuracy goals are identified for most samples (low to medium concentration) to meet the project objectives:

- Precision ±50 percent RSD (Relative Standard Deviation)
- Accuracy ±50 percent recovery

For concentrated (high hazard) waste samples, broader precision and accuracy goals are identified:

- Precision ± 100 percent RSD
- Accuracy ± 100 percent recovery.

Historical laboratory precision and accuracy data were reviewed in order to select analytical method suitable for the intended data uses. The analytical methods presented in Table 2-1 were selected because the precision and accuracy of these methods are suitable for risk assessment, modeling, and/or engineering evaluations for the Whitmoyer Laboratories Site.

Analytical precision and accuracy will be evaluated upon receipt of the laboratory data. Analytical precision will be measured as the relative standard deviation of the data from the laboratory (internal) duplicates. Analytical accuracy will be measured as percent recovery from matrix and surrogate spike samples.

Overall sampling and analytical precision and accuracy will be determined using the same rationale from blind field duplicates and laboratory internal QC data.

Field sampling precision and accuracy is not easily measured. Field duplicates, field (equipment rinsate) blanks, bottle blanks, and trip blanks (as described in Table 2-1) will be used to estimate field sampling precision and accuracy. Some estimate of field sampling precision and accuracy can be inferred by contrasting the overall precision and accuracy estimates obtained from field duplicates with internal laboratory precision and accuracy estimates.

Field contamination, sample preservation and sample handling will affect precision and accuracy. By following available Field Technical Guidelines or other accepted sampling protocols, precision and accuracy errors associated with field activities can be minimized. Any deviation from standard sampling procedures must be duly noted by the sampling team to ensure correct assessment of the data obtained from the sample in question.

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No project resources will be expended to develop precision and accuracy data for method (field or analytical) validation, except those commonly applied in the CERCLA program for collection of routine QA/QC data. Routine QA/QC data will include analyses from field duplicates, equipment rinsate blanks, bottle blanks, and trip blanks based on the existing guidance that specifies the type and proportion of samples submitted for QA/QC (EPA, 1987).

Validity of data (i.e., 95 percent confidence limit) with respect to its intended use will be assessed based on laboratory-supplied QA/QC data and protocols routinely employed for validation of Contract Laboratory Program (CLP) Routine Analytical Services (RAS) and Special Analytical Services (SAS) results. In general, results that are rejected by the validation process will be disqualified from application to the intended use. If critical data points are rejected, resampling will be necessary. Qualified data will be used to the greatest extent practicable.

- Representativeness

Section 4.3 of the RI/FS Work Plan details the site sampling program and rationale for sample locations. The sampling program is designed to ensure that the data obtained during the investigation accurately represent the actual site conditions and can be used to characterize the extent of onsite/offsite contamination.

In addition to the sampling program, sampling techniques may also affect representativeness. All sampling efforts will be conducted using procedures designed to maximize the goal that the sample be representative of the media from which it was taken. To ensure data represent site conditions, standard sampling procedures will be followed.

Section 4.0 of this Field Sampling and Analysis Plan (FSAP) provides details on the technical guidelines and procedures to be used by the field personnel for conducting the RI in order to collect samples which represent actual site conditions. For example, groundwater samples will be obtained from wells only after the well has been purged of three to five well volumes to ensure that standing water is removed and that the samples are representative of aquifer water quality. Surface water and sediment sample will be collected from the intermittent streams beginning from the downstream reach and proceeding upstream. Surface water samples will be obtained before the corresponding sediment sample to prevent undue disturbance to the sediment and possible introduction of contamination into the water sample.

- Completeness

The goal of the field investigation is to obtain data of sufficient quantity and quality to meet the project goals. Each media to be sampled is critical to these goals. The amount and type of data that might be lost due to sampling and/or analytical error cannot be predicted or evaluated until the analytical results are obtained. The criticality of any lost or suspect data will be evaluated in terms of the sample location, the parameter in question, the nature of the problem, the decision to be made with the data, the risk associated with an erroneous decision, etc. If, in the analysis of the laboratory results, it becomes apparent that the data for a specific medium are inadequate (i.e., uncertainty is increased beyond acceptable levels), critical locations or parameters will be resampled. For the Whitmoyer Laboratories Site, the following are examples of critical data points:

- Residential wells (arsenic, volatile organic, and base neutral acid extractable analysis.)

- The upstream sediment sample (Tulpehocken Creek) (analyzed for volatile organics, base/neutral/acid extractables, arsenic).

- Comparability

One of the objectives of the RI is to ensure that the analytical data are of comparable quality both between sample locations and with data from previous studies of the site. The proposed data collection mechanisms proposed in Section 4 are designed to produce comparable data. To ensure comparable data, standard recognized field and analytical methodologies will be followed. Section 4.0 of the FSAP provides details on the technical guidelines and procedures to be used by the field personnel or conducting the field activities.

To ensure comparability between samples over time, consideration will be given to seasonal conditions, flow, or other environmental factors that may influence the analytical results. For example, all groundwater and surface water sample will be collected during the same time period to reduce the variability associated with environmental conditions.

The data collected by the EPA in the recent past and analyzed by CLP Protocol should be comparable to CLP analyses performed for this investigation.

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Data will be reduced, reported, and documented in a consistent manner throughout the study. For example, water and sediment quality data will be reported using a consistent set of units throughout the study. Any deviations from established protocols will be noted in the data base so that data comparability can be maintained.

3.0 SUPPORT ACTIVITIES, DOCUMENTATION, PROJECT RESPONSIBILITIES FOR RI/FS FIELD INVESTIGATION

Section 3.0 describes the support activities, project responsibilities, and documentation required to ensure that the field activities implemented during the RI field investigation meet the data quality objectives for the site. Included in Section 3.0 are summaries of the following:

- Mobilization/Demobilization.
- Field Team Personnel and Responsibilities.
- Personnel Protection.
- Sample Container Requirements, Holding Times, and Preservation Methods.
- REM III Field Technical Guidelines Listing.
- Sample Identification System.
- Equipment Decontamination.
- Sample Packaging and Shipping.
- Documentation.
- Field Audits.
- Field Changes.
- Investigative Waste Disposal.
- Field Instrumentation.

3.1 MOBILIZATION/DEMOBILIZATION

Following approval of the Work Plan and this FSAP, the REM III team will begin mobilization activities. All field team members will review the Work Plan, FSAP, HASP, and SMP. In addition, a field team orientation meeting will be held to familiarize personnel with the scope of the RI field activities.

Equipment mobilization may include, but will not be limited to the mobilization and set up of the following equipment:

- Field office trailer
- Sanitary facilities
- Utility hook-ups
- Sampling equipment
- Hydrogeologic monitoring equipment
- Health, safety, and decontamination equipment
- Subcontractor equipment

The Field Operations Leader (FOL) will coordinate the mobilization of the field office, sanitary facilities, and utility hook-ups with the necessary vendors prior to arriving on site. The FOL will also make any necessary equipment purchases in order to conduct the field investigation. REM III field personnel will supervise the locating of the field office and sanitary facilities, and the installation of electric and telephone utilities.

The equipment for the hydrogeologic monitoring, soil, groundwater, surface water, sediment, air and wipe sampling, in addition to that needed for the health and safety monitoring

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investigation, will be mobilized and transported by field technicians from REM III offices in Pittsburgh to the site. After the field activities are completed, the field technicians will demobilize the equipment and drive back to Pittsburgh.

At the end of the field investigation, the field office, sanitary facilities, and utilities will be disconnected and demobilized under supervision of the REM III field personnel. The field personnel will load all the remaining equipment from the field investigation and drive back to Pittsburgh.

The subcontractors who are awarded the contracts to perform the well drilling, soil boring, test pitting, surveying, laboratory waste sampling and bulking, and possibly treatability study programs will begin to mobilize equipment immediately after receiving notice to proceed. The subcontractors will be responsible for mobilizing and demobilizing the equipment necessary to perform the work outlined in the bid specifications.

3.2 FIELD TEAM PERSONNEL AND RESPONSIBILITIES

The overall project organization and responsibilities of key personnel are discussed in Section 6.0 of the RI/FS Work Plan and Section 2.0 of the Site Management Plan (SMP). The onsite direction of the various field activities will be the responsibility of the Sampling Team Leader(s), who will report directly to the FOL and RI Task Manager. The Health and Safety Officer (HSO) will interact with field team members as required. Section 2.0 of the SMP presents the names and responsibilities of key personnel and displays the field team organization (SMP, Figure 2-1).

3.3 PERSONNEL PROTECTION

A site-specific Health and Safety Plan (HASP) has been prepared as part of the Field Operations Plan (FOP). The HASP requires personnel protection be utilized during all of the field activities. The level(s) of protection required for the various fieldwork tasks are described in the HASP. Section 8.2 of the HASP, Personal Protection, provides additional details. Section XI of the HASP details personal decontamination procedures.

3.4 REM III FIELD TECHNICAL GUIDELINES

All work conducted under the REM III contract must be consistent and produce good quality data. Data must be precise, accurate, representative, complete, and comparable. To meet these requirements and the specific DQOs, all site activities will be conducted according to Field Technical Guidelines (FTGs) or the site-specific modifications proposed, the Health and Safety Guidelines, and the Administrative Guidelines. EPA/NIOSH-approved sampling methodology will be used for the collection of asbestos/air monitoring samples. REM III Field Technical

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Guidelines and other sampling guidelines are presented in Appendix A. Applicable REM III Field Technical Guidelines for the Whitmoyer Laboratories Site are as follows:

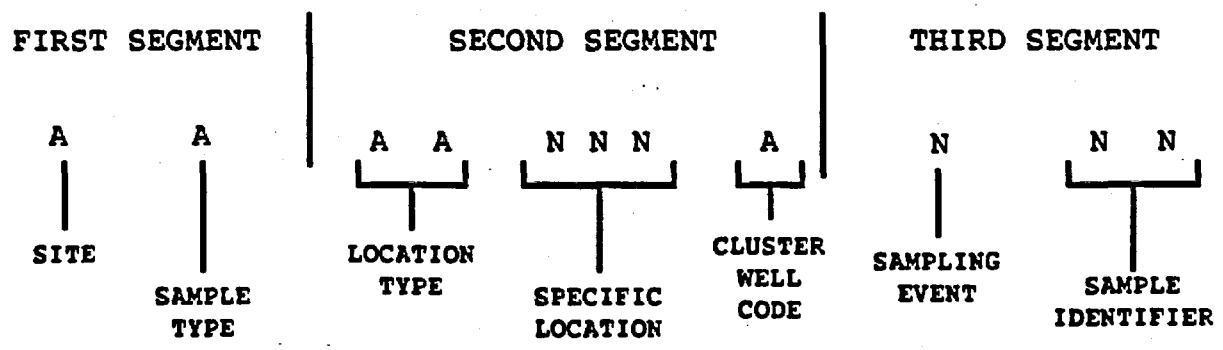
FT-6.02	Borehole and Sample Logging
FT-7.02	Groundwater Sample Acquisition
FT-7.03	Soil and Rock Sample Acquisition
FT-7.05	Sample Identification and Chain of Custody
FT-7.07	Sample Packaging and Shipping
FT-7.08	Surface Water and Sediment Sampling
FT-7.10	Onsite Water Quality Testing
FT-7.12	(Section 5.1.3) Wipe Sampling
FT-11.01	Drum Opening and Sampling
FT-11.04	Tank Sampling
FT-13.01	Preparation, Approval, and Submittal of Periodic Field Reports
FT-13.02	Forms Used in RI Activities
FT-13.03	Site Logbook
HS-1.08	Air Monitoring and Sampling

The above guidelines will be available in the field office trailer. Sample documentation, packaging and shipment for CLP samples will be performed in accordance with the "User's Guide to the Contract Laboratory Program" (December 1986).

3.5 SAMPLE IDENTIFICATION SYSTEM

Each sample taken from the Whitmoyer Laboratories Site will be assigned a unique sample tracking number. The sample tracking number will consist of a three-segment, alphanumeric code, which identifies the site, the sample type and location, the sampling event, and the specific sample (within the context of the other coding parameters). Other pertinent information regarding sample identification will be recorded in the field logbooks.

The alphanumeric coding to be used in the sample numbering system is explained in the following diagram and the subsequent definitions.



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Character Type:

A = Alpha
N = Numeric

Site:

W = Whitmoyer Laboratories Site

Sample Type:

S = Sample as required by the FSAP
D = Duplicate Sample
F = Field Blank Sample
T = Trip Blank Sample
B = Bottle Blank Sample

Location Type:

WA = Waste (includes all identified sources)
DW = Domestic Well
MW = Monitoring Well
SW = Surface Water
SD = Sediment
SO = Surface Soil
SS = Subsurface Soil
FT = Fish Tissue
FW = Fish (whole body)
WS = Wipe Sample
AS = Air Sample
RD = Roof Drainage Sample
TA = Tank Sample
DR = Drum Sample
PI = Piping Sample
TW = Tracer Sample from Monitoring Well

Specific Location:

Locations of a given type will be numbered in sequence beginning with "001." Subsurface soil samples from the test borings will be numbered by the same sequence as the monitoring well (groundwater) samples.

The monitoring well specific location sequence will begin with specific location number 101 to avoid confusion with previous monitoring well sampling efforts.

Monitoring Well Cluster Code:

An alpha code (a, b, c, . . .) will designate which monitoring well in a monitoring well cluster is being sampled. This space will be left blank for all other types of samples.

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Sampling Event:

Sampling events, or rounds, will be numbered in sequence beginning with "1." Two rounds of groundwater samples will be collected from both residential wells and monitoring wells.

Sample Identifier:

Samples for each site, location, and event will be numbered in sequence beginning with "01." This will be replaced by depths (in feet) for subsurface soil samples from borings. An example sample identification number from monitoring well 104A in the first sampling round would be:

WS-MW104A-101

A duplicate sample from the same well would be:

WD-MW104A-101

A subsurface soil sample from test boring 4 at a depth of 25 feet will be:

WS-SS-004-125

A subsurface soil sample from boring 4 at a depth of 15 feet will be:

WS-SS004-115

3.6 SAMPLE CONTAINER REQUIREMENTS, HOLDING TIMES, AND PRESERVATION METHODS

For the purposes of this section, the term "sample handling" includes the field-related considerations connected with the selection of sample containers, preservative types, allowable sample holding times, and the analyses to be requested. The EPA User's Guide to the Contract Laboratory Program (December 1986) and FT-7.07 address the topics of containers and preservation. Table 2-2 provides a site-specific summary of all sample handling consideration.

3.7 EQUIPMENT DECONTAMINATION

All nondedicated sampling equipment shall be decontaminated prior to sampling in the field and between each sample. This equipment may include scoop samplers, Kemmerer samplers, bailers, and stainless steel spoons.

The decontamination procedures are as follows:

- Potable water rinse.
- Alconox or liquinox detergent wash.
- Potable water rinse.
- Distilled/deionized water rinse.

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- Acetone or methanol rinse.
- Distilled/deionized water rinse.
- Air dry.
- Wrap in aluminum foil if small equipment. Place on clean plastic sheeting if large, only if not used immediately.

Exceptions include:

- Water level indicators, dissolved oxygen probe, conductivity probe, pH probe, Eh probe, conductivity probe, and submersible pumps. The following decontamination steps will be taken between sample points or measurements:

  - Clean that portion of the equipment which comes into contact with the media by rinsing thoroughly with deionized water.

- Filtering apparatus deconning procedures are as follows:

  - Alconox or Liquinox detergent wash.
  - Potable water rinse.
  - 10 percent nitric acid rinse.
  - Distilled/deionized water rinse.

- Split barrel samplers (soils investigations). Split barrel samplers used to collect soil samples for subsequent chemical analysis shall be deconned using the following procedures:

  - Potable water rinse.
  - Alconox or Liquinox detergent wash
  - Potable water rinse.
  - Acetone or methanol rinse.
  - Distilled/deionized water rinse.

- Aquatic biota sample processing equipment. Aquatic biota sample processing equipment, e.g., fish filleting knives, used to collect aquatic biota samples for subsequent chemical analysis shall be deconned using the following procedures:

  - Potable water rinse

  - Alconox or liquinox detergent wash

  - Potable water rinse

  - Distilled water rinse

  - Dilute nitric acid rinse (if heavy metals are suspected)

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- Distilled water rinse

- Wrap equipment in aluminum foil or place large equipment on aluminum foil or plastic sheets

Note: Since no aquatic biota samples will be analyzed for organic chemicals, the processing equipment will not be subjected to a hexane (or methanol) rinse step.

3.8 SAMPLE PACKAGING AND SHIPPING

Samples will be packaged and shipped in accordance with the EPA User's Guide to the Contract Laboratory Program. The Field Operations Leader (FOL) will be responsible for contacting the EPA Sample Management Office (SMO) for each shipment of samples and will report the following:

- Sampler name and telephone number.
- Case number and/or SAS number of the project.
- Site name/code
- Batch number.
- Exact number(s), matrix(ces), and concentration(s) of samples shipped.
- Laboratory(ies) to which samples were shipped.
- Carrier name and air bill number(s) for the shipment.
- Method of shipment (e.g., overnight, 2-day).
- Date of shipment.
- Suspected hazards associated with the samples or site.

3.9 DOCUMENTATION

Custody of samples must be maintained and documented at all times. Chain-of-custody begins with the collection of the samples in the field. Section C of Chapter 3 in the EPA User's Guide to the Contract Laboratory Program provides a description of the chain-of-custody requirements to be followed. An example of the chain-of-custody record is included in Appendix B.

In addition to the EPA-required CLP documentation and Quality Assurance (QA) of samples, certain standard forms will be completed for REM III Program sample description and documentation. These shall include the well sampling data sheet (for water samples taken from monitoring wells) and the sample logbook, which contains sample log sheets for all samples collected. An example of these forms can be found in REM III Guideline FT-13.02.

A bound/weatherproof field notebook shall be maintained by the field team. The field team leader, or designee, shall record all information related to sampling or field activities. This information may include sampling time, weather conditions, unusual events (well tampering), field measurements, etc.

A site logbook shall be maintained by the Field Operations Leader. The requirements of the site logbook are outlined in

REM III Guideline FT-13.03. This book will contain a summary of the day's activities and will reference the field notebooks when applicable.

Each field team leader who is supervising a subcontractor activity must complete a Daily Record Subsurface Investigation Report (DRSIR). A Weekly Field Summary Report (WFSR) will be completed for all subcontractor activities. The DRSIR documents the activities and progress of the daily drilling activities. The information contained within this report is used for billing verification and progress. The drillers signature is required at the end of each working day to verify hours worked, standby time, and material used. The WFSR summarizes the major activities onsite for a particular week. The DRSIR and WFSR will be sent to the Site Manager at the end of each week. An example of both forms is provided in Appendix B.

Chain-of-custody forms, laboratory results, raw data, etc. will be stored in REM III project files.

At the completion of field activities, the FOL shall submit to the Site Manager (SM) all field records, data, field notebooks, logbooks, chain-of-custody receipts, sample log sheets, drilling logs, daily logs, etc. The Site Manager shall ensure that these materials are entered into the REM III Program document control system in accordance with the Program Administrative Guidelines (PA-5).

3.10 FIELD AUDITS

A QA performance audit may be performed by a designated QA Specialist during the Remedial Investigation. The audit will include checks on adherence to the sampling protocols. Deviations from this FSAP shall be documented in the site logbook and a copy of the Field Change Request form should be available for the QA Specialist to review.

3.11 FIELD CHANGES

Changes in field operating procedures may be necessary as a result of changed field conditions or unanticipated events. Section 15.6 of the REM III Guidelines Quality Assurance Project Plan provides a detailed description of the procedures to be followed in the event of implementing field changes. A summary of the sequence of events associated with field changes is as follows:

- The FOL notifies the SM of the need for the change.
- If necessary, the SM will discuss the change with the pertinent individuals (e.g., EPA Region III RPM) and will provide a verbal approval or denial to the FOL for the proposed change.

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- The FOL will document the change on a Field Change Request form and forward the form to the SM at the earliest convenient time (e.g., end of the work week).

- The SM will sign the form and distribute copies to the Regional Manager, Quality Assurance Manager, Field Operations Leader, and the project file.

- A copy of the completed Field Change Request form will also be attached to the file copy of the affected document (e.g., WP, FSAP, SMP, HASP).

A Field Change Request form is located in the REM III Quality Assurance Project Plan and is to be completed whenever field changes are anticipated.

3.12 INVESTIGATIVE WASTE DISPOSAL

Onsite drilling cuttings will be returned to the ground where they were generated. Offsite drilling cuttings will be returned to the site for storage. Monitoring well purge water, and spent decontamination water will be collected on site. Currently, it is anticipated that some of this water will be discharged either to the Myerstown sewer system or to Tulpehocken Creek without pretreatment, while more contaminated water will be hauled offsite for subcontractor treatment and/or disposal.

3.13 FIELD INSTRUMENTATION

Numerous monitoring instruments will be used during activities and may include the following:

- Dissolved oxygen probe (every day of use)
- Temperature probe (every day of use)
- Specific conductance meter (every day of use)
- pH meter (every day of use)
- Eh meter (every day of use)
- Photoionization meter (every third day of use)
- Organic vapor analyzer (every third day of use)
- Electronic water level meter (every week of use)
- Nuclear Densometer (per manufacturer's recommendations)

Each device will be calibrated at a frequency as noted in parentheses above according to the manufacturer's operating manual. Calibration will be documented on an Equipment Calibration Log (Appendix B). During calibration, an appropriate maintenance check will be performed on pertinent components of equipment. If damaged or failed parts are identified during the daily maintenance check, and it is determined that the damage could have an impact on the instrument's performance, the instrument will be removed from service until the identified parts are repaired or replaced.

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4.0 FIELD OPERATIONS

The field investigation to be conducted at the Whitmoyer Laboratories Site will include the following activities.

- Mobilization/Demobilization
- Existing Monitoring Well Evaluation
- Monitoring Well Drilling/Installation
- Subsurface Soil Sampling
- Surface Soil Sampling
- Vault and Lagoon Sampling
- Surface Water and Sediment Sampling
- Biota Sampling
- Groundwater Sampling
- Drum and Tank Sampling
- Process Building Sampling

Activities which are to be performed during several of the individual site investigations are described in Sections 4.1.1 through 4.1.5. Activities specific to a particular source or media are described in the individual section corresponding to that source or media.

4.1 GENERAL FIELD ACTIVITIES

4.1.1 Monitoring Well Drilling/Installation/Sampling

Three types of monitoring wells are proposed for the Whitmoyer Laboratories Site field investigation: shallow, medium depth, and deep monitoring wells. Shallow monitoring wells will be used to monitor the first water-bearing zone encountered (excluding perched water zones) and are designed to provide information regarding shallow groundwater quality and flow directions. These wells are expected to average approximately 30 to 40 feet in depth. Medium-depth monitoring wells are designed to provide water quality data for the deeper, well developed flow zone identified in regional studies (see Work Plan) within the 70- to 80-foot depth interval. An examination of available boring logs for site-related monitoring wells reveals that slight increases in the number of fractures encountered occurred within the depth intervals of 50 to 60 and 75 to 100 feet. Based on this information, medium depth monitoring wells are expected to range from 60 to 100 feet in depth. Deep monitoring wells are proposed to obtain water quality data from flow zones less affected by local recharge/discharge conditions and provide information regarding possible alterations in groundwater flow directions between shallow, local flow systems and a deeper, more regional flow system. As fractures are generally more infrequently encountered with increasing depth, the projected average depths of the deep monitoring wells are difficult to predict with any degree of accuracy, however, it is expected that the wells will range from approximately 150 to 250 feet in depth.

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Thirty onsite monitoring wells and 22 offsite monitoring wells, including an estimated five rehabilitated wells, are planned for the field investigation. Tables 4-1 and 4-2 summarize the well installation program. Figures 4-1 and 4-2 show onsite and offsite monitoring well locations, respectively.

All monitoring well borings will be drilled using air rotary or air hammer drilling methods. Shallow monitoring well borings will be drilled through the overburden and approximately 3 to 5 feet into rock (nominal 8-inch diameter boring), then 6-inch-diameter black steel casing will be set and cement grouted into place. After allowing the grout to set up overnight, the boring will be continued into bedrock (minimum 5-5/8-inch diameter boring) until a significant water-yielding fracture or set of fractures (approximately 2+ gpm, field estimate) is encountered. Once an adequate water-yielding zone is encountered, the boring will be terminated and left as an open borehole monitoring well. Exceptions to this drilling/well construction method may occur adjacent to Tulpehocken Creek, where an increased overburden thickness may result in the water table being encountered above bedrock. In this case, a 2-inch-diameter PVC well will be constructed in the well boring, screened across the water table. Well screens will be 5 to 10 feet in length, with a 0.020-inch slot size. An appropriately sized sand pack (Number 20-30 U.S. Sieve Size) will be emplaced around and to 2 feet above the screen. A minimum 2-foot thick bentonite pellet seal will be set above the sand pack and allowed to hydrate, then the remainder of the annulus will be backfilled with a cement-bentonite grout, emplaced using a tremie pipe. The installation of 6-inch-diameter steel temporary casings may be required in overburden well borings, to prevent caving of the borehole sides during the PVC well installation process. The temporary casing will be removed after well installation is completed.

The depths of all backfill materials will be constantly monitored during the well installation process by means of a weighted stainless steel or plastic tape.

Medium depth and deep monitoring well borings will, as described previously, be drilled using air rotary or air hammer drilling methods. An 8-inch borehole will be drilled to a depth of 60 feet for medium depth wells, then 6-inch diameter casing will be set and grouted into place to seal off shallow water bearing zones. After allowing the grout to set up overnight, the boring will be continued (minimum 5-5/8-inch diameter boring) down until a water bearing fracture zone is encountered, then the boring will be terminated and left as an open borehole well. Deep monitoring well drilling/installation techniques will be similar to the procedure described for medium-depth wells, except that the 8-inch diameter boring will be drilled to a depth of 150 feet, then steel casing set and the boring continued as described for medium-depth wells.

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TABLE 4-1

PROPOSED ONSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE

Well No.	Depth	Const. Type	Purpose									Notes
			Vault Invest.	Lagoon Invest.	Process Bldgs. Invest.	Misc. Storage/ Dumping Area Invest.	Water Quality	Shallow GW Flow Directions	Vertical Gradients	SW/GW Inter-actions	Deep GW Flow Directions	
MW-100A	S	PVC	X				X	X	X	X		Along north wall of vault, near standpipe with maximum water-level fluctuations. Determine leakage from vault in NW vault corner.
MW-100B	M	OB	X				X		X	X		Adjacent to MW 100A; deeper water quality. Determine vertical flow gradient near vault and canal.
MW-101A	S	PVC	X				X	X		X		Along north wall of vault, east of MW-100A and MW-100B; water quality downgradient of vault, local flow directions. Determine leakage fro vault in NE corner.
MW-102A	S	OB	X				X	X				Along south wall of vault; water quality upgradient of vault, local flow directions. Determine contaminant contribution to groundwater flowing under the vault from lagoons.
MW-103A	S	OB		X			X	X	X			West of western lagoon area; water quality along west edge of site; influence of quarry pumping.

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TABLE 4-1
PROPOSED ONSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
PAGE TWO

Well No.	Depth	Const. Type	Purpose									Notes
			Vault Invest.	Lagoon Invest.	Process Bldgs. Invest.	Misc. Storage/ Dumping Area Invest.	Water Quality	Shallow GW Flow Directions	Vertical Gradients	SW/GW Inter-actions	Deep GW Flow Directions	
MW-103B	M	OB		X			X		X			Adjacent to MW-103A. Check for influence of quarry pumping deeper in aquifer, water quality.
MW-104A	S	OB		X			X	X		X		Downgradient of western lagoon area.
MW-105A	S	OB				X	X	X	X			In southwest corner of property, near area of standing liquid in 1969 photograph.
MW-105B	M	OB				X	X		X			Adjacent to MW-105A. Determine vertical gradients and deeper groundwater quality.
MW-106A	S	OB		X			X	X				Upgradient of eastern lagoon area; paired with existing well No. 1 to provide shallow/medium depth well cluster.
MW-107A	S	OB		X			X	X	X			Downgradient of eastern lagoon area. Determine shallow groundwater contamination.
MW-107B	M	OB		X			X		X			Adjacent to MW-107A. Determine vertical distribution of contamination, vertical flow gradients.

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TABLE 4-1
PROPOSED ONSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
PAGE THREE

Well No.	Depth	Const. Type	Purpose									Notes
			Vault Invest.	Lagoon Invest.	Process Bldgs. Invest.	Misc. Storage/ Dumping Area Invest.	Water Quality	Shallow GW Flow Directions	Vertical Gradients	SW/GW Inter-actions	Deep GW Flow Directions	
MW-107C	D	OB		X			X		X		X	Adjacent to MW-107A and MW-107B. Determine vertical distribution of contaminants, vertical flow gradients, deep groundwater flow directions.
MW-108A	S	PVC			X		X	X		X		Downgradient of Building 9 (maintenance garage) and related cesspool. Check for building-related groundwater contamination.
MW-109A	S	OB			X		X	X	X	X		Downgradient of Building 11 and laboratory cesspool. Primary focus on releases from laboratory cesspool.
MW-109B	M	OB			X		X		X	X		Adjacent to MW-109A; deeper water quality in potential former localized recharge area (cesspool); vertical gradients.
MW-110A	S	OB				X	X	X	X			Along south edge of site; upgradient water quality. Check for induced migration to south due to pumping of industrial well 1,500 feet south of site.

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TABLE 4-1
PROPOSED ONSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
PAGE FOUR

Well No.	Depth	Const. Type	Purpose									Notes
			Vault Invest.	Lagoon Invest.	Process Bldgs. Invest.	Misc. Storage/ Dumping Area Invest.	Water Quality	Shallow GW Flow Directions	Vertical Gradients	SW/GW Inter-actions	Deep GW Flow Directions	
MW-110B	M	OB				X	X		X			Adjacent to MW-110A. Determine vertical gradients in south site area. Check for induced flow to south.
MW-110C	D	OB				X	X		X		X	Adjacent to MW-110A. Deep groundwater quality; will be used with MW-107C and MW-117C to determine deep groundwater flow directions.
MW-111A	S	OB				X	X	X				Downgradient of drum storage area and potential waste dumping/burial area, which are two significant potential sources of contamination.
MW-112A	S	OB			X	X	X	X				South of Building 8 and potential waste disposal/burial area.
MW-113A	S	OB				X	X	X	X			South of Building 10. Located between process buildings area and residential wells south of site containing high levels of contaminants.

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TABLE 4-1
PROPOSED ONSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
PAGE FIVE

Well No.	Depth	Const. Type	Purpose									Notes
			Vault Invest.	Lagoon Invest.	Process Bldgs. Invest.	Misc. Storage/ Dumping Area Invest.	Water Quality	Shallow GW Flow Directions	Vertical Gradients	SW/GW Inter-actions	Deep GW Flow Directions	
MW-113B	M	OB			X	X	X		X			Adjacent to MW-113A. Check for potential for deeper contaminants to be migrating south to residential wells due to pumping of industrial well south of site.
MW-114A	S	OB			X		X	X				Downgradient of Building 10, upgradient of existing well No. 7 (highly contaminated).
MW-115B	M	OB				X	X		X			Adjacent to existing well No. 7. Determine deeper groundwater quality, vertical gradient.
MW-116A	S	OB				X	X	X	X			Adjacent to existing well No. 4 (315-foot-deep wastewater injection well; highly contaminated). Determine shallow groundwater quality.
MW-117A	S	PVC			X	X	X	X	X	X		Downgradient of waste pit located Adjacent to Building 6; major potential source area for arsenic and organics.
MW-117B	M	OB			X	X	X		X	X		Adjacent to MW-117A. Check for vertical migration of contaminants (waste pit may have been a local groundwater recharge area during past operations).

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TABLE 4-1
PROPOSED ONSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
PAGE SIX

Well No.	Depth	Const. Type	Purpose									Notes
			Vault Invest.	Lagoon Invest.	Process Bldgs. Invest.	Misc. Storage/ Dumping Area Invest.	Water Quality	Shallow GW Flow Directions	Vertical Gradients	SW/GW Inter-actions	Deep GW Flow Directions	
MW-117C	D	OB			X	X	X		X	X	X	Deep groundwater quality downgradient of both waste pits and deep injection well (well No. 4), combined with MW-107C and MW-110C to determine deep groundwater flow directions.
MW-118A	S	PVC			X		X	X		X		Downgradient of Buildings 1, 2, and 6 (major chemical processing buildings); may have to be placed across canal from buildings because of access restrictions.

S Shallow
M Medium
D Deep

SW Surface Water
GW Groundwater

OB Open Borehole Monitoring Well
PVC PVC Monitoring Well

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TABLE 4-2

PROPOSED OFFSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE

Well No.	Depth	Const. Type	Direction From Site	Purpose					Notes
				Water Quality	GW Flow Directions	Vertical Gradients	Secondary Source Area I.D.	SW/GW Inter-actions	
MW-201A	S	OB	W	X	X	X			Between site and quarry to the west. Provide data regarding influence of quarry pumping on groundwater flow directions and contaminant migration from site.
MW-201B	M	PVC	W	X		X			Between site and quarry to the west. Provide data regarding influence of quarry pumping on groundwater flow directions and contaminant migration from site.
MW-201C	D	PVC	W	X	X	X			Between site and quarry to the west. Provide data regarding influence of quarry pumping on groundwater flow directions and contaminant migration from site. Check to see if quarry is deep groundwater discharge point.
MW-202A	S	OB	S	X	X	X	X		Between site and contaminated wells to the south. Determine whether plant south of site may be potential secondary contaminant source area.
MW-202B	M	PVC	S	X		X	X		Between site and contaminated wells to the south. Determine whether plant south of site may be potential secondary contaminant source area.
MW-203B	M	PVC	S	X	X		X		Determine water quality south of the plant/contaminated residential well area.
MW-204A	S	OB	N	X	X	X			Determine water quality between site and residential area to the north.
MW-204B	M	PVC	N	X		X			Determine water quality between site and residential area to the north.
MW-205A	S	OB	N	X	X	X		X	Near ponds northeast of site. Determine whether site groundwater is migrating to ponds. Determine whether groundwater is discharging to ponds.

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TABLE 4-2
PROPOSED OFFSITE MONITORING WELL INSTALLATION PROGRAM
WHITMOYER LABORATORIES SITE
PAGE TWO

Well No.	Depth	Const. Type	Direction From Site	Purpose					Notes
				Water Quality	Shallow GW Flow Directions	Vertical Gradients	Secondary Source Area I.D.	SW/GW Inter-actions	
MW-205B	M	PVC	N	X		X		X	Near ponds northeast of site. Determine whether site groundwater is migrating to ponds. Determine whether groundwater is discharging to ponds.
MW-206A	S	OB	E	X	X	X		X	Located in area where inferred fault crosses Tulpehocken Creek. Check for concentration of contaminants in fault zone.
MW-206B	M	PVC	E	X		X		X	Located in area where inferred fault crosses Tulpehocken Creek. Check for concentration of contaminants in fault zone.
MW-207A	S	OB	E	X	X	X		X	Adjacent to large pond east of Myerstown. Determine water quality and groundwater/surface water interactions in the pond vicinity.
MW-207B	M	PVC	E	X		X		X	Adjacent to large pond east of Myerstown. Determine water quality and groundwater/surface water interactions in the pond vicinity.
MW-207C	D	PVC	E	X		X		X	Adjacent to large pond east of Myerstown. Determine water quality and groundwater/surface water interactions in the pond vicinity. Check to see if pond is deep groundwater discharge point.
MW-208A	S	OB	E	X	X	X		X	Adjacent to large pond near Millardsville. Determine whether contaminant plume has reached Millardsville area.
MW-208B	M	PVC	E	X		X		X	Adjacent to large pond near Millardsville. Determine whether contaminant plume has reached Millardsville area.

S - Shallow
M - Medium
D - Deep

OB - Open Borehole Monitoring Well
PVC - PVC Monitoring Well

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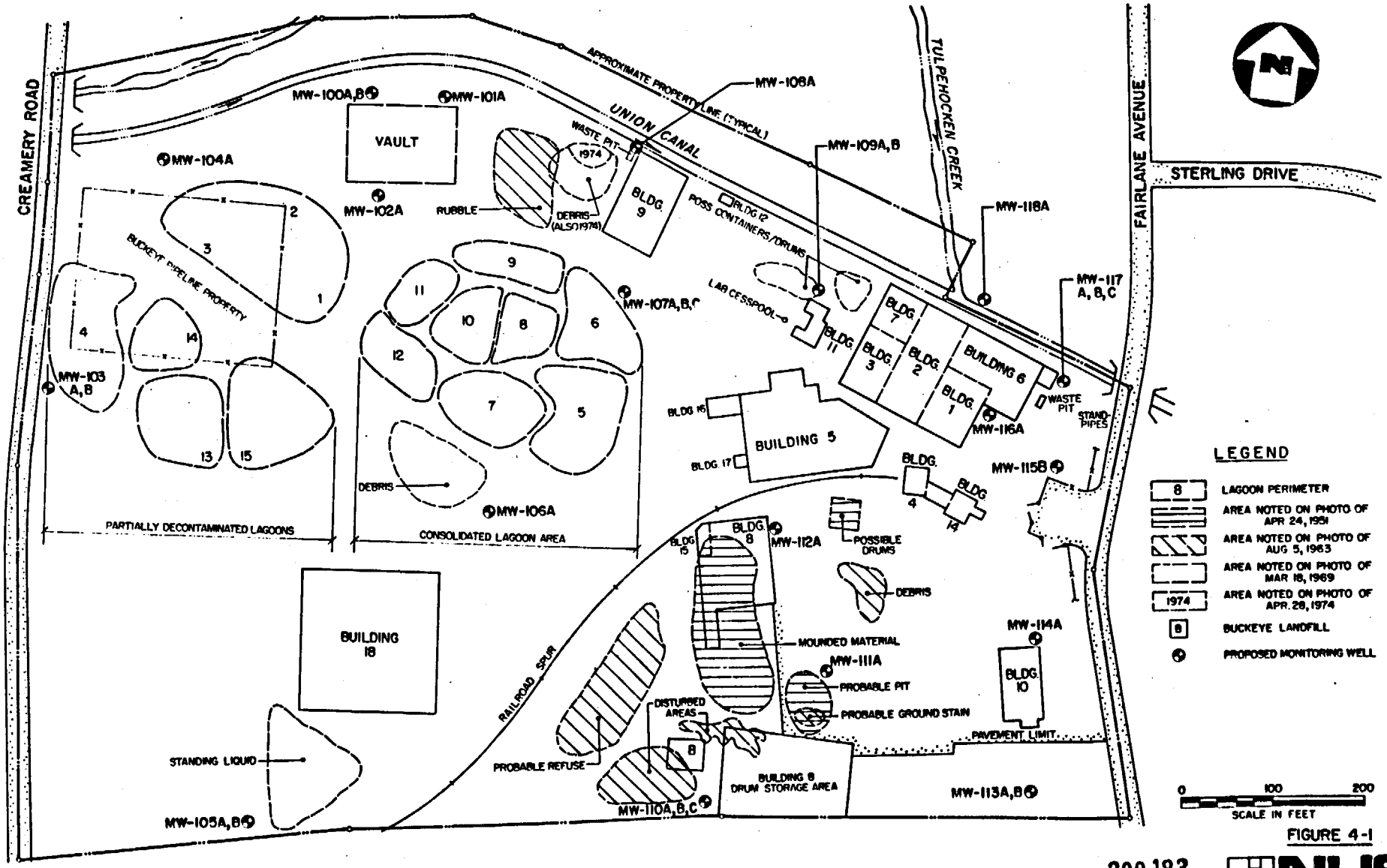

FIGURE 4-1

PROPOSED ONSITE MONITORING WELLS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

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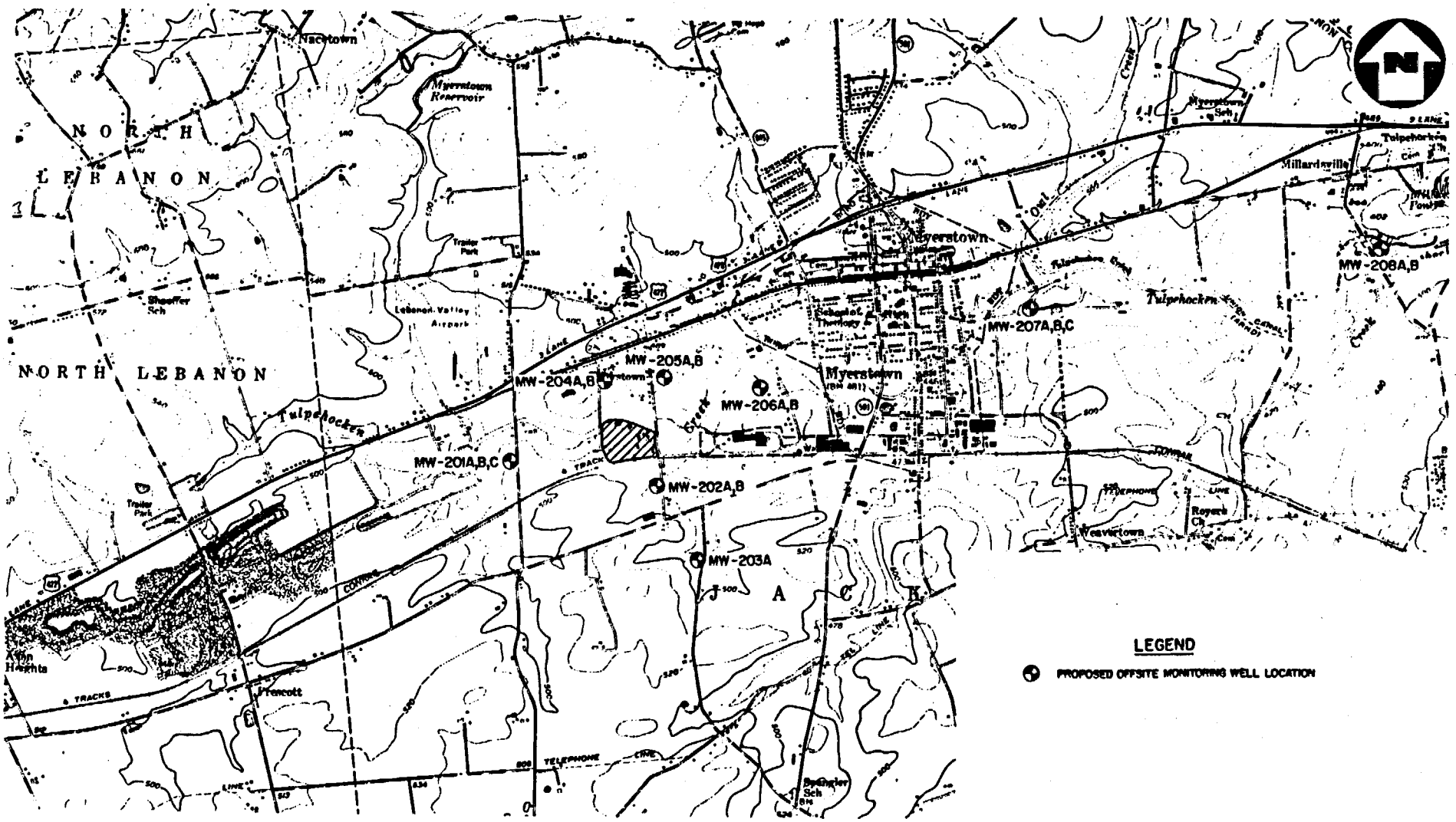

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FIGURE 4-2

PROPOSED OFFSITE MONITORING WELL LOCATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

0 2000 4000
SCALE IN FEET

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Protective steel casing equipped with locking steel caps will be installed around PVC wells. These casings will be grouted a minimum of 3-feet into the ground and will have at least one drain hole. In addition, a cement apron will be built up around the casing to prevent standing water around the well. Locking caps will be installed on the steel casings for open borehole wells. Keyed-alike locks will be supplied for all wells. After installation, the ground surface, the top of the riser pipe, and the top of the protective casing will be surveyed to within 0.01 foot vertical accuracy. In addition, the well will be measured to within 1.0 foot horizontal accuracy. Monitoring well construction details are illustrated in Figure 4-3.

Monitoring well borings will be logged through inspection of rock cuttings and observations of drilling conditions. A boring log will be completed for each boring drilled. At a minimum, the following information will be noted:

- Color
- Hardness (estimated)
- Lithologic/Mineralogic description
- Depths of fractures/voids
- Estimated water yields of fractures/voids

In addition, depths of lithologic contacts, depth of borehole, and drilling method descriptions should be included on each boring log, as well as any other pertinent observations. An example boring log is provided in Appendix B.

A well construction diagram will be completed for each monitoring well installed. Example monitoring well construction diagrams are provided in Appendix B.

Well Development

Monitoring wells will be developed after installation to remove sediments, drill cuttings, and residual drilling fluids from the area around the monitored interval of the boring. Wells will be developed by air lift, bailing and surging, or by pumping, as determined by the field geologist. Wells will be developed until water removed is visibly clear of suspended solids or until approved by the field geologist. Development water will be collected and containerized in 55-gallon drums (DOT Specification 17) or bulk storage containers for transport to a designated onsite storage area, or discharged with EPA/State approval.

Groundwater Sampling

Groundwater samples will be collected in accordance with FT-7.02 Sections 5.4.2 and 5.5.2 (exceptions as noted in Appendix A).

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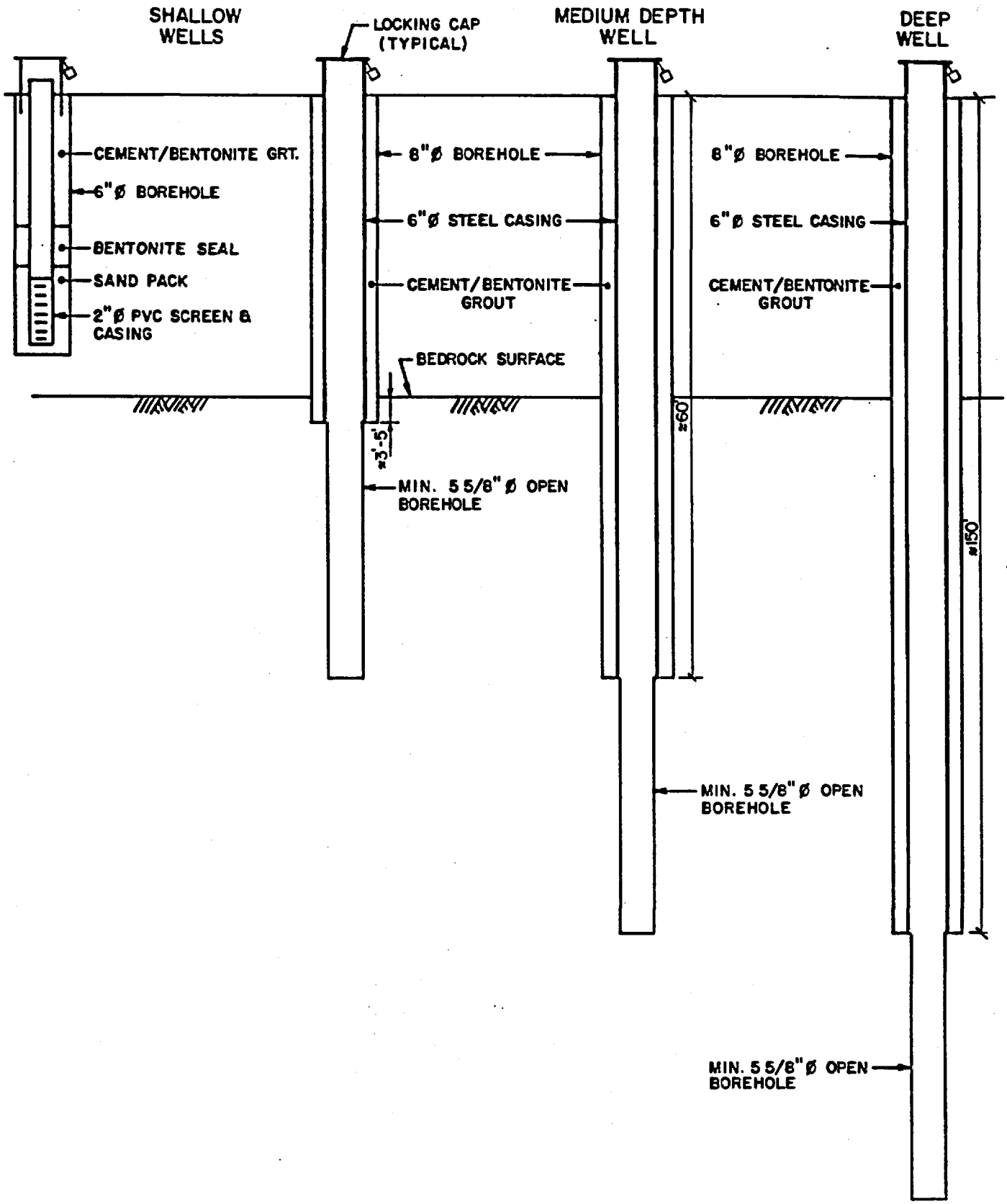

FIGURE 4-3

PROPOSED WELL CONSTRUCTION DETAILS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

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Prior to obtaining groundwater samples, the wells shall be purged using decontaminated stainless-steel bailers, surface pumps, or submersible pumps, depending on the depth of the well and the volume to be evacuated. The evacuation device will be placed just below the water table and lowered as the water level decreases to insure that stagnant water is removed. Conductivity, pH, and temperature will be measured on each volume of water removed. Three to five volumes will be removed, based on the consistency of the above measurements indicating that stagnant water has been removed and representative water of the aquifer of interest is present.

Volumes will be calculated by the formula $V = \pi r^2 h \times 7.48$ gallons/cubic foot, where V = volume, $\pi = 3.14$, r = radius of well in feet, h = total depth of well (feet) minus water level (feet) (water levels will be taken prior to purging). Once three to five volumes have been removed from the well, a deconned stainless steel bailer tied to polyethylene rope will be lowered into the well to obtain the water sample and placed into the appropriate sample bottles indicated in Table 2-2. If a well is purged to dryness with less than three to five volumes removed then the well, it will be allowed to recover to approximately 70 percent of the initial water level, then sampled. Sampling data will be recorded on the groundwater sampling sheet shown in Appendix B.

Residential well samples shall be collected using the following procedures:

- Obtain the well depth, casing size, and holding tank volume. Calculate the volume of water in the system as follows:

  Well volume (gallons) = π x (radius of well casing in feet)^2 x (feet of water standing in the well) x (7.48 gallons/feet^3)

  Total water volume (gallons) = well volume + holding tank volume.

- If a tap is available between the well head and the holding tank, purge three to five volumes from the system. If no tap is available, purge the total water volume calculated above from the system plus two additional well volumes. If information concerning well depth or holding tank volume is not available, purge the well for 15 minutes.

- Collect the sample from the tap closest to the well head, before the water is processed through any water-treatment devices. If it is not possible to sample before a treatment device, note this in the sample notebook. Do not take the sample from the garden hose.

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Note: Some well owners may be reluctant to allow their water to run for the period of time involved in purging three well volumes. Community relations considerations must be weighted against the need to obtain a representative sample, with the sampler having to make a judgment as to what actions should be taken. Exact times of purging must be recorded.

Field blanks (a.k.a. equipment rinsate blank) will be obtained under representative field conditions by running analyte-free deionized water through sample collection equipment (bailer) after decontamination and placing it is the appropriate sample containers for analysis. These samples are used to determine if decontamination procedures are sufficient.

Bottle blanks will be prepared in the field by pouring analyte-free deionized water into a set of sample collection bottles. They serve as an oversight function in assessing the effect of residual contamination in the sample collection bottle.

Trip blanks (volatiles only) will be prepared in the laboratory (or in the field, in an area outside of the zone of contamination) prior to the sampling event. Analyte-free deionized (HPLC) water is poured directly into the sample jar and then packaged for shipment with other samples. At no time after their preparation are trip blanks opened before they reach the laboratory.

Decontamination

All downhole drilling/sampling/testing equipment and the back end of the drilling rig must be steam cleaned prior to beginning monitoring well drilling/installation work, between each boring, any time the drill rig leaves the site prior to finishing a boring, and at the conclusion of the drilling program. Decontamination operations will consist of washing equipment using a high-pressure steam wash. Monitoring well casing and screens must also be decontaminated as described above, prior to installation (unless NSF-approved PVC pipe and screen is used - no decontamination required). Decontamination will occur in a designated area to be determined during mobilization activities. Equipment decontamination is also discussed in Section 3.7.

Aquifer Testing

Monitoring wells will be used for aquifer testing to determine the groundwater flow conditions in the water-bearing zones investigated by each well. Thirty of the 47 newly-installed monitoring wells will be tested. The wells to be tested will be selected in the field and will be chosen to provide data representative of observed variations of conditions. The data generated from these tests will be used to define the water-yielding characteristics of each formation, develop groundwater velocity values, and estimate the rate of

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groundwater movement across and away from the site. It is expected that slug tests and/or short-term pumping tests will be performed in the selected monitoring wells and evaluated using the most appropriate evaluation technique for each type of test and set of hydrogeologic conditions. Pressure transducers and data loggers will be used for data collection, where appropriate, to obtain the most accurate field data possible.

At a minimum, the following information will be collected for each well (when applicable) during performance of aquifer tests:

- Well number/depth/screened-open interval/diameter
- Static water level
- Pumping rate (for pump tests)
- Method of inducing water level change (for slug tests)
- Time/drawdown-recovery data in tested wells (and observation wells, if used)
- Distance from pumping well (for observation wells during pumping tests)
- Total time of test

Data generated by the tests will be documented on the appropriate data sheets and analyzed for the determination of aquifer characteristics. Example data sheets are provided in Appendix B.

Water Level Monitoring

At least two complete rounds of water levels will be obtained from the newly installed monitoring wells and staff gauges. Staff gauges will be installed directed above, adjacent to, and below the site in Tulpehocken Creek, in the canal adjacent to the site, and in the ponds located adjacent to monitoring well locations MW-205, MW-207, and MW-208. The staff gauges may be convenient permanent measuring points (bridges, etc.) or a stake driven into the pond sediments near the shoreline. All measurements for each collection round will be collected within a 24-hour period of consistent weather conditions to minimize atmospheric/ precipitation effects on groundwater conditions. Measurements will be taken with an electrical water level indicator (such as an M-Scope), steel tape, or popper, using the top of the well casing as the reference point for determining depths to water. Water level measurements will be recorded to the nearest 0.01 foot. The measuring device will be decontaminated between wells by cleaning the portion of the device which comes into contact with liquid contained in the monitoring well with methanol followed by deionized water. Any existing wells for which monitored intervals can be determined

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will be evaluated, and, if determined usable, a water level measurement taken.

Reporting

The following reports and documentation will be the responsibility of the field geologist during drilling activities. A copy of applicable forms that will be used by the site geologist are located in Appendix B.

Site Logbook - See REM III Program Guidelines FT-13.03.

Daily Shift Report - See Appendix B.

Boring Log - See Appendix B.

Overburden Monitoring Well Sheet - See Appendix B.

Bedrock Monitoring Well Sheet, Well Installed in Bedrock - See Appendix B.

Bedrock Monitoring Well Sheet, Open Hole Well - See Appendix B.

Data Sheet for Pumping Tests - See Appendix B.

Data Sheet for Slug Tests - See Appendix B.

Groundwater Level Measurement Sheet - See Appendix B.

Weekly Field Summary Report - See REM III Program Guideline 13.01, Attachment C.

The field geologist's logbook shall contain information about the drilling activities, such as start/finish times, standby times, and problems or changes encountered during drilling. Drilling/monitoring well construction information (i.e., footage drilled, depth of casing, etc.) will be recorded daily on the boring log and the overburden monitoring well sheet. The boring log, along with the geologist's logbook, will be used to prepare the Daily Record-Subsurface Investigation Report. This report will identify drilling activity and quantities of material used on a daily basis, and shall be signed by the drill foreman (or equivalent) and the site geologist. The reports shall be submitted to the Site Manager at the end of each well. These reports are also used to fill out the Daily Logbook.

4.1.2 Subsurface Soil Sampling

Subsurface soil samples will be obtained from test borings and test pits during the field investigation. The subsurface soil samples will be used to determine the extent of contaminated subsurface soils and to characterize any subsurface wastes encountered in disposal areas. The following subsections describe general subsurface soil sampling activities.

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4.1.2.1 Test Boring Drilling/Sampling

Test borings will be drilled both on and off site at selected locations according to the investigation plans described in the project Work Plan. The test borings will be used to provide subsurface soil samples for chemical analysis, to determine whether soils are a significant potential source of groundwater contaminants, and to determine the approximate extent of contaminated soils for use in evaluating feasibility study alternatives which may include soil excavation/treatment/ disposal. A total of 55 onsite and 22 offsite test borings are planned for the field investigation, located as indicated in Figures 4-4 and 4-5. Detailed descriptions of test boring activities are provided in the various investigation discussions presented later in Section 4. This subsection describes the overall methodology to be used in drilling and sampling test borings.

Test borings will be drilled using hollow stem augers. Borings will be extended to bedrock, then terminated and backfilled. Soil samples will be obtained continuously throughout the total depth of each boring. Unless otherwise specified, soil sampling will be performed using large diameter (3-inch O.D.) split-barrel samplers. Thin-walled (Shelby) tube sampling (ASTM-D-1587-83 [Sections 6.0 and 7.0], see Appendix C) may be required in certain instances.

A complete log of each test boring will be maintain by REM III, using the information in FT-6.02 (Sections 5.1 and 5.2, exceptions as noted in Appendix A) as a reference. Appendix B contains an example of the boring log description form.

At a minimum the boring log will contain the following information, when applicable, for each test boring:

- Sample numbers and types
- Sample depths
- Number of blows required to drive sampler each 6-inch interval
- Sample recovery/sample interval
- Soil density or cohesiveness
- Soil color
- USCS material description and symbol

In addition, depths of changes in lithology, sample moisture observations, depth to water, OVA/HNU readings (if taken), drilling methods, and total depth of each borehole should be included on each log, as well as any other pertinent observations that may be made.

All soil samples from each test boring will be consecutively numbered on the corresponding boring log, starting with S-1. Soil samples to be sent for chemical analysis will also be numbered based on the procedure described in Section 3.5.

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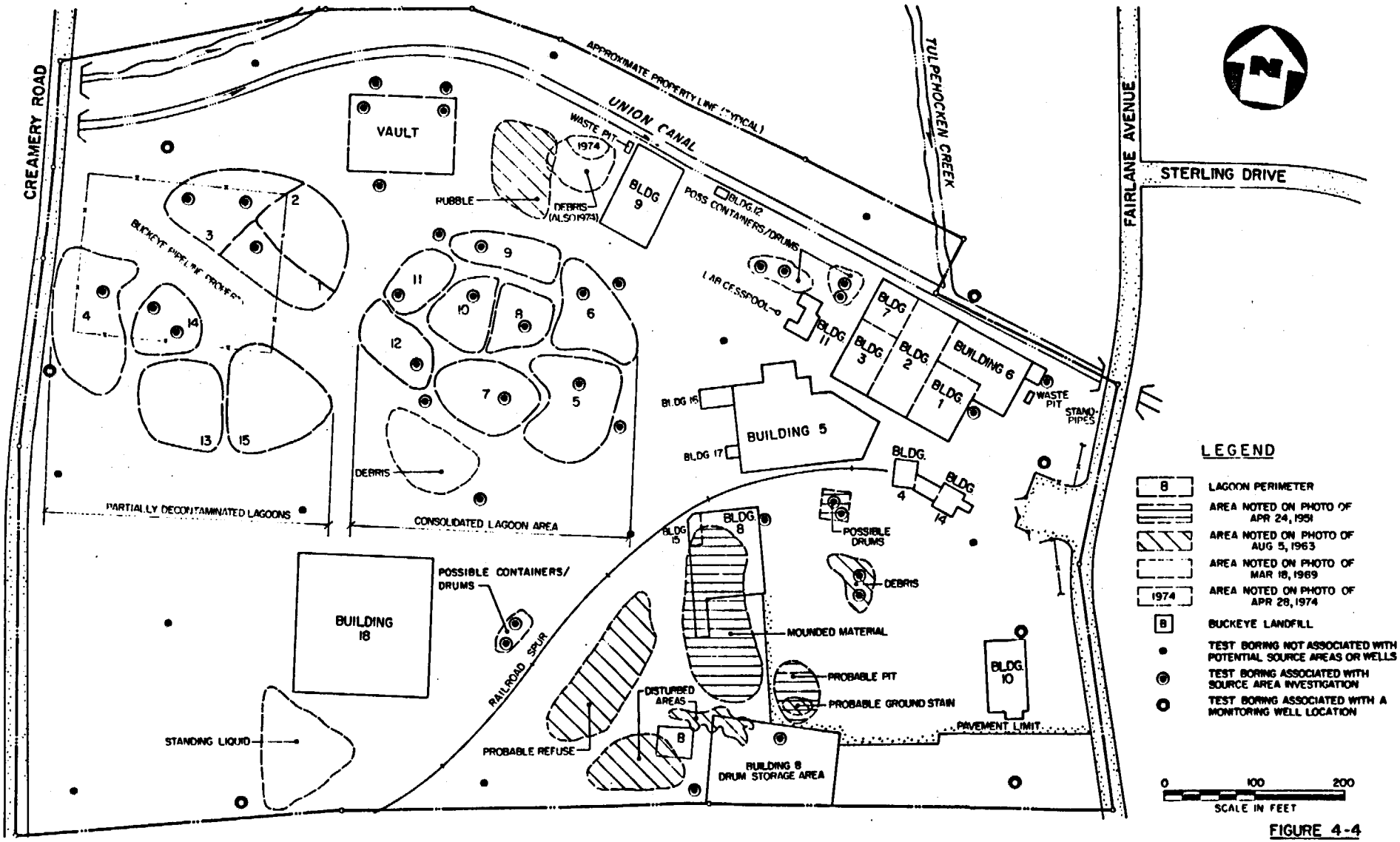

FIGURE 4-4

PROPOSED ONSITE TEST BORING LOCATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

NUS CORPORATION

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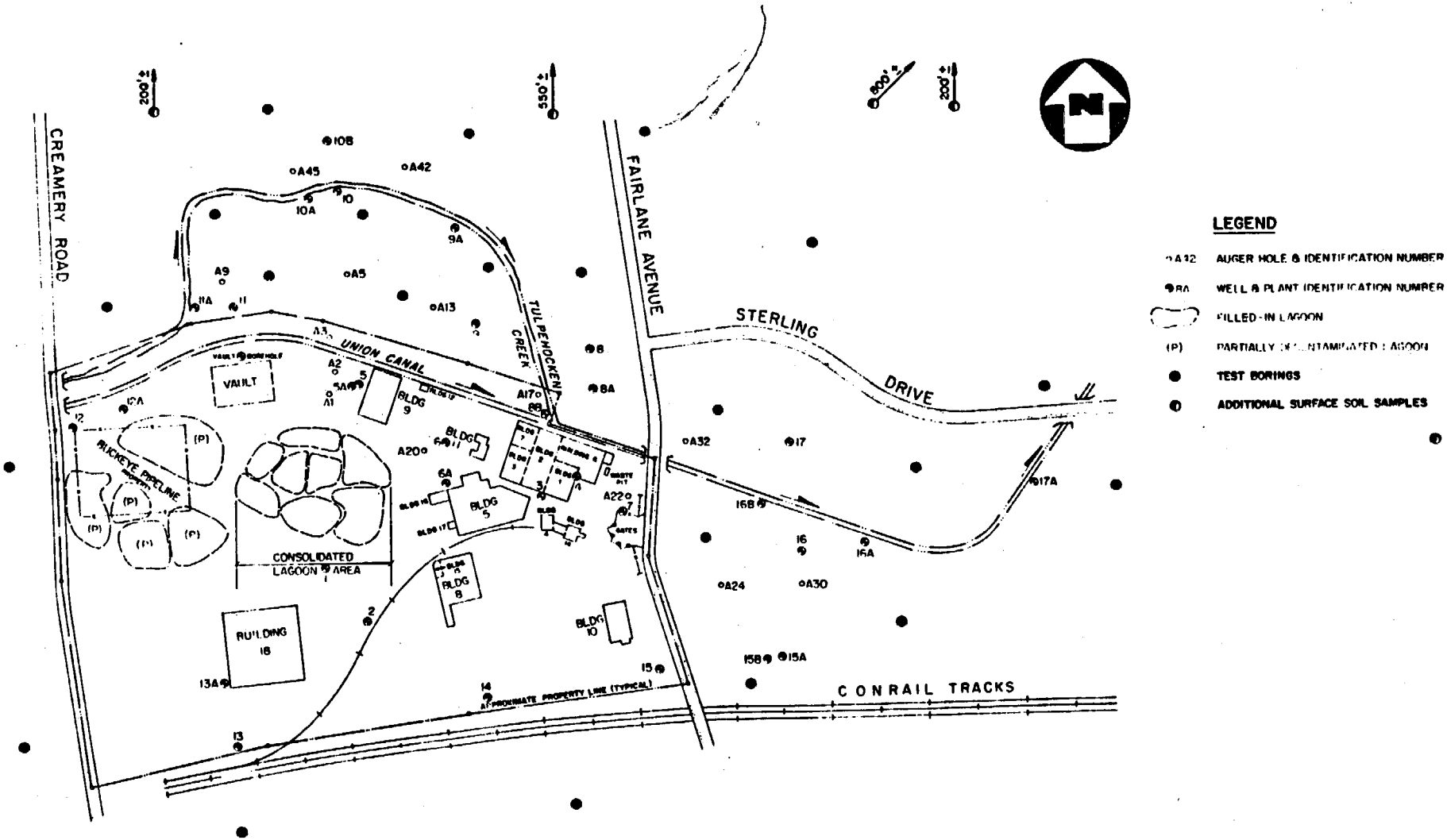

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FIGURE 4-5

PROPOSED OFFSITE TEST BORING LOCATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

NUS CORPORATION

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Each soil sample collected for chemical analysis will be placed in appropriately-sized laboratory-cleaned bottles, labeled, and submitted for analysis. The driller shall prepare a separate written boring log for each boring drilled, to be submitted to the field geologist at the conclusion of the field activities.

Thin-walled tube samples will be collected in accordance with FT-7.03 (Section 5.2.2, with exceptions noted in Appendix A). Grab samples to be used for geotechnical analyses requiring a large sample volume will be collected in accordance with FT-7.03 (Section 5.3, with exceptions noted in Appendix A).

Split-barrel and thin-walled tube samplers will be decontaminated before each use. Decontamination operations will conform to the following procedure:

- Potable water rinse
- Alconox or liquinox detergent wash
- Potable water rinse
- Distilled/deionized water rinse
- Acetone or methanol rinse
- Distilled/deionized water rinse

One or two subsurface samples will be obtained for chemical analysis from each non-source related test boring. One sample will be submitted for analysis from test borings which encounter bedrock at depths of 6 feet or less. Two samples will be submitted from test borings which encounter bedrock at depths of greater than 6 feet. In each test boring, a soil sample from directly above bedrock will be analyzed. In those borings where a second sample is to be analyzed, the second sample interval will be selected from the samples obtained at shallower depths, based on field conditions observed. Samples will be analyzed for the parameters described in Tables 2-1 and 2-2.

One or two subsurface samples will also be obtained for chemical analysis from source-related test borings. In those borings where wastes are encountered, the sample(s) will be taken from the waste interval(s) encountered. If no wastes are encountered, the sampling depths will correspond to the procedure described for non-source-related test borings. Details regarding source-related test borings are provided in the sections corresponding to each source investigation.

Upon completion of drilling and sampling activities, test borings will be backfilled using drilling cuttings and bentonite. Bentonite will be used in the bottom of borings which penetrate liner material and in other borings to fill any excess space not filled in with cuttings. As much as possible, the drilling cuttings will be segregated by depth. The cuttings will be backfilled to the same depths from which they originated.

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Downhole drilling equipment will be decontaminated between boreholes, by steam cleaning.

In addition to the one to two samples obtained from each test boring, a surface soil sample will be collected from the 0- to 3-inch depth interval at each boring location. The surface soil sample will be obtained using a stainless-steel trowel, which will be decontaminated between each use as described in Section 3.7. Surface soil sampling is described in detail in Section 4.1.3.

4.1.2.2 Test Pit Excavation/Sampling

Test pits will be excavated at selected locations on site, as described in the individual investigations presented in the Work Plan. Approximately 40 test pits will be excavated, at the approximate locations shown in Figure 4-6. The test pits are to be excavated in suspected waste disposal areas, in order to provide visual evidence of waste disposal activities and to obtain soil/waste samples for chemical analysis. Test pits have been proposed for investigating potential burial sites, wherever possible, as the test pits provide the clearest and largest picture of actual subsurface conditions, for the most commonly-used investigative techniques.

A backhoe will be used to excavate test pits at the selected locations. Test pits will be extended vertically to bedrock, to natural soils underlying waste deposits, or to the maximum reach of the backhoe (approximately 15 feet). The lateral and vertical extent of each test pit will be determined in the field based on observations made during excavation activities. Two or three samples will be obtained from each test pit excavated, at depths/ locations determined in the field based on observed subsurface conditions. Generally, one sample will be collected from the 0-3 inch interval, and one sample from soil just above bedrock. If the soil thickness is greater than 6 feet, a third sample will be collected. Waste deposits, discolored soils, or soils which contain volatile organics as evidenced by elevated readings on portable organic vapor detector instruments will be selected for sampling. Samples may be obtained either from soils contained in the backhoe bucket or directly from the test pit itself (if the test pit does not exceed 4 feet in depth at the time of sampling). Samples will be collected with a decontaminated stainless-steel scoop trowel from field-selected depths, as described above. Samples will be homogenized in a stainless-steel mixing bowl prior to placement in the appropriate sample containers. The backhoe bucket will be decontaminated by steam cleaning between test pits.

Each test pit excavated will be logged by the field geologist prior to backfilling. Included in the log will be descriptions of soils and wastes encountered, sampling depths, and the total depth of each pit. After excavation, sampling, and logging activities are completed, each test pit will be backfilled using

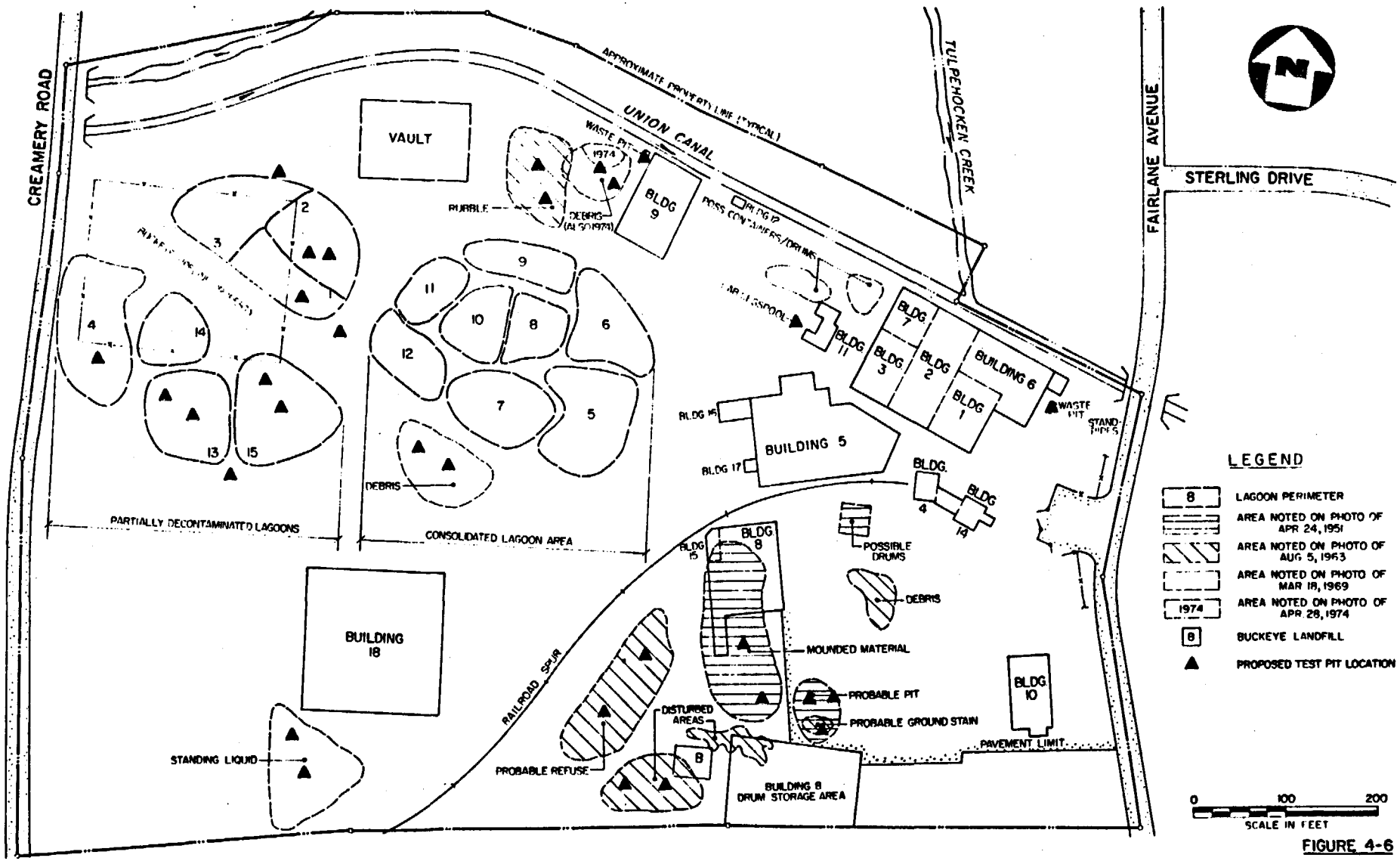

FIGURE 4-6

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PROPOSED TEST PIT LOCATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

NUS CORPORATION

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the excavated soils. The backhoe operator will be instructed to segregate excavated soils by depth and return these soils to their original depth, as much as possible.

4.1.3 Surface Soil Sampling

Surface soils will be sampled during the field investigation. Samples will be obtained at each test boring location, each test pit location, and selected other locations, as shown in Figures 4-4, 4-5, and 4-6. Approximately 123 surface soil samples will be taken during the field investigation. The soil samples will be submitted for chemical analysis, to determine the extent of contaminated surface soils associated with waste handling/disposal activities and airborne releases related to past operations.

Surface soil samples will be collected with a stainless steel scoop trowel from a depth of 0 to 3 inches, and homogenized in a stainless steel bowl prior to packaging. Samples will be collected in accordance with FT-7.03 (Section 5.3, exceptions noted in Appendix A).

4.1.4 Existing Monitoring Well Evaluation

Existing monitoring wells on site and in the site vicinity will be evaluated prior to the startup of investigative activities. The wells will be located in the field, using available site maps, then an assessment of the physical condition of each well will be made. The following observations will be made and documented:

- Well Number
- Well security (locked/unlocked)
- Condition of well casing and protective casing
- Well casing material
- Size of well casing
- Depth to groundwater
- Total depth of the well
- Identification and depth determination of any obstructions within the well

In addition to the above listed observations, any other pertinent observations that may be identified will be noted. The observed condition of the well will be compared with the original well logs, if available. Based on the field observations and on background information available, the existing wells will be evaluated as to their potential usefulness as sampling or water level measurement points. Selected wells will be integrated into the RI field investigation, if appropriate.

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4.2 SPECIFIC SITE INVESTIGATION ACTIVITIES

4.2.1 Vault Investigation

WLI company reports indicate that the vault contains 3.75-4 million pounds of arsenic, mostly in the form of calcium arsenate sludge. Additionally, drums containing aniline still bottoms and arsenic-bearing charcoal are reportedly present there. Observed fluctuations in water level measurements taken from the vault draw tubes indicate that the vault may be cracked and open to the environment. In addition to arsenic, a ground water sample taken from the borehole placed just north of the vault contained trans-1,2-dichloroethene, methylene chloride, PCE, TCE, and phenols.

The RI investigation is summarized in Table 3-5 of the Work Plan. As can be seen, samples of the vault contents will be collected from two borings. The two borings will be drilled into the vault wastes by backing a drilling rig to the edge of the vault, then drilling down into the vault using hollow stem augers. Each boring will be drilled to the base of the vault. Split-barrel sampling will be performed continuously during drilling operations, using the methodology described in Section 4.1.2.1. Two subsurface samples from each boring will be submitted for chemical analysis. One subsurface soil sample will be obtained from each boring from the 8-foot thick bottom layer of calcium arsenate sludge. The other sample from each boring will be obtained from the contaminated soils overlying the sludge. Soil samples will be homogenized in stainless steel mixing bowls prior to packaging. Sample analyses and bottle/preservation requirements for these samples are presented in Tables 2-1 and 2-2.

Four monitoring wells will be placed at three locations around the vault perimeter, for chemical sampling (MW-100A, MW-100B, MW-101A, and MW-102A). Proposed well locations are shown on Figure 4-1. These wells will also be used for water level measurements and detecting a tracer introduced into the vault to help determine if the vault is leaking. Table 4-1 summarizes the proposed well installation program for the vault.

Section 4.1.1 describes monitoring well drilling/installation/ sampling activities for the field investigation. Groundwater sample analysis is described in Tables 2-1 and 2-2.

The tracer to be used in the leak detection investigation will be lithium, considered one of the most useful ionic tracers available for groundwater tracer studies. Lithium is a metal with a low background concentration in natural waters. The tracer will be injected through a well point, which will be driven into the wastes near the northwestern corner of the vault. Approximately 50 gallons of water containing a lithium concentration of 200 ppm will be injected into the well point, then monitoring wells along the northern edge of the vault will be periodically sampled for the presence of the tracer.

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Chemical analysis (once a week for an estimated 13 weeks after tracer introduction) of the samples will be used to determine whether the tracer is present in the sample or not, as concentrations as low as 0.01 ppm can be detected in the laboratory. If the tracer is not observed over a 3-4 week period of time, another batch of tracer may be injected.

Along with obtaining water levels from monitoring wells, water levels in the well point and draw tubes will be periodically measured to establish a correlation (or lack of) between groundwater fluctuations and water level fluctuations within the vault. Water level measurements will be obtained 3 times per week until a correlation (or lack of) is established. If a correlation is established, this will indicate that the vault floor or walls are cracked and that groundwater is potentially being impacted by wastes within the vault.

Three soil borings will be drilled adjacent to the monitoring wells and sampled. Soil boring drilling and sampling techniques are discussed in Section 4.1.2.1. The reason soil borings are being drilled adjacent to the monitoring wells is that the monitoring well drilling technique is not conducive for soil sampling. It was determined to be more cost-effective to drill soil borings adjacent to the monitoring wells rather than adapt the monitoring well installation method.

Two or three samples will be collected per boring, depending on the soil layer thickness. The first sample will be collected at a depth of 0-3 inches to provide an escimate of contaminant concentration in the upper layer of soil. The upper soil layer could serve as a source for inhalation/ingestion, dermal contact, and/or soil runoff to Union Canal. A second sample will be collected from the soil at the soil-bedrock interface. If the soil thickness is greater than 6 feet, a third sample will be collected somewhere in the 3 inch-top of bedrock depth interval, at the geologist's discretion, based on visual observation and screening with an HNU.

4.2.2 Consolidated Lagoons Investigation

The primary objectives of the consolidated lagoons investigation are to better define contaminant concentrations inside the lagoons (including spatial variation), determine the lagoon contents contribution to groundwater, determine the permeability of the lagoon cap, sludge and liner, determine the lagoon's consolidation and strength characteristics, and demonstrate treatment options for the lagoon contents, if warranted.

To define contaminant concentrations in the lagoons, one soil boring will be drilled and sampled to bedrock per lagoon. Hollow stem auger drilling techniques and both split-barrel and thin-walled tube sampling will be implemented. Section 4.1.2.1 describes general drilling/sampling techniques to be used.

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One sample will be collected for chemical analysis from each boring location at a 0-3 inch depth. This will be a surface soil sample, obtained as described in Section 4.1.3. A second sample (subsurface) will be collected for chemical analysis from the former western lagoons sludge. This sludge, which was excavated and placed on top of the original eastern lagoons sludge, should be distinguishable by the presence of admixed soil and rocks. The third and last sludge sample collected for chemical analysis from each borehole will be collected from the original eastern sludge material. This material should be at the lagoon bases and relatively free of soil and rocks.

From every lagoon boring, one of the two subsurface sludge samples will be submitted for a full scan of TAL metals and TCL (BNA and VOA) analytes. These samples will be selected at the geologist's discretion, based on visual contamination and HNU screening. If no sample intervals are visually different or emit organic odors detectable with an HNU, the sample to be submitted for full scan analysis will be decided by the geologist.

Thin-walled tube sampling will be attempted at the surface (cap), within the lagoon sludges, and at the base (liner) of four of the lagoon boreholes. All remaining boreholes, and sampling intervals between the thin-walled tube sampling depths in the four selected boreholes, will be sampled using split-barrel samplers.

The four thin-walled tube samples of the lagoon capping material will be collected and tested for permeability. The sampling team will attempt to collect these samples in thin-walled tubes. If this is successful, the sample will be analyzed for unit weight/water content (ASTM-D-2216-80), grain size distribution (ASTM-D-422-63), specific gravity (ASTM-D-854-3), Atterberg limits (ASTM D 4318-84), and triaxial permeability (EPA Method 9100.2.8, SW-846). If the thin-walled tube sample cannot be collected or pushed properly, in-place density and water content will be estimated using a nuclear densometer (ASTM-D-2922-81, contained in Appendix C). This measurement will be made in the field if the thin-walled tube sample cannot be collected and in the laboratory if the sample cannot be extracted properly. Once the in-place density and water content are known, the sample will be prepared to the average field density in the laboratory and submitted for triaxial permeability. Atterberg limits, grain size distribution, and specific gravity testing will also be conducted. Once these test results have been received, estimates of the in situ permeability will be derived and applied to the conceptual model for the consolidated lagoons.

Four subsurface sludge (with possible intermixed soil) samples will be collected for strength, consolidation, and permeability characteristics testing. The strength and consolidation characteristics tests will be performed to allow an engineering determination of whether the lagoon sludge will support a RCRA-

type cap if this remedial alternative is deemed appropriate. The permeability tests will be conducted to provide an estimate of the subsurface sludge material's permeability. This estimate will serve as input to the consolidated lagoons conceptual model. If thin walled tubes can be secured for the subsurface sludge samples, the samples will be subjected to unit weight/water content, one-dimensional consolidation (ASTM-D-2435-80), unconfined compressive strength (ASTM-D-2166-66), grain size distribution, and specific gravity tests. If thin walled tube samples cannot be obtained, drive samples will be subjected to grain size distribution, specific gravity, water content, and Atterberg limit tests. In both cases, engineering estimates of permeability and bearing capacity will be made from the test results.

The drilling rig will also be used to attempt to collect four thin walled tube samples of the liner material. If this is not possible, drive samples will be collected. Thin walled tube samples will be subjected to unit weight/water content, grain size distribution, specific gravity and triaxial permeability tests. Drive samples will be subjected to grain size, water content, and specific gravity tests. Liner permeability will be estimated based on the test results.

Any liner material excavated will be replaced with bentonite so that the lagoon will be left in as good a condition as when the drilling commenced.

The permeability test data will serve as inputs into a vadose zone conceptual model to be used for estimating the consolidated lagoon's contaminant contribution to groundwater. Additional model inputs include precipitation (P), evaporation (E), and transpiration (T). These inputs will be estimated from pertinent literature.

Another necessary model input is lagoon content leachability. To measure this, four vacuum pressure lysimeters will be placed in the sludge within the lower portion of lowest sludge layer. Lysimeters will have a porous teflon intake section with a lower PVC storage section. The lysimeters will be installed at the selected depths within each designated borehole. The installation procedure will consist of backfilling each borehole to within approximately 1 to 3 feet of the desired sampling interval, using bentonite chips/powder, then the lysimeter will then be suspended in the boring at the appropriate depth and a silica flour slurry placed around the lysimeter and to 3 feet above the lysimeter intake. The remainder of the boring will be backfilled with bentonite, to provide a competent seal. These lysimeters will be sampled twice for chemical analysis. A more detailed description of the installation process is included in Appendix C.

A second measure of lagoon content leachability will be subjecting a split of the 4 lagoon samples submitted for the full-scan chemical analysis to the Toxicity Characteristic

Leaching Procedure (TCLP). The TCLP test results may or may not be entirely representative of leachability, however, as the test will be conducted at a pH of 5, whereas water in contact with the lagoon contents may be at a different pH. The solubility of ferric arsenate is known to be pH-sensitive. The TCLP results will also be used to determine if the lagoon contents are a "hazardous waste" under the RCRA regulations.

Five test borings will be drilled to bedrock around the perimeters of the consolidated lagoons. Two of the borings will be located adjacent to monitoring wells, with the other three evenly spaced around the lagoon area perimeter. The boring locations are shown on Figure 4-4. These holes will be drilled to confirm the areal extent of the lagoons and to provide soil contaminant concentration information for soil surrounding the lagoons.

Split-barrel sampling will be performed in these perimeter borings continuously throughout the total depth of the boring. Two or three samples will be collected from the borings, for chemical analysis, depending on soil thickness. Regardless of soil-thickness, samples will be collected from the 0-3 inch interval and from soil just above bedrock. If the soil thickness is greater than six feet, a third sample will be collected from an interval somewhere between a depth of 3 inches-6 feet at the geologist's discretion, based on visual observations and HNU readings. A total of 13 soil samples have been estimated for budgeting and scheduling purposes. Test boring drilling/sampling activities are described in Section 4.1.2.1. Surface soil sampling techniques (for the 0-3 inch sample) are described in Section 4.1.3. Sample analysis, packaging, and preservation requirements are provided in Tables 2-1 and 2-2.

Four monitoring wells will be installed around the lagoon's perimeter, at two locations, as shown on Figure 4-1. Drilling/installation/sampling of these wells is discussed in Section 4.1.1. Two rounds of groundwater samples for chemical analyses will be collected form the lagoon wells. Analyses to be performed are described in Section 2. Contaminant concentrations in apparent upgradient and downgradient wells will be compared to indicate if the lagoons are contributing contaminants to ground water.

4.2.3 Excavated Lagoons

The primary objectives of the excavated lagoons investigation are to determine if any sludge has remained in place after the lagoons consolidation, to determine if the former lagoons operation led to soil contamination adjacent to the lagoons, and to determine if residual contamination, if any, at the excavated lagoons site is leading to ground water contamination.

As stated above, reports in WLI's files and from former employees indicate that nearly all of the sludge once present in

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the western lagoons has been excavated and placed on top of the eastern lagoon sludge. To confirm these reports, 14 test pits or soil borings (two per lagoon, see Figure 4-6) will be advanced to bedrock, and visual observations for the presence of sludge made by the geologist. Soil borings will be used on the Buckeye Pipeline property to minimize site disturbance, while test pits will be used elsewhere. Additionally, two or three samples will be collected from one of the two test pits or borings located within each lagoon. The first sample, from a 0-3 inch depth, will be taken to provide surficial soil concentration information for evaluating the inhalation/ ingestion, dermal contact and surface runoff pathways. Surface soil sampling techniques are presented in Section 4.1.3. The second sample will be collected from soil (or sludge) at the soil-bedrock interface. This second sample will be collected to determine sludge (if present) contaminant concentrations, or soil concentrations at the bedrock-soil interface. Finally, if the pit depth is greater than 6 feet a third sample will be collected from somewhere between the 3-inch depth and the top of bedrock, at the geologist's discretion, based on visual observation and HNU readings. This last sample will be biased to identify the maximum amount of contamination in the test pit. If no unusual intervals are identified during excavation activities, the third sample will be collected from an interval selected by the geologist. The other test pit excavated at each lagoon will be logged only, with no sampling performed. The determination of which pit will be sampled will be made based on observed subsurface conditions. If wastes are encountered in the first pit excavated into a given lagoon, that pit will be sampled and the second pit logged only. If no wastes are encountered in the first pit, it will be logged only and the second pit sampled, regardless of whether wastes are visually identified within it or not. Test pit excavation/sampling is discussed in more detail in Section 4.1.2.2.

Three test pits will also be excavated around the lagoon perimeter, to determine if there is any residual sludge beyond the former lagoons' boundaries or if soil concentrations have become elevated due to proximity with the former lagoons. Similar to the lagoon test pits, two or three soil samples will be collected, depending on pit depth. The first sample, from a 0-3 inch depth, will be taken to provide surficial soil concentration information for evaluating the inhalation/ ingestion, dermal contact and surface runoff pathways. The second and third samples will be collected to provide subsurface soil contaminant concentrations to be used in estimating the amount of contaminant in the soil possibly available to ground water.

Finally, three monitoring wells (MW-103A, MW-103B, MW-104A) will be installed around the perimeter of the former lagoons (see Figure 4-1). Drilling, installation, and sampling of monitoring wells is described in Section 4.1.1. The wells will provide ground water quality information for the northwest portion of the site, and may indicate whether the excavated lagoons are a

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continuing source of groundwater contamination or not. Soil and groundwater sample analyses are discussed in Section 2.

4.2.4 Process Buildings

The primary objectives of the process building investigation are to determine if surface buildups on the buildings and equipment present a threat to human health, to determine if atmospheric concentrations of volatile organics and asbestos inside the buildings pose a threat to human health, to determine if roof runoff during rain and snow melt events can possibly degrade surface water, to determine whether soil contaminant concentrations near and under the buildings are elevated from past operations, and to determine if past operations at the buildings (including wastewater disposal into well No. 4) has contributed contaminants to groundwater.

The condition of the process buildings presently is largely unknown. Due to health and safety concerns, the buildings were not entered during the site visits. When the door to Building 1 was opened, a strong organic odor was noticed. Additionally, large volumes of full laboratory containers were visible in Buildings 2 and 8.

One building, Building 18, is presently being used as a food warehouse. This building, the newest on site, was only used as a warehouse by WLI. Since food storage is believed to be regulated by other agencies, this building will only be subjected to a walk-through inspection. If unexpected conditions are found, the sampling strategy will be revised per EPA direction.

There is a concern that residual chemicals from production and storage may be present in the remaining buildings, both in the vapor and particulate form. Additionally, residual liquids from production may be present in the process equipment and piping. Finally, there reportedly are full containers (drums, etc.), in addition to the laboratory containers, present in the buildings. Human exposure from inhalation/ingestion and direct contact is possible.

The first process building task is initial entry into the buildings to set up air monitors. This initial data collection, which is discussed in more detail in the Whitmoyer Laboratories RI/FS Health and Safety Plan (HASP), will be used to establish the level of worker protection when work is ongoing in the buildings. Data from this exercise will also be used when evaluating the "no-action" alternative for the buildings.

The buildings of primary concern from a health and safety viewpoint are Buildings 1-3 and 5-7. The reason for this concern is there are no chemical respiratory cartridges approved for the removal of aniline, which was used in Buildings 1-3 and 6-7, or methyl bromide, which was used in Building 5.

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Therefore, gaseous concentrations of these chemicals will be monitored in the buildings where they are suspected.

To monitor the aniline and methyl bromide gaseous concentrations in the air, a metered volume of air from the buildings will drawn across standard silica gel and petroleum based charcoal sorbent media tubes, which have been selected for their affinity for methyl bromide and aniline, respectively. Two tubes of sorbent media will be linked in series to evaluate breakthrough from the first tube in the series. An SKC pump, drawing air at 100-150 cc/min for 8 hours, will be used to obtain the samples. Following sample collection, the sorbent media tubes will be shipped off for immediate analysis. Tables of breakthrough values are available for aniline and methyl bromide from the sorbent suppliers; if the concentration in the first tube is near the breakthrough value, the second tube will be analyzed. Once the analytical results are available, the Health and Safety Office (HSO) will determine the level of protection necessary for the workers.

Other organic chemical vapor concentrations in the building air will be monitored with a HNU and OVA. This information will also be used in establishing safe worker protection levels. Additionally, these qualitative data will be used in the exposure assessments for the buildings.

Once the worker protection level has been established, the buildings will be inventoried. Room conditions, including presence of equipment, piping, residual liquids, containers, buildup of dust or grime on surfaces, asbestos, and any special conditions will be noted. Additionally, the quantity of each type of building material, e.g., concrete block, will be estimated. Finally, maps showing the general building layouts and key features will be prepared immediately after this inventory to facilitate future efforts in the buildings.

Wipe samples will be collected from the inner surfaces of roofs (or ceilings), walls, and floors of rooms suspected of being contaminated. Generally, one roof, floor and wall wipe sample each will be collected per suspected room.

Since it has not been possible to inventory the buildings, the total number of building wipe samples to be collected is not known with certainty. An estimate of 100 samples has been derived for budget and schedule purposes.

Wipe samples will be collected with Whatman 541 filter paper or equivalent. The sample will be collected by rubbing moistened filter paper over a 100 sq. cm. area. Water will be used for moistening metals samples and a 1:4 acetone/hexane mixture used for BNA samples. Once the samples are collected they will be placed in clean sample containers and shipped for analysis. Wipe sampling procedures are further described in FT-7.12, Section 5.1.3, provided in Appendix A (exceptions as noted).

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The analytical results will be related back to the known area of the sample. In this way the results can be converted to units such as µg/sq. cm. The converted results can then be used as input for modeling exposure for building occupants.

Six wipe samples will be collected from the outer building surfaces directly adjacent to building exhausts. These sites have been known to accumulate elevated concentrations of contaminants at other sites. The same protocols will be followed as for inner building surface wipe samples.

Wipe samples will also be collected from pieces of equipment in the buildings. To reduce the number of samples, wipe samples will be composited from several pieces of equipment in a general area, where practical. As for the building surface samples, a 100 sq. cm. surface area will be wiped per sample. Water will be used for moistening the filter paper for metals samples, while a 1:4 acetone/hexane mixture will be used for BNA samples. Once the samples are collected they will be placed in clean sample containers and shipped for analysis.

The analytical results from the equipment wipe samples will also be related back to the known area of the sample, to permit modeling the exposure for building occupants.

Again, since the buildings have not been inventoried, the exact number of equipment wipe samples has not been established. An estimated 50 equipment wipe samples, exclusive of QA/QC samples, has been estimated for budgeting and scheduling purposes.

Possible asbestos ceiling materials were noted during the previous site visits. These materials may be releasing asbestos fibers to the building air, creating a potential health threat. To evaluate this potential threat, a REM III asbestos expert will inventory the building materials and piping coating. Additionally, bulk samples of suspected material will be collected for analysis.

The asbestos samples will be collected according to protocols presented in Appendix G of EPA documents 560/5-85-024, "Guidance for Controlling Asbestos-Containing Materials in Buildings." A copy of the sampling protocol is included in Appendix A.

Bulk samples of the ceiling materials will be collected with a small coring device. Bulk samples of piping material will be collected using forceps. Sample locations will be wetted prior to sample collection to limit dust generation. The sample areas will be repaired using putty or an encapsulant following sampling.

The samples will be analyzed using polarized light dispersion staining. The sample analyses will follow EPA protocols for asbestos analysis. Details on the sampling and analytical methods are continued in Tables 2-1 and 2-2.

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If many rooms and/or piping materials are suspected of containing asbestos, only a representative subset will be tested. Ten samples are estimated for budgeting and scheduling purposes.

In addition to the original atmospheric measurements, volatile organic levels will be measured periodically using a HNU and OVA. Although this information will be primarily used for insuring that the worker protection level selected remains appropriate, this qualitative data will also be available for the exposure assessment.

To determine if residual liquids remain in the piping, piping valves will be opened. If liquids are present, they will be drummed; samples will be collected by filling the appropriate sample containers directly from the valves. Sample packaging, shipping, and holding time requirements are presented in Section 3.6. The sample team will estimate the volume of liquid present in the piping system sampled. Fifty piping liquids samples have been estimated for budgeting and scheduling purposes. The sample team will attempt to refine this number early in the building investigation to allow laboratory scheduling.

WLI company files indicate that roof runoff from the Building 1-7 complex commonly contained elevated levels of arsenic when sampled in the late 70's. To determine if this situation is still occurring, water coming from the roof drains will be sampled during a rain event. No criteria for the rain event, e.g., greater than 1 inch, will be specified. The samples will be considered representative if the water coming from the roof drains is due to precipitation. Key data regarding the sampling, e.g., total amount of rainfall, total amount prior to sampling, and length of time from the start of rain until the sampling time, will be recorded in the field logbook. The number of roof drains at the site is presently unknown. A total of 7 roof drain samples (exclusive of QA/QC samples) has been estimated for budgeting and scheduling purposes. Samples will be collected from the downspouts into decontaminated glass or stainless steel containers, then transferred to the appropriate sample bottles. Sample bottle and preservation requirements are described in Section 3.6.

In the unlikely event that it does not rain sufficiently to cause roof runoff while the sampling team is in the field, artificial roof runoff samples will be created by hosing down the roofs with Myerstown municipal water. This water is tested frequently and contains relatively little, if any, contaminants. To determine the arsenic contribution from the municipal water (and hose apparatus), a field blank will be collected by filling clean sample bottles directly from the hose during the sampling event.

In order to properly dispose the laboratory wastes on site, a subcontractor will be procured to segregate and drum compatible

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wastes that can be disposed similarily, e.g., by incineration. To ensure compatibility, wastes will be analyzed for compatibility parameters, e.g., radioactivity, in the field. Wastes will also be segregated based on disposal parameters, e.g., halogen content. For example, flammable non-halogen wastes will be combined and segregated for potential treatment in an offsite incinerator. If halogenated wastes were to be combined with non-halogenated wastes, the combined wastes may have a chloride content too high to make incineration feasible.

Once drums of compatible wastes have been filled, they will be sampled by the subcontractor. The samples will be analyzed for parameters necessary to evaluate disposal options for the wastes, e.g., BTU content.

Samples from drums containing liquids will be obtained with glass tubes, as described in FT-11.01, Sections 5.7 and 5.8 (Appendix A, exceptions as noted), while solid samples will be collected with stainless steel scoops or another appropriate sampling device (e.g., nonsparking devices). Each solid sample will be homogenized in a stainless steel mixing bowl prior to packaging.

There is a concern that process operations has elevated soil contaminant concentrations near the buildings. To test this hypothesis, three test borings will be drilled adjacent to but outside of the buildings. The boring locations are shown in Figure 4-4. The drilling/sampling of exterior test borings is discussed in detail in Section 4.1.2.1.

Two or three soil samples will be collected per boring, depending on the soil thickness. A surface sample will be collected from the depth interval 0-3 inches. Sampling methodology is described in Section 4.1.3. These samples will be used to evaluate surface runoff, inhalation/ingestion, and dermal contact risk.

Subsurface soil samples will also be collected to provide subsurface soil contaminant concentrations to be used in estimating the amount of contaminant in the soil possibly available to groundwater. One or two subsurface samples will be collected, depending on the depth to bedrock. A subsurface sample will be collected from each boring at the soil/bedrock interface. If bedrock is at a depth greater than 6 feet, a second subsurface sample, collected from the interval below the depth that the surface sample was collected and above the soil/bedrock interface sample depth, will be sent for analysis. The sample interval will be specified by the geologist, based on the visual observation and HNU readings. This last sample will be biased to attempt to identify the maximum amount of contamination in the interval. If no unusual soil layers are identified during drilling, the third sample will be collected from an interval selected by the geologist.

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Monitoring wells will be installed adjacent to Buildings 1, 2, and 8 (MW-116A, MW-118A, MW-112A, located in Figure 4-1). In addition, monitoring wells MW-115B, MW-114A, MW-113A, and MW-113B will be installed along the eastern property boundary near the process buildings. Section 4.1.1 described well drilling/installation activities and summarizes the drilling program (Table 4-1). Groundwater and soil sample holding times, bottle, and preservation requirements are described in Tables 2-1 and 2-2.

4.2.5 Drums and Tanks Investigation

The primary objectives of the drums and tank investigation at the Whitmoyer Laboratories Site are to estimate the number of full and partially-full drums being stored there, to determine the contents of the non-empty drums, to determine if any of the tanks on site contain liquids or sludges, and to chemically and physically characterize the liquids or sludge present.

Apparently 600 full and partially full drums are being stored on site, as of May 1988. The majority of these drums are reportedly well marked regarding their origin (as opposed to their chemical contents) and contain approximately 65 different types of materials. Additionally, approximately 47 drums of unknown origin are reportedly present on site.

The first drum investigative activity will be to collect several samples from drums with similar markings and compare these samples for homogenity. It is expected, based on former employee reports, that these drums are relatively homogeneous. If they are not, the existing sampling plan will be reevaluated.

Once the homogeneity of the drum group has been established, a sample from each drum group and each drum of unknown origin will be analyzed for compatibility parameters, e.g., radioactivity and halogen content, in the field. Once these analyses are complete, the drums will be placed into categories, based on compatibility and likely disposal alternatives. It is expected that as many as 30 categories will be required to classify the drums.

After the categorization is complete, composite samples will be created for each category. Aliquots from each drum group and unknown drum will be used for the composites, based on a volume percentage. In other words, if one drum group, e.g., methanol still bottoms, makes up 80 percent of the volume of one drum category, 80 percent of that category's sample will consist of a methanol still bottom aliquot.

Samples from drums containing liquids will be obtained with glass tubes, as described in FT-11.01, Sections 5.7 and 5.8 (Appendix A, exceptions as noted), while solid samples will be collected with stainless steel scoops or another appropriate sampling device (e.g., nonsparking devices). Each solid sample will be homogenized in a stainless steel mixing bowl prior to

field analysis. A total of 150 drums will be sampled for field analysis; 30 composite laboratory samples (exclusive of QA/QC samples) has been estimated for budgeting and scheduling purposes. In addition to chemical quality parameters, the composite samples will be analyzed for selected parameters to permit evaluation of drum disposal options. Drum sample holding time and packaging requirements are described in Tables 2-1 and 2-2.

Similarly, the volume of liquids contained in each tank on site will be established using an appropriate sounding device. The approximate volume of liquids (and sludge) in each tank, if any, will be calculated. Following this, all of the non-empty tanks will be sampled using grab samplers or another applicable sampling device. Tank sampling will be performed in accordance with FT-11.04 (Appendix A, exceptions as noted). A total of 10 tank samples (exclusive of QC samples) is estimated for budgeting and scheduling purposes.

4.2.6 Waste Pits (Buildings 6, 9, and 11)

The main objective of the waste pits investigation is to determine if a "hot spot" of residual soil contamination which could act as a source for groundwater degradation is present at the sites of the former and present waste pits.

Since it is presently unknown if any residual soil contamination remains at the sites of the former and present waste pits, the waste pit investigation will essentially be a screening investigation. Soil adjacent to the former (Buildings 9 and 11) waste pits will only be sampled at one location (test pit), while two locations (test pits) will be sampled adjacent to the Building 6 (Department 8101) waste pit (see Figure 4-6). If this soil is found to contain elevated contaminant concentrations, the need for future work beyond the scope of this Work Plan will be assessed.

To perform soil sampling adjacent to the waste pits, a test pit will be excavated to bedrock at each of the four sample locations. Since the former waste pit locations are known only approximately, the sample team will be better able to obtain samples adjacent to the pits using a backhoe rather than test borings. Since the former waste pits are no longer used and should not contain liquid wastes, there is no concern about damaging the cinder block walls during excavation activities. On the other hand, the sample team will use caution so as to not disturb the Building 6 (Department 8101) waste pit, which was being used when the facility closed. Test pit excavation/sampling techniques are discussed in detail in Section 4.1.2.2.

Two or three samples from each test pit will be collected. The first sample, from a 0-3 inch depth, will be taken to provide surficial soil concentration information for evaluating the inhalation/ingestion, dermal contact and surface runoff

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pathways. Surface soil sampling procedures are described in Section 4.1.3. The second (and third) samples will be collected from subsurface sample intervals determined by the geologist based on visual observation and HNU readings. These samples will be collected to provide subsurface soil contaminant concentrations to be used in estimating the amount of contaminant in the soil possibly available to groundwater. The subsurface samples will be biased to identify the maximum amount of contamination in the boring. If no unusual intervals are identified during the test pit excavation, one subsurface sample will be collected from the soil directly overlying bedrock.

To aid in the determination of contaminant leachability from the soil, as well as to determine if some of the soil could be considered "hazardous waste," one subsurface samples from one-half of the test pits will be submitted for TCLP metal analyses. The TCLP procedure is going to be used for hazardous waste determinations under EPA's RCRA regulations in the near future.

Sample analyses, packaging requirements, and preservation requirements are described in Tables 2-1 and 2-2.

Two monitoring wells will be installed at one location adjacent to the cesspool adjacent to Building 11 (MW-109A, MW-109B), three wells will be installed at one location adjacent to the Building 6 cesspool (MW-117A, MW-117B, and MW-117C), and one well will be installed downgradient of the cesspool at Building 9 (MW-108) (see Figure 4-1 and Table 4-1). Multiple wells are proposed for the Building 6 and 11 cesspools, as these cesspools have been targeted as areas of particular concern and data regarding both the vertical extent of contamination and vertical groundwater gradients near the Union Canal and Tulpehocken Creek is needed at these locations. Monitoring well drilling/installation/sampling is described in Section 4.1.1.

The Building 6 waste pit was filled with liquids when the site was visited in January, 1988. To assess the condition of the pit walls and floor (and reduce the exposure threat to the workers onsite), this pit will be pumped out. The pit water will be combined with well development water and disposed appropriately.

4.2.7 1951 Waste Pit

The probable pit (see Figure 1-3) identified in 1951 is suspected of containing buried waste materials, including fiber drums containing aniline still bottoms. The primary 1951 waste pit investigation objectives are to determine if any buried wastes or "hot spots" of residual soil contamination are present in the probable pit vicinity.

Three test pits will be excavated to bedrock in the pit vicinity in order to obtain soil/waste samples for analysis. Test pit

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excavation/sampling methodologies are discussed in detail in Section 4.1.2.2.

Three samples from each test pit will be collected. The first sample, from a 0-3 inch depth, will be taken to provide surficial soil concentration information for evaluating the inhalation/ingestion, dermal contact and surface runoff pathways. The second (and third) samples will be collected from subsurface sample intervals determined by the geologist based on visual observation and HNU readings. These samples will be collected to provide subsurface soil contaminant concentrations to be used in estimating the amount of contaminant in the soil possibly available to groundwater. The subsurface samples will be biased to identify the maximum amount of contamination in the test pit. If no unusual intervals are identified during the test pit excavation, one subsurface sample will be collected from the soil lying directly above bedrock.

To aid in the determination of contaminant leachability from the soil, as well as to determine if some of the soil could be considered "hazardous waste," one of the subsurface samples from 50 percent of the test pits will be submitted for TCLP metal analyses. The TCLP procedure is going to be used for hazardous waste determinations under EPA's RCRA regulations in the near future.

Monitoring well MW-111A will be installed immediately downgradient of the waste pit (and the adjacent drum storage area) to provide groundwater quality data for this area. Monitoring well drilling/installation/sampling is described in Section 4.1.1.

Groundwater and soil/waste analyses, container requirements and preservation requirements are provided in Tables 2-1 and 2-2.

4.2.8 Photographic Anomalies

Nine various photographic anomalies, e.g., rubble piles and unidentified debris, were located when previous aerial photography from the site was reviewed (see Figure 1-3). Residual contamination may be present at these sites.

The primary photographic anomalies investigation objective is to determine if any buried wastes or "hot spots" of residual soil contamination are present in the probable pit vicinity. Since it is presently unknown if any residual soil contamination remains at the aerial anomalies sites, the investigation planned is essentially a screening investigation.

Two test pits will be excavated to bedrock at each site, to obtain soil samples for chemical analysis. Test pit excavation/sampling activities are discussed in detail in Section 4.1.2.2.

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Two or three samples from each test pit location will be collected. The first sample, from a 0-3 inch depth, will be taken to provide surficial soil concentration information for evaluating the inhalation/ingestion, dermal contact and surface runoff pathways. The second (and third) samples will be collected from subsurface sample intervals determined by the geologist based on visual observation and HNU readings. These samples will be collected to provide subsurface soil contaminant concentrations to be used in estimating the amount of contaminant in the soil possibly available to groundwater. The subsurface samples will be biased to identify the maximum amount of contamination in the boring. If no unusual intervals are identified during the test pit excavation, one subsurface sample will be collected from the soil lying directly above bedrock.

To aid in the determination of contaminant leachability from the soil, as well as to determine if some of the soil could be considered "hazardous waste," one subsurface sample from every other test pit will be submitted for TCLP metal analyses. The TCLP procedure is going to be used for hazardous waste determinations under EPA's RCRA regulations in the near future.

Monitoring wells will be installed adjacent to selected anomaly areas. Monitoring wells MW-119A and MW-119B are located next to an area of standing liquid identified in a 1969 photograph and will provide water quality and water level data for the southwest area of the site. Monitoring wells MW-110A, MW-110B, and MW-110C are located adjacent to a disturbed area identified from 1963 photographs and will provide water quality and water level data (including vertical head distributions) for the southern area of the site. Well locations are shown on Figure 3-1. Monitoring well drilling/installation/sampling is described in Section 4.1.1.

Soil and groundwater sample analyses, containerization requirements, and preservation requirements are provided in Tables 2-1 and 2-2.

4.2.9 Former DDAA Storage Areas

DDAA was reportedly stored on the surface at two locations onsite during the early 1960's. Reportedly this material was excavated and recycled. Soil underneath the DDAA piles was reportedly also excavated and placed in the vault. The arsenic and aniline contents of soil which remained in place was not specified. There is a concern that residual contamination could pose a threat via direct contact, inhalation/ingestion, surface runoff or infiltration to groundwater.

The primary DDAA storage areas investigation objective is to determine if any "hot spots" of residual soil contamination are present at these locations. Since it is presently unknown if any residual soil contamination remains at the DDAA sites, the investigation planned is essentially a screening investigation.

Two test pits will be excavated to bedrock at each former DDAA storage area site to obtain soil samples for chemical analysis. Test pit excavation/sampling techniques are discussed in detail in Section 4.1.2.2.

Two or three samples from each test pit location will be collected. The first sample, from a 0 - 3 inch depth, will be taken to provide surficial soil concentration information for evaluating the inhalation/ingestion, dermal contact and surface runoff pathways. Surface soil sampling procedures are described in Section 4.1.4. The second (and third) samples will be collected from subsurface intervals determined by the geologist based on visual observation and HNU readings. These samples will be collected to provide subsurface soil contaminant concentrations to be used in estimating the amount of contaminant in the soil possibly available to groundwater. The subsurface samples will be biased to identify the maximum amount of contamination in the boring. If no unusual intervals are identified during the test pit excavation, one subsurface sample will be collected from the soil lying directly above bedrock.

To aid in the determination of contaminant leachability from the soil, as well as to determine if some of the soil could be considered "hazardous waste," one subsurface sample from every other test pit will be submitted for TCLP metal analyses.

Soil sample analyses, container requirements, and preservation requirements are specified in Tables 2-1 and 2-2.

4.2.10 Drum Storage Areas

Historic aerial photos from the site indicate that drums have been stored at several unpaved locations (see Figure 1-3). There is concern that drum leakage, spillage, etc. may have created "hot spots" of residual soil contamination at these locations. Since it is presently unknown if any residual soil contamination remains at the drum storage sites, the planned investigation will essentially be a screening investigation.

Two soil borings will be excavated to bedrock at each former drum storage area site in order to obtain soil samples for chemical analysis. Soil borings were selected here since some of the drum storage locations are now covered by pavement, and the minimization of pavement disruption is desired.

Two or three soil samples will be collected per boring, depending on the soil thickness. The first sample will be collected from a 0-3 inch depth if no pavement is present, to provide surficial soil concentration information for evaluating the inhalation/ingestion, dermal contact and surface runoff pathways. If pavement is present, the first sample will be collected from the top layer of soils underlying the pavement and associated sub-base. Sample results from this interval will be used to assess the degree of shallow soil contamination.

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Subsurface soil samples will also be collected to determine subsurface soil contaminant concentrations. One or two subsurface samples will be collected, depending on the depth to bedrock. A subsurface sample will be collected from each boring at the soil-bedrock interface. If bedrock is at a depth greater than 6 feet, a second subsurface sample will be submitted for analysis from the interval below the depth that the surface sample was collected and above a depth of 6 feet. The sample interval will be specified by the geologist, based on visual observation and HNU readings. This last sample will be biased to identify the maximum amount of contamination in the interval. If no unusual soil layers are identified during the drilling, the third sample will be collected from an interval selected by the geologist.

To aid in the determination of contaminant leachability from the soil, as well as to determine if some of the soil could be considered "hazardous waste," one of the subsurface samples will be submitted for TCLP metals analyses.

Test boring drilling/sampling operations are described in Section 4.1.2.1. Sample analyses, containerization requirements, and preservation requirements are presented in Tables 2-1 and 2-2.

4.2.11 Onsite Soils Investigation

An onsite subsurface soils investigation is proposed in order to evaluate soil conditions in areas not adjacent to identified source areas. The investigation entails the drilling and sampling of 18 test borings (see Figure 4-4) and the chemical analysis of selected soil samples from each boring. A surface soil sample and one or two subsurface soil samples are to be taken from each test boring. One subsurface soil sample will be obtained from directly above bedrock. A second sample will be submitted for analysis from a field-selected interval between the surface and top of bedrock samples, if the depth to bedrock exceeds 6 feet. Section 4.1.2.1 details the test boring drilling and sampling techniques to be implemented. Soil samples will be analyzed for the parameters listed in Table 2-1. Sample bottle requirements and preservation requirements are presented in Section 3.6.

4.2.12 Offsite Soils Investigation

The offsite soils investigation is designed to provide data regarding the extent of contamination in soils in the local area surrounding the site. Drilling and sampling methodologies for the 22 borings (located as shown in Figure 4-4) and additional surface soil samples proposed for this study are presented in Sections 4.1.2.1 and 4.1.3, respectively. A surface soil sample and one or two subsurface soil samples are to be taken from each test boring. One subsurface soil samples will be obtained from directly above bedrock. A second sample will be submitted for analysis from a field-selected interval between the surface and

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top of bedrock samples, if the depth to bedrock exceeds 6 feet. Analytical parameters, bottle requirements and preservation requirements for soil samples are presented in Tables 2-1 and 2-2.

4.2.13 Surface Water and Sediment

Groundwater discharge and surface runoff are believed to be responsible for an increase in water and sediment arsenic concentrations as Tulpehocken Creek passes the site. Additionally, groundwater discharge has reportedly raised arsenic levels in the abandoned quarries near the site. Very few data regarding other contaminant concentrations in surface water and sediment were identified during the data review. To characterize the health and environmental risks presented by contaminant concentration increases in surface water and sediment, the following program has been developed.

The primary surface water and sediment investigation objectives are to determine the contaminant levels in surface water and sediment as Tulpehocken Creek enters and leaves the site, the extent of downstream contamination, if any, the contaminant levels in abandoned quarries near the site, and the effect that contaminants from the Whitmoyer site in surface water and sediment is having on aquatic biota.

The first item in the surface water program is to determine the effect(s) the Whitmoyer Laboratories Site is having on Tulpehocken Creek during different baseflow conditions. To measure these effects, the surface water will be sampled twice (once in July and once in late September or early October 1983). One of these sampling events will occur during summer baseflow, while the second event will occur during late summer or early fall, when low baseflow is expected to occur. Stream flow measurements will be taken prior to sampling. Both field-filtered and unfiltered samples will be collected from 14 locations in Tulpehocken Creek (see Table 4-3). These locations are shown in Figures 4-7 and 4-8.

Stream flow volumes will be measured at the upstream and downstream sampling locations closest to the site during each of the two sampling rounds. A Gurleymeter or similar device will be used to measure stream velocities at selected points across the stream channel. A profile of the stream will also be developed by measuring the width of the stream and measuring water depths at selected points across the stream cross-section. The number of depth and flow velocity measurements to be taken at each flow volume measuring station will be determined in the field, based on observed conditions within the stream channel. The stream cross-section and flow velocity data will be combined to determine flow volume per unit time at each measurement station.

The surface water samples will be collected by immersing the appropriate sample containers at the above locations in a zone

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TABLE 4-3

SURFACE WATER/SEDIMENT LOCATIONS AND RATIONALE
WHITMOYER LABORATORIES SITE

Station(1) Number	Description	Rationale
1(3,4)	Tulpehocken Creek at T-489 Bridge - Upstream	Determine background surface water/sediment quality
2(2,3)	Tulpehocken Creek at Ramona Road Bridge	Determine surface water/sediment quality as stream enters site
3(4)	Union Canal upstream of vault	Assess impact from site on reach from Station 2 to Station 3
4(4)	Union Canal at fish pond	Assess impact from site on reach from Station 3 to Station 4
5	Union Canal prior to confluence with Tulpehocken Creek	Assess impact from site on reach from Station 4 to Station 5
6	Tulpehocken Creek north of vault	Assess impact from site on reach from Station 2 to Station 6
7	Tulpehocken Creek north of stack	Assess impact from site on reach from Station 6 to Station 7
8(2.3,4)	Tulpehocken Creek at Fairlane Avenue Bridge	Assess impact from site on reach from Stations 5 and 7 to 8
9	Tulpehocken Creek at Race Street	Assess impact from site on reach from Station 8 to Station 9
10(2)	Tulpehocken Creek at College Avenue Bridge	Assess impact from site on reach from Station 9 to Station 10
11	Tulpehocken Creek above Sewage Treatment Plant (STP)	Assess impact from site or reach from Station 10 to Station 11
12	Tulpehocken Creek below STP	Assess impact of site (and STP) from Station 11 to Station 12
13(3)	Tulpehocken Creek Womelsdorf Bridge	Assess impact of site on reach from Station 12 to Station 13
14(3,4)	Tulpehocken Creek above Charming Forge Lake	Assess impact of site on reach from Station 13 to Station 14
15(4)	Charming Forge Lake	Assess impact of site on Charming Forge Lake
16(4)	Myerstown Pond	Assess impact from site
17(4)	Lakeside Quarry	Assess impact from contaminated groundwater

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TABLE 4-3
SURFACE WATER/SEDIMENT LOCATIONS AND RATIONALE
WHITMOYER LABORATORIES SITE
PAGE TWO

Station(1) Number	Description	Rationale
18	Wenger Quarry No. 1	Assess impact from contaminated groundwater
19	Wenger Quarry No. 2	Assess impact from contaminated groundwater
20	Abandoned Quarry west of site	Assess impact from contaminated groundwater

(1) Tulpenhocken Creek Station numbers can be cross-referenced with Figures 4-7 and 4-8.
(2) Surface water and sediment at these sites to be analyzed for TAL inorganics and TCL (BNA and VOA) for the second sampling round. All other samples will be analyzed for indicator parameters, arsenic, and iron only.
(3) A benthic macroinvertebrate study will be conducted at these sites.
(4) Fish will be captured and chemically analyzed at these sites.

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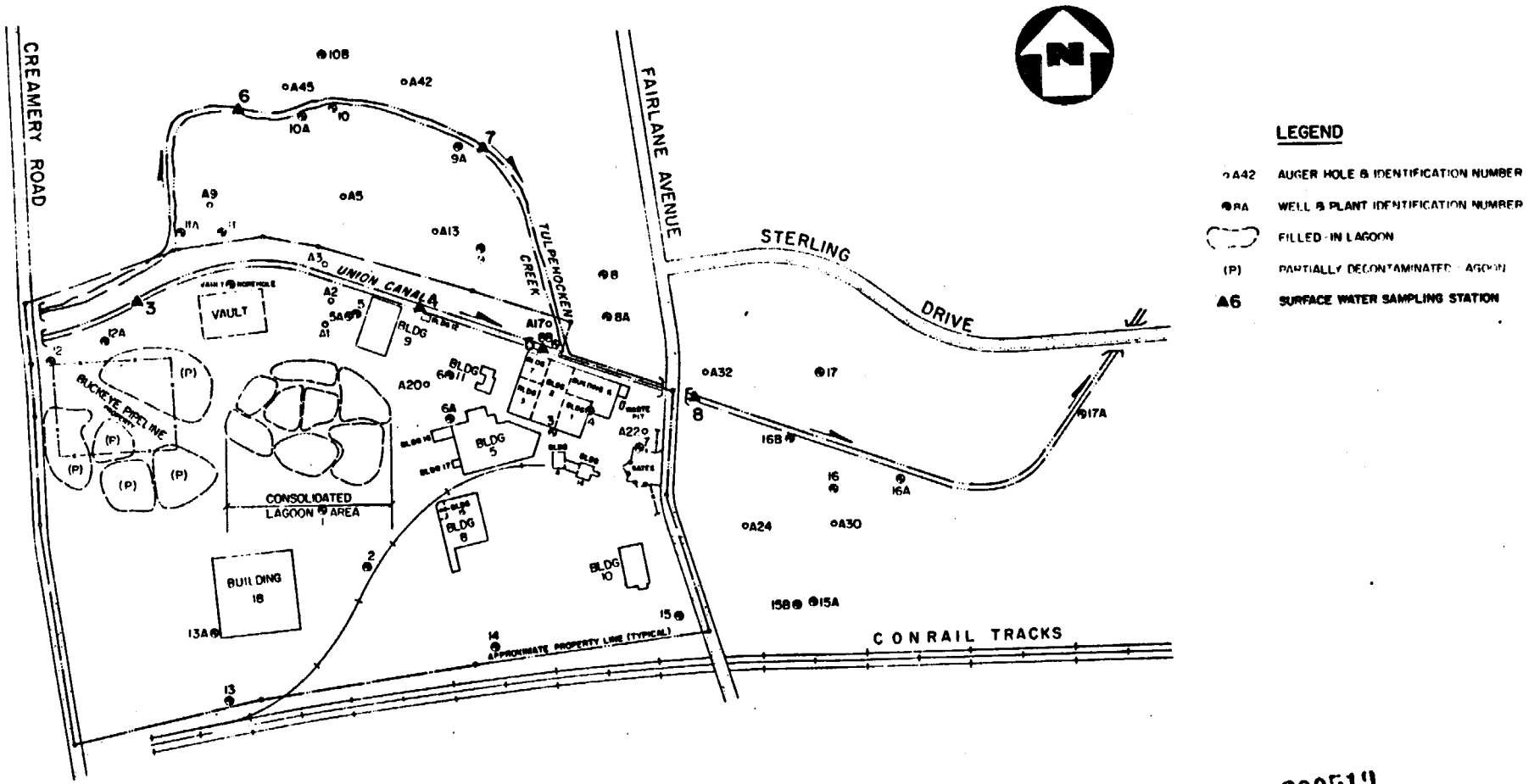

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FIGURE 4-7

LOCAL SURFACE WATER SAMPLING STATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

NUS CORPORATION

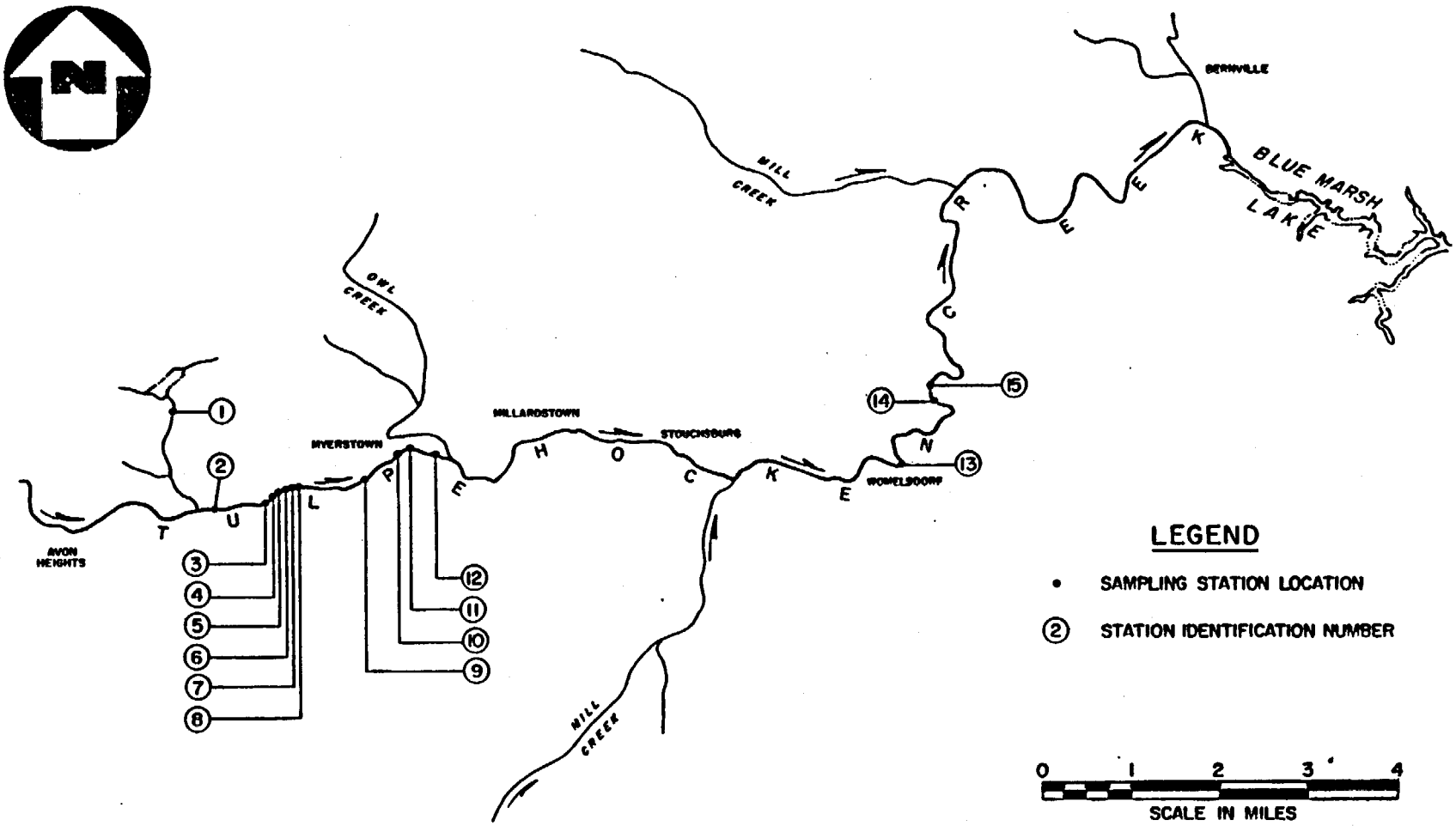

FIGURE 4-8

REGIONAL SURFACE WATER SAMPLING STATIONS
WHITMOYER LABORATORIES SITE, MYERSTOWN, PA

NUS CORPORATION

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at each location where the stream is well-mixed. Tulpehocken Creek will be sampled from downstream to upstream during the sampling events to avoid entraining sediments in the stream flow which could possibly be sampled at downstream locations. Both filtered and unfiltered surface water samples will be collected for comparison. The filtered samples will be collected using a 0.45 micron filter and a peristaltic pump, which does not contact the sample. FT-7.08, Section 5.3 (Appendix A, exceptions as noted) provides additional details regarding surface water sampling.

At 3 of the 14 sample locations, the upstream Prescott Drive Bridge, the immediately downstream Fairlane Avenue Bridge, and the further downstream College Street Bridge, unfiltered surface water samples will be collected for a full TCL (VOA and BNA) and TAL inorganics scan during the second sampling round. These samples will be used to assess the level of contaminants other than arsenic in the creek.

There is a concern that the acute freshwater quality criteria for arsenic will be exceeded during rain events, due to overland transport of both dissolved and sorbed arsenic. To address this concern, an overland transport model will be developed.

The approach to modeling the site for overland transport will be to collect pertinent modeling data before and during a rain event, followed by calibrating two or three simple models with the collected data. These models will then be used to predict the effects of different types of rain events, using historical precipitation records.

To provide stream flow and overland transport arsenic contributions during a rain event, unfiltered surface water samples will be collected from the Ramona Road bridge and Fairlane Avenue bridge sample stations during and immediately after a rain event. Three samples will be collected from the Ramona Road (upstream) location. These samples will be collected: one at the start of the rainstorm, one during the storm, and one at the storm's conclusion.

Twenty-seven samples will be collected from the downstream location. These samples include one at the beginning of the rain, one during the rain, one at the rain's conclusion, followed by one per hour during the next 24 hours. Additionally, stream flow volumes will be measured at both sample points at the time of each sample's collection, using the procedure described previously in this section. Finally, the rainfall intensity will be measured by a continuous rainfall recorder. This effort will be coordinated with the National Weather Service to ensure a substantial storm will occur and to know when the storm has concluded.

Tulpehocken Creek sediment samples will be collected during the second round of surface water sampling only at all 14 creek stations. These samples will be collected after the surface

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water sample is collected using a stainless steel scoop. The top 1 foot of sediment will be sampled. At the sample locations the exact sampling spot will be selected from the area at the location with the maximum amount of fines (small particles) present. Since these areas are expected to have the most contamination, this represents a worst-case, biased sampling strategy. FT-7.08, Section 5.4, (Appendix A, exceptions as noted) describes sediment sampling techniques.

The sediment samples from the three sample locations where surface water will be subjected to a full TCL-TAL scan will also be analyzed for BNA, VOA and inorganic analytes. This data will be evaluated to determine the presence of other contaminants in the creek sediment at the site.

Six surface water and sediment samples will also be collected from lakes and quarries near the site. These bodies of water, which may be influenced by ground and surface water contamination from the site, are Myerstown Pond, Lakeside Quarry, Charming Forge Lake, an abandoned quarry west of the site, and two abandoned quarries on the Wenger property northeast of the site.

Prior to sampling these lakes, a dissolved oxygen (DO) and conductivity vertical profile in the lake will be generated by lowering a DO-conductivity probe into the lake. If a lake is found to be well-mixed, a surface water grab sample will be collected from anywhere in the lake water column. If a lake is found to be stratified, a grab sample will be collected from the deepest (most anaerobic) zone. This zone is likely to have the highest arsenic concentrations in the lake. Water samples will be collected from a small boat with a Kemmerer sampler or similar device.

Due to the difficulty in collecting sediment samples at significant water depths, these samples will be collected from shallow zones (or ledges) in the lakes. Samples will be collected from the area of the lake where surface or groundwater most affected by the site would be entering the lake. This protocol will bias the sample to increase the probability of finding the highest sediment contaminant concentrations in the lake.

Biological Assessment

Aquatic biological surveys of areas impacted by the Whitmoyer Laboratories site will include a benthic macroinvertebrate survey of Tulpehocken Creek and a fishery survey of area lakes, as well as Tulpehocken Creek. Survey locations are listed in Table 4-3. A wetlands delineation study will also be included. Should results of the surface water, sediment, or fish tissue chemical analysis show unusually high concentrations of arsenic, or other chemicals, the need for additional sampling will be assessed.

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Benthic Macroinvertebrates

Macroinvertebrates are important intermediaries in the utilization and recycling of nutrients in the aquatic environment. they also serve as a major food source for fish and help determine the well-being of these populations. They also possess several characteristics which make them useful for detecting environmental stresses. First, most members possess limited mobility so that their status reflects conditions in the immediate vicinity of the collection. Secondly, they have life spans from several months to a few years. Thus, their community structure reflects conditions in the recent past, including intermittent fluctuations of water quality which would be difficult to detect with periodic chemical sampling.

Macroinvertebrate sampling will consist of either quantitative or semi-quantitative collections. These types of collection determine the abundance of each taxa per unit area of habitat providing measures of population densities and community diversity which may be used to detect variations over time and location. Community diversity reflects both the abundance and evenness of distribution of individuals in a collection. Lowered diversity values are often found immediately below a point source of pollution, because the communities are made up of many individuals from a pollution tolerant species.

Transects consisting of riffle-type habitat will be located within the study area. Table 4-3 lists proposed benthic macroinvertebrate sampling locations. Specific transect locations will be assigned prior to the invertebrate survey and will be photo-documented at the time of selection. An effort will be made to locate all transects near surface water sampling points. Transects will be located to assure similar substrate and habitat type at all locations within each stream.

Macroinvertebrates will be sampled at two stations along each riffle transect. Each station will be located mid-way between each stream bank and mid-stream. Samples will be collected with a Surber bottom sampler (0.1 m^2 surface area), using equal time and effort at each station. However, should the depth of the stream exceed one foot at the majority of sampling locations, semi-quantitative collections will be made using a D-frame net (30 cm wide x 25 cm high), using equal time and effort at each station. The technique involves placing the net against the stream bottom and thoroughly disturbing the substrate directly upstream by kicking. Macroinvertebrates dislodged from the substrate are carried into the net by water current. A single sample is constituted by pooling two subsamples collected over a period of 1 minute each from the same area.

The use of kicknets as employed in this project is supported by scientific literature. According to Frost, et al. (1971), kicknet samples from similar habitats provide consistent information, and samples collected by different individuals showed little variation when habitats were similar. Frost,

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et al. (1971) noted that 87 percent of all benthic taxa were collected with two kicknet samples. Pollard and Kinney (1979), in a USEPA document, also compared the kicknet technique to other sampling methods. They found that the kicknet method collected more taxa and individuals per sample with equivalent or lower variability than the Surber sampler and the portable invertebrate box sampler. It should be pointed out that only one of the aforementioned samplers will be used at all locations in the study area, depending on field conditions.

Samples will be fixed in the field with 70 percent ethanol and returned to the laboratory where the macroinvertebrates will be separated from the substrate, sorted, identified, and counted.

Samples will be analyzed individually for number of taxa and number of individuals per taxon. Community analyses on individual samples will include community diversity (Shannon-Weiner) index and percent composition by taxa.

Fish Sampling

Stream and lake fisheries will be sampled near the Whitmoyer Laboratories Site and analyzed for arsenic assimilation in fish organs and tissues. Collections will also be analyzed for species composition and relative abundance at each station. Table 4-3 lists fish sampling locations. All stations will be photo-documented when they are located.

Each stream station will be sampled using electrofishing equipment. Nets will be placed at the upper and lower limits of each station to block the movements of fish during shocking runs. A standard length of stream (200 feet) will be sampled at each location. All individuals collected will be identified, weighed and measured (total length) in the field. Voucher specimens will be preserved in a 10 percent formalin solution and returned to the laboratory. Individuals selected for tissue analysis will be wrapped in aluminum foil, frozen using dry ice, and returned to the laboratory for processing.

Stations located at standing bodies of water will be sampled using gill nets, minnow traps, and/or boat mounted electrofishing equipment. Fish collections will be processed as described above for stream sampling. The total area sampled at each stations will depend on the availability of fish and the total volume of sample required to perform the laboratory analysis.

Trout stocked by the Pennsylvania Fish Commission will be collected if encountered. However, any trout collected may be recent introductions into the stream and will have limited exposure to chemicals leaching from the site. Therefore, resident benthic feeding species (e.g., carp or suckers) and game fish (e.g., bass or panfish) populations will also be collected for laboratory analysis. Field biologists will select a minimum of five individuals from the most abundant species of

benthic feeding and game fish collected for each composite tissue sample transferred to the laboratory for processing. However, more than five fish from a single species may be needed to attain the volume of sample required for chemical analysis. All individuals from each species selected will be wrapped in aluminum foil, labeled, chilled, and transported to the laboratory for processing.

Four composite fish samples will be collected for analysis from each station. Two composite whole body samples (one composite of benthic feeders and one composite of game fish) will be collected to provide data on cumulative uptake of chemical in tissue and organs. Two composite fillet samples will also be collected to analyze the uptake of chemicals in edible portions of trout and resident game fish.

Each composite sample will be prepared using a minimum of five individual fish for the whole body analysis and ten fillets for the edible portion tissue analysis. Preparing the composite sample will involve homogenizing all tissue for each composite sample in a tissue blender. Edible portions of fish will be removed using filleting knives on a work surface of aluminum foil. All filleting equipment, homogenizing equipment, and work surfaces will be decontaminated prior to and between each station and fish species processed. Homogenized samples will then be transferred to glass sample bottles, wrapped in aluminum foil, and frozen prior to shipment to the analytical laboratory for chemical analysis.

The following is a summary of the sampling protocols.

Field Collection Procedures

- Field collections will be made using electrofishing equipment, nets (experimental gill and/or seines), baited lines, and minnow traps.
- Fish will be collected, sorted by species, wrapped in aluminum foil, and stored in coolers containing dry ice.
- Samples will remain in custody through preparation of composite samples.
- After laboratory processing, samples will be overnight expressed to analytical laboratory using standard chain of custody forms.
- An attempt should be made to process at least two composite samples at each station location as follows:
  - Composite fillet sample: edible portion of game fish (at least 5 individuals from the same species and approximately the same length)

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- Composite whole body sample: whole body sample of benthic feeding fish (at least 5 individuals from the same species and approximately the same length)

- Species to be analyzed will be determined after all collections have been made.

- Attempts will be made to use the same game fish and benthic feeding fish for chemical analysis at each station.

Fish Processing Procedures

- Locate and arrange fish samples for processing near work area. A minimum of 5 individuals are required for each composite sample.

- Weigh (kg), measure total length (mm), and take scale sample (if possible) of each individual and record on data sheet. Small benthic feeding fish may be weighed as a group and average weight calculated.

- Determine if collection is part of a composite fillet sample or composite whole body sample. If fillet sample, decontaminate filleting equipment and fillet fish using standard techniques on aluminum foil.

- Cut fish tissue into 1 to 3 inch cubes. Homogenize tissue cubes in decontaminated tissue blender. Process at least 5 fish in blender. If more sample is required, continue to process individuals until the required volume of sample has been homogenized. Record number of fish and total weight processed.

- Alternately fill pre-cleaned glass sample bottles with tissue samples. As an example: if 750 ml of sample is required, arrange three 250 ml sample bottles side by side. Fill bottle one, 1/3 full, fill bottle two, 1/3 full, fill bottle three, 1/3 full. Continue this alternating procedure until all sample bottles have been filled (leave approximately 10 percent head space for sample expansion).

- Place sample label on outside of bottle.

- Wrap sample bottle in aluminum foil and secure with freezer tape.

- Attach sample tag to outside of aluminum foiled sample bottle.

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- Freeze homogenized tissue sample and wrap samples in insulating materials (newspaper) prior to shipment to analytical laboratory.

- Decontaminate all processing equipment before storing or processing additional tissue samples.

Field biologists will survey the Whitmoyer Laboratories Site adjacent to Union Canal and Tulpehocken Creek for the presence of wetland areas in late August. Survey methods used will be those outlined by the EPA's Wetland Identification and Delineation Manual (April, 1987).

4.2.14 Offsite Hydrogeologic Investigation

The offsite hydrogeologic investigation proposed is designed to provide data with which to assess current groundwater quality conditions in the local area surrounding the site. The offsite hydrogeologic investigation is summarized in Table 4-2. Figure 4-2 shows offsite new monitoring well locations.

New monitoring wells proposed for the investigation (MW-201 through MW-208B) will be drilled and constructed, as described in Section 4.1.1. The sampling of both these wells and selected previously-existing monitoring wells, estimated at five, will be performed according to the methodology presented in Section 4.1.1. Sampling of residential wells will be performed by flushing water through the home's distribution system for 15-30 minutes, then withdrawing a sample from the system at the closest point possible to the well. If possible, the water sample will be obtained at a point prior to circulating through any filter or treatment system which may be hooked up to the water distribution system. Offsite groundwater analyses, bottle requirements, and preservation requirements are described in Tables 2-1 and 2-2.

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APPENDICES

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APPENDIX A

REM III FIELD TECHNICAL GUIDELINES AND EPA/NIOSH TECHNICAL GUIDELINES

~~classifications may be warranted when the first boring is completed. Although this guideline indicates that geologists will be performing the logging, other qualified geoscience personnel (geotechnical engineers, civil engineers) may perform this work in most cases.~~

5.0 GUIDELINES

5.1 DRILLING LOGS AND DOCUMENTATION

Each boring shall be fully described on a boring log similar or equivalent to that shown in ~~Attachment A~~ the boring section. The rig geologist shall log the boring as it is being drilled by recording relevant data, listed below, on either the appropriate boring log or in a bound field notebook. Boring log forms may be transcribed from the field note book, but must be completed at a minimum on a weekly basis. Data which shall be included in the logs, when applicable are:

1. Identifying number and location of each boring.

2. Depths in feet and tenths of feet.

3. Soil classifications in accordance with the Unified Soil Classification System (see Section 5.2.1 and Attachment B). These classifications will be prepared in the field by the geologist and will be subject to revision based on laboratory tests or subsequent review.

4. A full description of soil samples. For split-spoon, solid tube, thin wall, soil core, or otherwise intact samples, the description will include but not be limited to the USCS two-letter classification, plus a more complete verbal description of color, consistency, grain size and size distribution (see Section 5.2).

5. Depth limits, type and number of each sample taken. All samples shall be numbered consecutively.

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6. ~~The number of blows required for each six inch penetration of split-spoon sampler and for each twelve inch penetration of casing; hammer weight and length of fall for split-spoon or driven samplers; hydraulic pressure used to push thin-wall tubes. If thin-wall tubes are pushed manually, that will be indicated.~~

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7. Depth to water as first encountered during drilling, along with the method of determination. Any distinct water-bearing zones below the first zone also will be noted.

8. If drilling fluid is used the fluid losses, interval over which they occur and the quantity lost will be recorded.

9. ~~A general description of the drilling equipment used. This description, including such information as rod size, bit type, pump type, rig manufacturer, and model, may be provided in a general legend.~~

10. Dates and ~~times~~ of start and completion of boring.

11. Names of Contractor, driller and rig geologist.

12. Size and length of casing used in each borehole.

13. Observations of visible contamination for each sample or from cuttings that appear contaminated.

14. Field instrument readings, such as from temp., pH, specific cond., HNU or OVA meters (see HS-3.01 & 3.02).

As the boring is drilled, the rig geologist will evaluate adjacent samples recovered, together with observation of the drill cuttings, wash water (if any), drill performance, etc., to determine appropriate stratigraphic definitions or distinctions within the soil column. Such contacts or breaks between strata must be determined by the rig geologist and indicated on the boring log. If such information is not provided, the "log" is nothing more than a listing of individual sample descriptions. In general, a stratigraphic unit contains only similar soils which can be classified within the same two-letter USCS classification category symbol. In some cases, significant differences in soil color, grain size distribution, strength, etc., would be sufficient to classify soils having the same two-letter USCS classification category symbol, into two or more distinct strata.

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After the rig geologist has indicated the appropriate stratigraphic breaks on the log, he/she should develop and record an appropriate description for each defined stratigraphic unit. Each description should contain information about the

color, grain size distribution, consistency, moisture, etc., and the appropriate two-letter USCS classification category symbol.

STET ~~Each sample collected for chemical or geotechnical analysis (see Guideline FT-7.03 for sampling methodology) will be labeled according to Guideline FT-7.05 (Sample Identification and Chain-of-Custody), and proper chain-of-custody procedures will be initiated for chemical samples. Sample preservation is described in Guideline FT-7.06 and shipping in Guideline FT-7.07. Soils should be described according to the visual-manual method ASTM D 2488-84.~~

5.2 CLASSIFICATION OF SOILS

All classification data should be written directly on the boring log (if there is enough space) or in a field notebook. The method of deriving the classification should be described, or reference to this guideline or other manuals should be made. Handling of samples during soil classification should be coordinated with chemical sampling activities if appropriate.

5.2.1 USCS Classification

Soils are to be classified according to the Unified Soil Classification System (USCS). ~~This method of classification is detailed in Attachment B.~~ STET STET This method of classification identifies soil types on the basis of grain size and liquid limits, and categorizes them by two-letter symbols.

In the USCS system, fine-grained soils, or fines, are classified as those which will pass through a No. 200 U.S. standard sieve (0.074 mm) and are of two types: silt (M) and clay (C). Some classification systems define size ranges for these soil particles, but for field classification purposes, they are identified by their respective behaviors only. Organic material (O) is a common component of soil but has no size range, and is recognized by its composition.

Coarse-grained soils are divided into two types, rock fragments and sand or gravel. Gravelly soils are identified by a (G) as the first letter in the two-letter symbol, whereas sandy soils are identified with an (S). The term rock fragments should be used to indicate granular materials resulting from the breakup of rock. These materials are normally angular, indicating little or no transport from their source. When the term "rock fragments" is used it should be followed by a size designation such as "(1/4"-1/2" diameter)" or "coarse-sand size" either immediately after the entry or in the remarks column. The USCS classification would not be affected by this variation in terms.

The second letter in the two-letter USCS symbol provides information about the grain size distribution of granular soils, or the plasticity characteristics of fine-grained soils. These second-letter modifiers are (P) poorly graded/well sorted, (W) well graded/poorly sorted, (C) clayey, (M) silty, (L) low plasticity, or (H) high plasticity.

5.2.2 Color

Soil colors should be described utilizing a single color descriptor preceded, when necessary, by a modifier to denote variations in shade or color mixtures. A soil could therefore be referred to as "gray" or "light gray" or "blue-gray". Since color can be utilized in correlating units between sampling locations, it is important that color descriptions be kept consistent throughout the field operations.

Colors must be described while the sample is still moist. Soil samples should be broken or split vertically to describe colors. Soil sampling devices tend to smear the sample surface creating color differences between the sample interior and exterior. ~~Munsell Color Charts or equivalent must be used, for soil and GSA rock color charts, and for rock.~~

5.2.3 Relative Density and Consistency

To classify the relative density and/or consistency of a soil, the geologist must first identify the soil type. Granular soils contain predominantly sands and gravels and are generally noncohesive (particles do not adhere well when compressed). Finer grained soils (silts and clays) are cohesive (particles will adhere together when compressed).

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The density of noncohesive, granular soils is classified according to standard penetration resistances obtained from split barrel sampling methods detailed in Guideline FT-7.03. Those designations are:

Designation	Standard Penetration Resistance (blows per foot)
Very loose	0 to 4
Loose	5 to 10
Medium dense	11 to 30
Dense	31 to 50
Very dense	Over 50

Standard penetration resistance is the number of blows required to drive a split-barrel sampler with a 2-in. outside diameter 12 in. into the material using a 140-lb hammer falling fruely through 30 in. The sampler is driven through an 18-in. or 24-in. sample interval and the number of blows is recorded for each 6-in. increment. The density designation of granular soils is obtained by adding the number of blows required to penetrate the second and third 6 inches of each sample interval. It is important to note that if gravel or rock fragments are broken by the sampler or if rock fragments are lodged in the tip, the resulting blow count will be erroneously high, reflecting a higher density than actually exists. This should be noted on the log and referenced to the sample number.

The consistency of cohesive soils is determined by performing field tests and identifying the consistency as shown in Attachment C. The consistency of cohesive soils is determined either by blow counts or most accurately by a pocket penetrometer or field Torvane device in accordance with ASTM D2573-72(1978). The pocket penetrometer method is conducted on a selected sample of the soil, preferably the lowest 0.5 ft of the sample in the split-barrel sampler. The sample should be broken in half and the penetrometer pushed into the end of the sample to determine the consistency. Do not determine consistency by attempting to penetrate a rock fragment. If the sample is decomposed rock, it is classified as a soft decomposed rock rather than a hard soil. The pocket penetrometer or Torvane may be used in conjunction with blow counts to determine cohesive soil consistency.

5.2.4 Soil Components

In nature, soils are comprised of particles of varying size and shape and are combinations of the various soil types. Attachment B lists grain size classifications to be used in describing soils or rocks. The following terms are useful in the description of soil components:

Terms Identifying Proportion of the Component	Defining Range of Percentages by Weight
trace	0-10%
little	11-20%
some	21-35%
"and"	36-50%

These descriptions are adopted from the Burmeister Classification System (Reference 4 of this guideline), and are more completely described in Attachment H.

5.2.5 Moisture

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Moisture content is estimated in the field according to four categories: dry, moist, wet, ~~and saturated~~. In dry soil, there appears to be little or no water. Saturated samples obviously have all the water they can hold. Moist and ~~wet~~ classifications are somewhat subjective and often are determined by the individual's judgement. A suggested parameter for judging this in a fine-grained soil would be calling a soil wet if rolling it in the hand or on a porous surface liberates water, i.e., ~~dirties or~~ muddies the surface. Whatever method is adopted for describing moisture, it is important that the method used by an individual remains consistent throughout an entire drilling job.

Laboratory or field tests for water content should be performed if the natural water content is important.

5.2.6 Stratification

~~Stratification can only be determined after the sample barrel is opened. The stratification or bedding thickness for soil and rock is dependent on grain size and composition. The classification to be used for stratification description is shown in Attachment D.~~

5.2.7 Additional Descriptors

Geologic descriptors of soils encountered in borings should be included, if appropriate, even though they are not required for soil classification by the USCS: For example, the angularity of non-cohesive grains (rounded, subrounded, angular, subangular), the shape of the grains, cementation and carbonate content (HCl reaction). The classification or identification of soils using a system other than USCS may be added, but must be identified.

5.2.8 Quick Field Identification Aids and Helpful Hints

In addition to visual observation of the soils recovered in sampling devices, certain quick field tests may be performed to assist in classifying these soils. Since many of these quick field tests require some additional handling of the samples, they should only be used in cases where doing so will not be hazardous. Some of these visual aids in soil identification are:

- To evaluate plasticity to distinguish between clay and silts, dry a pat of soil quickly by placing it on a hot surface (i.e., exhaust pipe of the drill rig). Attempt to crumble the fully dried pat in the hand. Clays will tend to break into fragments, with increasing strength displayed by clays of greater plasticity (CH soils). Conversely, pure silt will have virtually no internal cohesion and will very easily pulverize to a very fine powder.

- When a pat of wet silt is held in the hand and shaken (by taping one hand against the other), free water will appear on the surface of the soil, which when touched will recede back into the pat of soil.

- Clays are sticky to the touch, while silts give no such sticky feeling. Highly plastic clays (CH) will exhibit a greasy feeling.

- Organic soils are usually dark in color (dark brown or black), have an organic (earthy) odor, and often contain remnants of the vegetable matter from which they were formed. When hydrogen peroxide is applied to organic soils, it will bubble and fizz; however, this same reaction can also be caused by certain metals (e.g., iron) # in the soil.

- With experience, the percentage of fines in granular soils can be judged by the degree to which handling the wet soil dirties or stains one's hand or gloves. Relatively clean (<5% fines) soils (SP, GP, SW, GW) leave little or no stain, while soils with more than 12% fines (SC, SM, GC, GM) will leave a noticeable stain when handled wet.

- The ability to roll a "thread" of a fine grained soil is an indication of its plasticity. In a moist state highly plastic soils (CH) can be rolled to a very thin (1/16-inch) diameter without breaking, while non-cohesive pure silt cannot be rolled to a thread without crumbling.

- To aid in identifying the grain size distribution of granular soils, samples of each fraction (fine, medium, coarse) can be prepared in the laboratory and used in the field for comparison against the sample. Such comparative samples can either be contained in individual vials or glued on a piece of cardboard.

- Well graded granular soils, within the limited definition of USCS (SW or GW), do not frequently occur in nature. Therefore, while a sample may appear to contain all of the sizes for granular soil (fine, medium and coarse), it is not likely to contain them in the proper proportions to meet the USCS definitions for well graded soil. Thus, field classifying such soils as poorly graded (SP or GP) is more likely to be correct in most cases.

5.3 CLASSIFICATION OF ROCKS

Rocks are grouped into three main divisions: sedimentary, igneous and metamorphic. Sedimentary rocks are by far the most predominant type exposed at the earth's surface. The following basic names are applied to the type of rocks found in sedimentary sequences:

1. Sandstone - Made up predominantly of granular materials ranging between 1/16 and 2 in. in diameter.

2. Siltstone - Made up of granular materials less than 1/16 in. in diameter. Fractures irregularly. Medium thick to thick bedded.

3. Claystone - Very fine grained rock made up of clay and silt-size materials. Fractures irregularly. Very smooth to touch. Generally has irregularly spaced pitting on surface of drilled cores.

4. Shale - A fissile very fine grained rock. Fractures along bedding planes.

5. Limestone - Rock made up predominantly of calcite ($CaCO_3$). Effervesces upon the application of hydrochloric acid.

6. Coal - Rock consisting mainly of organic remains.

7. Others - Numerous other rock types are present in the geologic section. Their overall abundance is dependent upon the geographical locations.

In classifying a sedimentary rock the following hierarchy should be noted:

- Rock Type
- Color
- Bedding Thickness
- Hardness
- Fracturing
- Weathering
- Other characteristics

All classification data should be written directly on the boring log or in a field notebook. The method of deriving the classification should be described or reference to this guideline or other manuals used should be included.

5.3.1 Rock Type

As described above, there are numerous names for sedimentary rocks. In most cases a rock will be a combination of several rock types, therefore a modifier such as a sandy siltstone or a silty sandstone can be used. The modifier indicates that a significant portion of the rock type is composed of the modifier. Other modifiers can include carbonaceous, calcareous, siliceous, etc.

Grain diameters are used for the classification of clastic sedimentary rock. Attachment E is the Udden-Wentworth classification that will be assigned to sedimentary rocks. The individual boundaries are slightly different than the USCS subdivision for soil classification. For field determination of grain sizes, a scale can be used for the coarse grained rocks.

The division between very fine sandstone and siltstone is probably not measurable in the field. The boundary should be determined by use of a hand lens. If the grains cannot be seen with the naked eye but are distinguishable with a hand lens, the rock is a siltstone. If the grains are not distinguishable with a hand lens, the rock is a claystone.

5.3.2 Color

The color of a rock can be determined in the same manner as for soil samples. Rock core samples should be classified while wet, when possible, and air cored samples should be scraped clean of cuttings prior to color classifications. ~~Munsell Color Charts or equivalent must be used for rock descriptions.~~ GEA ~~Munsell Color Charts will be used for soil.~~

5.3.3 Stratification

The bedding thickness designations applied to soil classification will ~~also~~ be used for rock classification.

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5.3.4 Hardness

The hardness of a rock is a function of the compaction, cementation, and mineralogical composition of the rock. A relative scale for sedimentary rock hardness is as follows:

Soft - Weathered, considerable erosion of core, easily gouged by screwdriver, scratched by fingernail. Soft rock crushes or deforms under pressure of a pressed hammer. This term is always used for the hardness of the saprolite (decomposed rock which occupies the zone between the lowest soil horizon and firm bedrock).

Medium soft - Slight erosion of core, slightly gouged by screwdriver, or breaks with crumbly edges from single hammer blow.

Medium hard - No core erosion, easily scratched by screwdriver or breaks with sharp edges from single hammer blow.

Hard - Requires several hammer blows to break and has sharp conchoidal breaks. Cannot be scratched with screwdriver.

Note the difference in usage here of the words "scratch" and "gouge". A scratch should be considered a slight depression in the rock (do not mistake the scraping off of rock flour from drilling with a scratch in the rock itself), while a gouge is much deeper.

5.3.5 Fracturing

The degree of fracturing of a rock is described by measuring the fractures or joint spacing. After eliminating drilling breaks, the average spacing is calculated and the fracturing is described by the following terms:

Very broken (V. BR.) - Less than 2 in.
Broken (BR.) - 2 in. to 1 ft.
Blocky (BL.) - 1 to 3 ft.
Massive (M.) - 3 to 10 ft.

The structural integrity of the rock can be approximated by calculating the Rock Quality Designation (RQD) of cores recovered. The RQD is determined by adding the total lengths of all pieces exceeding four inches and dividing by the total length of the coring run, to obtain a percentage:

$$RQD = (r/l) \times 100$$

where:

r = Total length of all pieces of the lithologic unit being measured, which are greater than 4 inches in length, and have resulted from natural breaks. Natural breaks include slickensides, joints, compaction slicks, bedding plane partings (not caused by drilling), friable zones, etc., and

l = Total length of the coring run.

5.3.6 Weathering

The degree of weathering is a significant parameter that is important in determining weathering profiles and is also useful in engineering designs. The following terms can be applied to distinguish the degree of weathering.

Fresh - Rock shows little or no weathering effect. Fractures or joints have little or no staining and rock has a bright appearance.

Slight - rock has some staining (i.e., discoloration along joints, cracks or exposed surfaces) which may penetrate several centimeters into the rock. Clay filling of joints may occur. Feldspar grains may show some alteration.

Moderate - Most of the rock, with exception of quartz grains, is stained. Rock is weakened due to weathering and can be easily broken with hammer.

Severe - All rock, including quartz grains, is stained. Some of the rock is weathered to the extent of becoming a soil. The rock is very weak and crumbly.

5.3.7 Other Characteristics

The following items should be included in the rock description:

1. Description of contacts between two rock units. These can be sharp or gradational.

2. Description of any filled cavities or vugs.

3. Description of any joints or open fractures.

4. Notation of joints with depth, approximate angle to vertical, any mineral filling or coating, and degree of weathering.

As an attachment to the log, additional information should be provided, including an estimation of the degree of cementation and type of cement for granular sedimentary rocks; a description of the texture and fabric of the rock (i.e., the shape and relationship of component particles or crystals); and the structure or macroscopic features of the rock mass. Generally, rock structure is best seen in the outcrop rather than the hand specimen, but some indications of structure (e.g., horizontal or dipping beds, open joints) can be obtained from core samples.

5.3.8 Additional Terms Used in the Description of Rock

The following terms are used to further identify rocks:

1. Seam - Thin (12 in. or less), probably continuous layer.

2. Some - Indicates significant (15 to 40 percent) amounts of the accessory material. For example, rock composed of seams of sandstone (70 percent) and shale (30 percent) would be "sandstone -- some shale seams."

3. Few - Indicates small (0 to 15 percent) amounts of the accessory material. For example, rock composed of seams of sandstone (90 percent) and shale (10 percent) would be "sandstone -- few shale seams."

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4. Interbedded - Used to indicate thin or very thin alternating seams of material occurring in approximately equal amounts. For example, rock composed of seams of sandstone (50 percent) and shale (50 percent) would be "interbedded sandstone and shale."

5. Interlayered - Used to indicate thick alternating seams of material occurring in approximately equal amounts.

5.4 BOREHOLE GEOPHYSICAL LOGGING

5.4.1 General

Geophysical well logs can be utilized to determine the lithology, geometry, electrical properties, bulk density, radioactivity, permeability, porosity, moisture content and specific yield of water-bearing rocks. Geophysical well logging, also called borehole or downhole geophysics, includes all techniques utilizing a sensing device which is raised and lowered in the borehole while continuously recording a physical parameter. This parameter may be interpreted to determine the physical characteristics of subsurface geologic materials, the fluids contained within these materials, and the construction of the well.

A summary of the commonly available types of geophysical logs and their applications is presented in Attachment F. The type of logging to be performed at a particular site depends greatly upon the amount and type of geologic information required, and the geologic environment of the site. Geophysical logs are normally performed in suites of log types to aid in interpretation and correlation of information.

The general principles and rules of log interpretation are universal, regardless of differences in specific instrumentation. Each type of geophysical logging tool is calibrated and logging is performed in accordance with the manufacturer's specifications and certain industry standards. This assures objective and consistent results and interpretation.

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If S > H use S, if S < H use H

Vt = (Vc + Vf) (7.48)

Where,

Vc = Volume of water in casing, ft^3

Vf = Volume of water in filter pack, ft^3

Vt = Total volume, gal

di = inside diameter of casing, ft

do = outside of diameter of casing, ft

dH = diameter of borehole, ft

TD = total depth of well, ft

H = depth to water, ft, from ground surface

S = depth to base of seal, ft, from ground surface

P = estimated porosity of filter pack (for most Ottawa, Morie #1 sand or glass beads this value is estimated at a range of 30 to 35%)

7. Determine the minimum number of volumes to be evacuated before sampling.

5.4 EVACUATION OF STATIC WATER (PURGING)

5.4.1 General

The amount of flushing a well should receive prior to sample collection will depend on the intent of the monitoring program and the hydrogeologic conditions. Programs to determine overall quality of water resources may require long pumping periods to obtain a sample that is representative of a large volume of that aquifer. The pumped volume may be specified prior to sampling so that the sample can be a composite of a known volume of the aquifer.

For defining a contaminant plume, a representative sample of only a small volume of the aquifer is required. These circumstances require that the well be pumped enough to remove the stagnant water but not enough to induce significant groundwater flow from other areas. Generally three to five well volumes are considered effective for purging a well.

~~An alternative method of purging a well, and one accepted in Regions I and IV, is to purge a well continuously (usually using a low volume, low flow pump) while monitoring specific conductance, pH, and water temperature until the values stabilize.~~

The site hydrogeologist, geochemist and risk assessment personnel shall define the objectives of the groundwater sampling program in the Work Plan, and provide appropriate criteria and guidance to the sampling personnel on the proper methods and volumes of well purging.

5.4.2 Evacuation Devices

The following discussion is limited to those devices which are commonly used at hazardous waste sites. Attachment A provides guidance on the proper evacuation device to use for given sampling situations. Note that all of these techniques involve equipment which is portable and readily available.

Bailers - Bailers are the simplest evacuation devices used and have many advantages. They generally consist of a length of pipe with a sealed bottom (bucket-type bailer) or, as is more useful and favored, with a ball check-valve at the bottom. An inert line (e.g., Teflon-coated) is used to lower the bailer and retrieve the sample.

Advantages of bailers include:

- Few limitations on size and materials used for bailers
- No external power source needed
- Bailers are inexpensive, and can be dedicated and hung in a well to reduce the chances of cross-contamination
- There is minimal outgassing of volatile organics while the sample is in bailer
- Bailers are relatively easy to decontaminate.

Limitations on the use of bailers include the following:

- It is time consuming to remove stagnant water using a bailer
- Transfer of sample may cause aeration
- Use of bailers is physically demanding, especially in warm temperatures at protection levels above Level D.

Suction Pumps - There are many different types of inexpensive suction pumps including centrifugal, diaphragm, peristaltic, and pitcher pumps. Centrifugal and diaphragm pumps can be used for well evacuation at a fast pumping rate and for sampling at a low

pumping rate. The peristaltic pump is a low volume pump (therefore not suitable for well purging) that uses rollers to squeeze a flexible tubing, thereby creating suction. This tubing can be dedicated to a well to prevent cross contamination. The pitcher pump is a common farm hand-pump.

These pumps are all portable, inexpensive and readily available. However, because thay are based on suction, their use is restricted to areas with water levels within 20 to 25 ft of the ground surface. A significant limitation is that the vacuum created by these pumps can cause significant loss of dissolved gases and volatile organics. In addition, the complex internal components of these pumps may be difficult to decontaminate.

Gas-Lift Samplers

This group of samplers uses gas pressure either in the annulus of the well or in a venturi to force the water up a sampling tube. These pumps are also relatively inexpensive. Gas lift pumps are more suitable for well development than for sampling, because the samples may be aerated, leading to pH changes and subsequent trace metal precipitation or loss of volatile organics. An inert gas such as nitrogen is generally used.

Submersible Pumps

Submersible pumps take in water and push the sample up a sample tube to the surface. The power sources for these samplers may be compressed gas or electricity. The operation principles vary and the displacement of the sample can be by an inflatable bladder, sliding piston, gas bubble, or impeller. Pumps are available for 2-in diameter wells and larger. These pumps can lift water from considerable depths (several hundred feet).

Limitations of this class of pumps include:

- They may have low delivery rates
- Many models of these pumps are expensive
- Compressed gas or electric power is needed
- Sediment in water may cause clogging of the valves or eroding the impellers with some of these pumps
- Decontamination of internal components is difficult and time-consuming.

5.5 SAMPLING

5.5.1 Sampling Plan

The sampling approach consisting of the following, should be developed as part of the FSAP prior to the field work:

1. Background and objectives of sampling
2. Brief description of area and waste characterization
3. Identification of sampling locations, with map or sketch, and applicable well construction data (well size, depth, screened interval, reference elevation)
4. Sampling equipment to be used
5. Intended number, sequence volumes, and types of samples. If the relative degrees of contamination between wells is unknown or insignificant, a sampling sequence which facilitates sampling logistics may be followed. Where some wells are known or strongly suspected of being highly contaminated, these should be sampled last to reduce the risk of cross-contamination between wells as a result of the sampling procedures.
6. Sample preservation requirements
7. Working schedule
8. List of team members
9. List of observers and contacts (see Guideline FT-7.04)
10. Other information, such as the necessity for a warrant or permission of entry, requirement for split samples, access problems, location of keys, etc.

5.5.2 Sampling Methods

The collection of a groundwater sample is made up of the following steps:

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1. HSO or designee will first open the well cap and use volatile organic detection equipment (HNU or OVA) on the escaping gases at the well head to determine the need for respiratory protection.

2. When proper respiratory protection has been donned, sound the well for total depth and water level (using clean equipment) and record these data in the field notebook. Calculate the fluid volume in the well according to section 5.3 of FT-7.02.

3. Calculate depth from the casing top to the midpoint of the screen or well section open to the aquifer. Any dry wells encountered must be noted.

4. Select appropriate purging equipment (see Attachment B). If an electric submersible pump with packer is chosen, go to Step 11.

5. Lower purging equipment or intake into the well to a short distance below the water level and begin water removal. Collect the purged water and dispose of it in an acceptable manner. Lower the purging device, as required, to maintain submergence.

6. ~~If pumping, measure water level with an electric sounder in uniform increments of 15- to 30-second intervals. If bailing, measure water levels as needed for a good record. This method of purging is not recommended in Region IV although it is minimally acceptable. (These data may be used to estimate aquifer transmissivity and other hydraulic characteristics.)~~

7. ~~Measure rate of discharge frequently. A bucket and stopwatch are most commonly used; other techniques include using pipe trajectory methods, weir boxes or flow meters.~~

8. Observe peristaltic pump intake for degassing "bubbles." If bubbles are abundant and the intake is fully submerged, this pump is not suitable for collecting samples for volatile organics. The preferred method for collecting volatile organic samples and accepted by EPA Regions I through IV is with a bailer.

9. Purge a minimum of three-to-five casing volumes before sampling. In low permeability strata (i.e., if the well is pumped to dryness), one volume will suffice. Allow the well to recharge to at least 70% of the static water level and then sample.

10. If sampling using a pump, lower the pump intake to midscreen or the middle of the open section in uncased wells and collect the sample. If sampling with a bailer, lower the bailer to sampling level before filling (this requires use of other than a "bucket-type" bailer). Purged water should be collected in a designated container and disposed of in an acceptable manner.

11. (For pump and packer assembly only). Lower assembly into well so that packer is positioned just above the screen or open section and inflate. Purge a volume equal to at least twice the screened interval or unscreened open section volume below the packer before sampling. Packers should always be tested in a casing section above ground to determine proper inflation pressures for good sealing.

12. In the event that recovery time of the well is very slow (e.g., 24 hours), sample collection can be delayed until the following day. If the well has been bailed early in the morning, sufficient water may be standing in the well by the day's end to permit sample collection. If the well is incapable of producing a sufficient volume of sample at any time, take the largest quantity available and record in the logbook.

13. Add preservative if required (see Guideline FT-7.06). Label, tag, and number the sample bottle(s) (see Guideline FT-7.05). Tape the lid on securely and mark the tape with the date and the collector's initials.

14. Replace the well cap. Make sure the well is readily identifiable as the source of the samples.

15. Pack the samples for shipping (see Guideline FT-7.07). Attach a custody seal to the shipping package as described in Guideline FT-7.05. Make sure that traffic reports and chain-of-custody forms are properly filled out and enclosed or attached (see Guidelines FT-7.04 and FT-7.05).

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5.5.6 Handling and Transporting Samples

After collection, samples should be handled as little as possible. It is preferable to use self-contained "chemical" ice (e.g., "blue ice") to reduce the risk of contamination. If water ice is used, it should be bagged and steps taken to ensure that the melted ice does not cause sample containers to be submerged and thus possibly become cross-contaminated. All sample containers should be enclosed in plastic bags or cans to prevent cross-contamination (see Guideline FT-7.06). Samples should be secured in the ice chest to prevent movement of sample containers and possible breakage. Sample packing and transportation requirements are described in guideline FT 7.07.

5.5.7 Sample Holding Times

Holding times (i.e. allowed time between sample collection and analysis) for routine samples are given in Guideline FT-7.06.

5.6 RECORDS

Records will be maintained for each sample that is taken. The sample log sheet (Attachment B) will be used to record the following information:

- Sample identification (site name, location, project no.; sample name/number and location; sample type and matrix; time and date; sampler's identity)
- Sample source and source description
- Field observations and measurements (appearance; volatile screening; field chemistry; sampling method); volume of water purged prior to sampling; no. of well volumes purged.
- Sample disposition (preservatives added; lab sent to, date and time; lab sample number, EPA Traffic Report or Special Analytical Services number, chain-of-custody number, sample bottle lot number)

16. Decontaminate all equipment ~~(See Guideline FT-6.03).~~

5.5.3 Sample Containers

For most samples and analytical parameters, either glass or plastic containers are satisfactory. Guideline FT-7.06 describes the required sampling containers for various analytes at various concentrations.

5.5.4 Preservation of Samples and Sample Volume Requirements

Sample preservation techniques and volume requirements depend on the type and concentration of the contaminant and on the type of analysis to be performed. Guideline FT-7.06 describes the sample preservation and volume requirements for most of the chemicals that will be encountered during hazardous waste site investigations. Guideline FT-10.03 describes the preservation requirements for microbial samples.

5.5.5 Field Filtration

In general, preparation and preservation of water samples includes some form of filtration. All filtration must occur in the field immediately upon collection. In Region I, all inorganics are to be collected and preserved in the filtered form including metals. The recommended method is through the use of a disposable in-line filtration module (0.45 micron filter) utilizing the pressure provided by the pumping device for its operation.

~~In Region II, metals samples are to be collected and preserved unfiltered.~~ In Region III ~~and IV~~, samples collected for metals analysis are also to be unfiltered. However, if metals analysis of monitoring wells is required, then both an unfiltered and filtered sample are to be collected. Filtration and preservation are to occur immediately in the field with the sample aliquot passing through a 0.45 micron filter. Samples for organic analyses shall never be filtered. Filters must be prerinsed with organic-free water.

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5.2.2 Thin Wall (Shelby Tube) Sampling

When it is desired to take undisturbed samples of soil, thin-walled seamless tube samplers (Shelby tubes) will be used. The following method applies:

1. Clean out the hole to the sampling elevation being careful to minimize the chance for disturbance or contamination of the material to be sampled. In saturated materials, withdraw the drill bit slowly to prevent loosening of the soil around the hole and maintain the water level in the hole at or above groundwater level.

2. The use of bottom discharge bits or jetting through an open-tube sampler to clean out the hole shall not be allowed. Any side discharge bits are permitted.

3. The sampler must be of a stationary piston-type, to limit sample disturbance and aid in retaining the sample. Either the hydraulically operated or control rod activated-type of stationary piston sampler may be used. Prior to inserting the tube sampler in the hole, check to insure that the sampler head contains a check valve. The check valve is necessary to keep water in the rods from pushing the sample out of the tube sampler during sample withdrawal and to maintain a suction within the tube to help retain the sample.

4. With the sampling tube resting on the bottom of the hole and the water level in the boring at the natural groundwater level or above, push the tube into the soil by a continuous and rapid motion, without impacting or twisting. In no case shall the tube be pushed further than the length provided for the soil sample. Allow a free space in the tube for cuttings and sludge.

5. After pushing the tube, the sample should sit 5 to 15 minutes prior to removal. Immediately before removal, the sample must be sheared by rotating the rods with a pipe wrench a minimum of two revolutions.

6. Upon removal of the sampler tube from the hole, measure the length of sample in the tube and also the length penetrated. Remove disturbed material in the upper end of the tube and measure the length of sample again. After removing at least an inch of soil, from the lower

end and after inserting an impervious disk, seal both ends of the tube with at least a 1/2-inch thickness of wax applied in a way that will prevent the wax from entering the sample. Newspaper or other types of filler must be placed in voids at either end of the sampler prior to sealing with wax. Place plastic caps on the ends of the sampler, tape them into place and then dip the ends in wax to seal them.

7. Affix labels to the tubes as required in Guideline FT-7.05, and record sample number, depth, penetration, and recovery length on the label. Mark the same information and "'up" direction on the tube with indelible ink, and mark the end of the sample. Complete Chain-of-Custody and other required forms (see Guidelines FT-7.04 and FT-7.05.) Do not allow tubes to freeze, and store the samples vertically (with the same orientation they had in the ground, i.e., top of sample is up) in a cool place out of the sun at all times. Ship samples protected with suitable resilient packing material to reduce shock, vibration, and disturbance, and in accordance with Guideline FT-7.07.

8. Using soil removed from the ends of the tube, make a careful description using the methods presented in Guideline FT-6.02.

9 When thin-wall tube samplers are used to collect soil for certain chemical analyses, it may be necessary to avoid using wax, newspaper, or other fillers. The FSAP for each site should address specific materials allowed dependent on analytes being tested.

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Thin-walled undisturbed tube samplers are restricted in their usage by the consistency of the soil to be sampled. Often very loose and/or wet samples cannot be retrieved by the samplers, and soils with a consistency in excess of very stiff cannot be penetrated by the sampler. Devices such as Dension or Pitcher cores can be used in conjunction with the tube samplers to obtain undisturbed samples of stiff soils. Using these devices normally increases sampling costs and therefore their use should be weighed against the increased cost and the need for an undisturbed sample. In any case, if a sample cannot be obtained with a tube sampler, an attempt should be made with a split barrel sampler at the same depth so that at least a sample can be obtained for classification purposes.

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5.3 SURFACE SOIL SAMPLES

For loosely packed earth, stainless steel (organic analyses) or plastic (inorganic analyses) scoops or trowels, or waste pile samplers (described below) can be used to collect representative samples. For densely packed soils or deeper soil samples, a hand or power soil auger may be used.

The following methods are to be used:

1. Use a soil auger for deep samples (6 to 12 inches) or a scoop or trowel for surface samples. Remove debris, rocks, twigs, and vegetation before collecting ~~200 to 250 grams of~~ soil. Mark the location with a numbered stake if possible and locate sample points on a sketch of the site.

2. Transfer ~~100 to 200 grams of~~ the sample to a 250-ml. container. Attach a label and identification tag. Record all required information in the field logbook and on the sample log sheet, Chain-of-Custody record, and other required forms (see Guidelines FT-7.04 and FT-7.05).

3. Store the sampler in a plastic bag until decontamination or disposal. Use a new or freshly-decontaminated sampler for each sample taken.

4. Tape the lid of the sample bottle securely and mark the tape with the date and sample collector's initials.

5. Pack and ship as described in Guideline FT-7.07.

6. When a representative composited sample is to be prepared (e.g., samples taken from a gridded area or from several different depths), it is best to composite individual samples in the laboratory where they can be more precisely composited on a weight or volume basis. If this is not possible, the individual samples (all of equal volume, i.e., the sample bottles should be full) should be placed in a stainless steel bucket, mixed thoroughly using a stainless steel spatula or trowel, and a composite sample collected.

5.4 WASTE PILE SAMPLES

Use of stainless steel or plastic scoops or trowels to obtain small discrete samples of homogeneous waste piles is usually sufficient for most conditions. Layered (nonhomogeneous) piles require the use of tube samplers or triers to obtain cross-sectional samples.

1. Collect small, equal portions of the waste from several points around the pile, penetrating it as far as practical. Use numbered stakes, if possible, to mark the sampling locations and locate sampling points on the site sketch.

2. Collect a waste sample ~~totaling 100 to 200 grams~~ and place it in a 250-ml. glass container. Attach a label and identification tag. Record all the required information in the field logbook and on the sample log sheet and other required forms (see Guidelines FT-7.04 and FT-7.05).

Repeat steps 3-6 as given in Section 5.3 for surface soil samples.

For layered, nonhomogeneous piles, grain samplers, sampling triers, or waste pile samplers must be used at several representative locations to acquire a cross-section of the pile. The basic steps to obtain each sample are:

1. Insert a sampler into the pile at a 0- to 45-degree angle from the horizontal to minimize spillage.

2. Rotate the sampler once or twice to cut a core of waste material. Rotate the grain sampler inner tube to the open position and then shake the sampler a few times to allow the material to enter the open slits. Move the sampler into position with slots upward (grain sampler closed) and slowly withdraw it from the pile.

Repeat steps 3-6 as given in Section 5.3 for surface soil samples.

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evidence under Rule 803(b) of the Federal Rules of Evidence (P.L. 93-575).

Chain-of-custody procedures, recordkeeping, and documentation are an important part of the management control of samples in the REM III Program. Regulatory agencies must be able to provide the chain of possession and custody of any samples that are offered for evidence, or that form the basis of analytical test results introduced as evidence. Written procedures must be available and followed whenever evidence samples are collected, transferred, stored, analyzed, or destroyed.

5.2 SAMPLE IDENTIFICATION

The following information shall be written in the sample log book when in-situ measurements or samples for laboratory analysis are collected:

- project code
- station number
- location of station
- date and time of measurement
- samples used if any
- field observations (include date and time)
- level of personnel protection (if required)
- equipment used to make physical measurements and collect samples
- calibration data for equipment used.

Measurements and observations shall be recorded using black, waterproof ink.

5.2.1 Sample Label

Samples, other than in-situ measurements, are removed and transported from the sample location to a laboratory or other location for analysis. Before removal, however, a sample is often divided into portions, depending upon the analyses to be performed. Each portion is preserved in accordance with the Sampling Plan. Each sample container is identified by a sample label (see Attachment A).

Sample labels are provided by ZPMO or the REM III Regional Offices. The sampler fills out the following information on the sample label:

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- **Project** — EPA Work Assignment Number
- **Sample Number** — The unique sample number identifying this sample
- **Date** — A six-digit number indicating the month, day, and year of sample collection; e.g., 12/21/85
- **Time** — A four-digit number indicating the 24-hour time of collection (for example: 0954 is 9:54 a.m., and 1629 is 4:29 p.m.)
- **Medium** — Water, Soil, Sediment, Sludge, Leachate, etc
- **Sample Type** — Grab or Composite
- **Preservation** — Type, quantity, and concentration of preservative added
- **Analysis** — Same as Analyses on Sample Identification Tag (see Section 5.2.2)
- **Sampled By** — Name of the sampler
- **Lab #** — The receiving laboratory assigns the lab# to the sample label (this number is not to be used for on-site analyses)
- **Remarks** — If for CLP analysis, include the CLP case or SAS number, and CLP sample number from the traffic report, SAS Packing List, or Dioxin Shipment Record (see Guideline FT-7.04). Also, pertinent observations of the sampler (e.g., sequence number for sequential samples).

5.2.2 Sample Identification Tag

A Sample Identification Tag (Attachment B) must also be used for samples collected for CLP (Contract Laboratory Program) analysis. Sample ID tags are not required in EPA Region II. The Sample Identification Tag is a white, waterproof paper label, approximately 3-by-6 inches, with a reinforced eyelet, and string or wire for attachment to the neck of the sample bottle. The Sample Tag is a controlled document, and is

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provided by the regional EPA office. The field sampler completes the sample tag and attaches the the sample tag to the field sample container. Following sample analysis, the Sample Tag is retained by the laboratory as evidence of sample receipt and analysis.

The following information is recorded on the tag:

. Site Name/Project Code	EPA Work Assignment Number (contact the regional environmental services division for preference)
. Field Identification or Station Number	Same as Sample Number on Sample Label
. Month/Day/Year	Same as Date on Sample Label
. Time	Same as Time on Sample Label
. Designate: Comp/Grab	Designate the sample as either grab or composite
. Station Location	Site-specific station location designation defined in Site Operation Plan
. Type of Sample	Type of Sample (matrix), and a brief description of the sampling location
. Samplers	Same as Sampled By on Sample Label
. Signature	The Sampler signs the sample tag
. Preservative	Yes or No
. Analyses	Check appropriate box(es)
. Remarks	Same as Remarks on Sample Label (make sure CLP Case No/SAS No. and CLP sample numbers are recorded)
. Lab Sample No.	Same as Lab # on Sample Label

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The tag is then tied round the neck of the sample bottle.

~~If the sample is to be split, it is equally divided into two similar sample containers. Identical information is completed on the label attached to each split and both of these are marked "Split" on the "Remarks" line.~~

Blank, duplicate, or field spike samples shall not be identified as such on the label, as this may compromise the quality control function. Sample blanks, duplicates, spikes and splits are defined in Guideline FT-1.01.

5.3 CHAIN-OF-CUSTODY PROCEDURES

After collection, separation, identification, and preservation, the sample is maintained under chain-of-custody procedures until it is in the custody of the analytical laboratory and has been stored or disposed of.

5.3.1 Field Custody Procedures

1. Samples are collected as described in the site-specific Sampling Plan. Care must be taken to record precisely the sample location and to ensure that the sample number on the label exactly matches those numbers on the sample log sheet and the Chain-of-Custody Record.

2. The person undertaking the actual sampling in the field is responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

3. When photographs are taken of the sampling as part of the documentation procedure, the name of the photographer, date, time, site location, and site description are entered sequentially in the site logbook as photos are taken. Once developed, the photographic prints shall be serially numbered, corresponding to the logbook descriptions.

4. Sample labels shall be completed for each sample, using waterproof ink unless prohibited by weather conditions, e.g., a logbook notation would explain that a pencil was used to fill out the sample label because a ballpoint pen would not function in freezing weather.

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5.3.2 Transfer of Custody and Shipment

Samples are accompanied by a Chain-of-Custody Record Form. ~~The Chain-of-Custody Records used in EPA Regions I through IV each differ slightly (See Attachments C-1 through C-4).~~ The appropriate form should be obtained from the EPA Regional Office or REM III Regional Office in which the work takes place. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the Record. This Record documents sample custody transfer from the sampler, often through another person, to the analyst in the laboratory. The Chain-of-Custody Record is filled out as follows:

1. Enter header information (project number and name, CLP case No. or SAS No.) For each station number, enter date, time, composite/grab, station location, number of containers, analytical parameters, Traffic Report/SAS Packing List/Dioxin Shipment Record, and Sample Identification Tag Number (in Remarks column or Description of Samples column for Region II).

2. Also, for the Region II form, the signature of the sampler goes in the "person assuming responsibility for sample" column.

3. Sign, date, and enter the time under "Relinquished by" entry.

4. Make sure that the person receiving the sample signs the "Received by" entry, or enter the name of the carrier (e.g., UPS, Federal Express) under "Received by." Receiving laboratory will sign "Received for Laboratory by" on the lower line and enter the date and time.

5. Enter the bill-of-lading or Federal Express airbill number under "Remarks or Reason for Change of Custody," if appropriate.

5. Place the original (top, signed copy) of the Chain-of-Custody Record Form in the appropriate sample shipping package. Retain a copy with field records.

6. Sign and date the custody seal, a 1- by 3-inch white paper label with black lettering and an adhesive backing. Attachment D is an example of a custody seal. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field. Custody seals are provided by ZPMO or the REM III regional offices on an as-needed basis.

7. Shipping containers should be secured to ensure samples have not been disturbed during transport by using nylon strapping tape and EPA custody seals. The custody seals should be placed on the containers so that they cannot be opened without breaking the seal.

8. Complete other carrier-required shipping papers.

The custody record is completed using black waterproof ink. Any corrections are made by drawing a line through and initialing and dating the change, then entering the correct information. Erasures are not permitted.

Common carriers will usually not accept responsibility for handling Chain-of-Custody Record Forms; this necessitates packing the record in the sample container (enclosed with other documentation in a plastic zip-lock bag). As long as custody forms are sealed inside the sample container and the custody seals are intact, commercial carriers are not required to sign off on the custody form.

The laboratory representative who accepts the incoming sample shipment signs and dates the Chain-of-Custody Record, completing the sample transfer process. It is then the laboratory's responsibility to maintain internal log books and custody records throughout sample preparation and analysis.

5.3.3 Receipt for Samples Form

Whenever samples are split with a private party or government agency, a separate Receipt for Samples Record Form (see Attachment E) is prepared for those samples and marked to

indicate with whom the samples are being split. The person relinquishing the samples to the party or agency shall require the signature of a representative of the appropriate party acknowledging receipt of the samples. If a representative is unavailable or refuses to sign, this is noted in the "Received by" space. When appropriate, as in the case where the representative is unavailable, the custody record should contain a statement that the samples were delivered to the designated location at the designated time. This form must be completed and a copy given to the owner, operator, or agent-in-charge even if the offer for split samples is declined. The original is retained by the Field Operations Leader.

6.0 REFERENCES

USEPA, 1984. User's Guide to the Contract Laboratory Program, Office of Emergency and Remedial Response, Washington, D.C.

Program Guideline FT-7.04 - Management of Sampling and Required Forms

7.0 ATTACHMENTS

Attachment A - Sample Label

Attachment B - Sample Identification Tag

Attachment C-1 - Chain-of-Custody Record Form for Use in Region I

Attachment C-2 - Chain-of-Custody Record Form for Use in Region II

Attachment C-3 - Chain-of-Custody Record Form for Use in Region III

Attachment C-4 - Chain-of-Custody Record Form for Use in Region IV

Attachment D - Chain-of-Custody Seal

Attachment E - Receipt for Samples Form

EBASCO PROJECT: _____

SAMPLE NO. _____

DATE: __/__/__ TIME: _____ HRS

MEDIUM: _____

TYPE: GRAB ☐ COMPOSITE ☐

PRESERVATION: _____

ANALYSIS: _____

SAMPLED BY: _____

LAB NO.: _____

REMARKS: _____

ATTACHMENT A

SAMPLE LABEL

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☆ GPO 505-552

Designate: Grab / Comp

Time

Month/Day/Year

Station No.

Project Code

Samplers (Signatures)

Station Location

Preservative:
Yes ☐ No ☐

ANALYSES

BOD Anions Solids (TSS) (TDS) (SS)	
COD, TOC, Nutrients	
Phenolics	
Mercury	
Metals	
Cyanide	
Oil and Grease	
Organics GC/MS	
Priority Pollutants	
Volatile Organics	
Pesticides	
Mutagenicity	
Bacteriology	

Remarks:

Tag No.	Lab Sample No.
3 60966	

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

EPA

ATTACHMENT B

SAMPLE IDENTIFICATION TAG

300548

ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement

REGION 3
Curtis Bldg., 6th & Walnut Sts.
Philadelphia, Pennsylvania 19106

CHAIN OF CUSTODY RECORD

PROJ NO. | PROJECT NAME

SAMPLERS: (Signature)

STA. NO.	DATE	TIME	GRAB	COMP	STATION LOCATION	NO. OF CONT.	REMARKS

Relinquished by: (Signature) | Date / Time | Received by: (Signature)

Relinquished by: (Signature) | Date / Time | Received by: (Signature)

Relinquished by: (Signature) | Date / Time | Received for Laboratory by: (Signature)

Relinquished by: (Signature) | Date / Time | Remarks

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

3-15966

ATTACHMENT C-3

CHAIN-OF-CUSTODY RECORD FORM FOR USE IN REGION III
(Original is 8-1/2 x 11 3/4")

300548A

CUSTODY SEAL

Date

Signature

CUSTODY SEAL

Date

Signature

ATTACHMENT D

CHAIN-OF-CUSTODY SEAL

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EBASCO

EBASCO SERVICES INCORPORATED

ENVIRONMENTAL PROTECTION AGENCY

REM III PROGRAM GUIDELINES

CATEGORY:	TITLE:	No. FT-7.07
Field Technical	Sample Packaging and Shipping	DATE: 10/30/87
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1.0 PURPOSE

This guideline provides instructions for sample packaging and shipping in accordance with U.S. Department of Transportation (DOT) regulations.

2.0 SCOPE

Samples collected at hazardous waste sites usually have to be transported elsewhere for analysis. This requires that the samples be appropriately preserved to prevent or minimize chemical alteration prior to analysis (see Guideline FT-7.06), and be transported to protect their integrity, as well as to protect against any detrimental effects from leakage or breakage. Regulations for packaging, marking, labeling, and shipping hazardous materials and wastes are promulgated by the U.S. Department of Transportation and described in the Code of Federal Regulations (49 CFR 171 through 177, in particular 172.402h, Packages Containing Samples). In general, these regulations were not intended to cover shipment of samples collected at controlled or uncontrolled hazardous waste sites or samples collected during emergency responses. However, the EPA has agreed through a memorandum of agreement to package, mark, label, and ship samples observing DOT procedures. The information presented here is for general guidance. More detailed information is contained in the Ebasco Hazardous Materials Transportation Guide (see Reference 2 in Section 6.0 of this guideline) and 49 CFR 171-177.

This guideline is applicable to all samples taken from uncontrolled hazardous substance sites for analysis at laboratories away from the site.

3.0 DEFINITIONS

Carrier - A person or firm engaged in the transportation of passengers or property.

Hazardous Material - A substance or material in a quantity and form which may pose an unreasonable risk to health and safety or property when transported in commerce ("commerce" here to include any traffic or transportation). Defined and regulated by DOT (49 CFR 173.2) and listed in Attachment A of this guideline.

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Hazardous Waste - Any substance listed in 40 CFR Subpart D (261.30 et seq) or otherwise characterized as ignitable, corrosive, reactive, or EP toxic as specified under 40 CFR Subpart C (261.20 et seq) that would be subject to manifest requirements specified in 40 CFR 262. Defined and regulated by EPA.

Marking - Applying the descriptive name, instructions, cautions, weight, or specification marks or combination thereof required to be placed outside containers of hazardous materials.

n.o.i. - Not otherwise indicated.

n.o.s. - Not otherwise specified.

ORM - Other regulated material.

Packaging - The assembly of one or more containers and any other components necessary to assure compliance with the minimum packaging requirements of 49 CFR 172, including containers (other than freight containers or overpacks), portable tanks, cargo tanks, tank cars, and multiunit tank car tanks.

Placard - Color-coded, pictorial sign depicting the hazard class symbol and name to be placed on all four sides of a vehicle transporting certain hazardous materials.

Reportable Quantity (RQ) - A parenthetical note of the form "(RQ-1000/454)" following an entry in the DOT Hazardous Materials table (49 CFR 172.101) indicates the reportable quantity of the substance in pounds and kilograms. If a spill of that amount or more of the substance occurs during transit or storage, a report must be filed with DOT according to 171.15-17 concerning hazardous materials incidents reports. If the material spilled is a hazardous waste, a report must always be filed, regardless of the amount, and must include a copy of the manifest. If the RQ notation appears, it must be shown either immediately before or after the proper shipping name on the shipping paper (or manifest). Most shipping papers and manifests will have a column designated "HM" which may be used for this purpose.

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4.0 RESPONSIBILITIES

Field Operations Leader or Team Sampling Leader - responsible for determining that samples are properly packaged and shipped.

Sampling personnel - responsible for implementing the packaging and shipping requirements. The chain-of-custody procedures and requirements are described in Guideline FT-7.05.

5.0 GUIDELINES

5.1 INTRODUCTION

Samples collected for shipment from a site should be classified as either environmental or hazardous material (or waste) samples. In general, environmental samples are collected off-site (for example from streams, ponds, or wells) and are not expected to be grossly contaminated with high levels of hazardous materials. On-site samples (for example, soil, water, and materials from drums or bulk storage tanks, obviously contaminated ponds, lagoons, pools, and leachates from hazardous waste sites) are considered hazardous. A distinction must be made between the two types of samples in order to:

- Determine appropriate procedures for transportation of samples. If there is any doubt, a sample should be considered hazardous and shipped accordingly.
- Protect the health and safety of laboratory personnel receiving the samples. Special precautions are used at laboratories when samples other than environmental samples are received.

5.2 ENVIRONMENTAL SAMPLES

5.2.1 Packaging

Environmental samples may be packaged following the procedures outlined in Section 5.4 for samples classified as "flammable liquids" or "flammable solids." Requirements for marking, labeling, and shipping papers do not apply.

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Environmental samples may also be packaged without being placed inside metal cans as required for flammable liquids or solids.

- Place sample container, properly identified and with a sealed lid, in a polyethylene bag, and seal the bag.
- Place sample in a fiberboard container or metal picnic cooler which has been lined with a large polyethylene bag.
- Pack with enough noncombustible, absorbent, cushioning materials to minimize the possibility of the container breaking.
- Seal large bag.
- Seal or close outside container.

EPA Region IV has slightly different packing and shipping requirements, see Attachment E for details.

5.2.2 Marking/Labeling

Sample containers must have a completed sample identification tag (except in Region II) and the outside container must be marked "Environmental Sample." The appropriate side of the container must be marked "This End Up" and arrows placed appropriately. No DOT markings or labeling are required.

5.2.3 Shipping Papers

No DOT shipping papers are required. However, the appropriate chain-of-custody forms must be included with the shipment.

5.2.4 Transportation

There are no DOT restrictions on mode of transportation.

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5.3 DETERMINATION OF SHIPPING CLASSIFICATION FOR HAZARDOUS MATERIAL SAMPLES

Samples not determined to be environmental samples, or samples known or expected to contain hazardous materials, must be considered hazardous material samples and transported according to the requirements listed below.

5.3.1 Known Substances

If the substance in the sample is known or can be identified, package, mark, label, and ship according to the specific instructions for that material (if it is listed) in the DOT Hazardous Materials Table, 49 CFR 172.101. A copy of this table is available from Regional Program Offices or ZPMO.

Unz and Company have published the following steps to help in locating a proper shipping name from the Hazardous Materials Table, 49 CFR 172.101.

1. Look first for the chemical or technical name of the material, for example, ethyl alcohol. Note that many chemicals have more than one technical name, for example, perchlorethylene (not listed in 172.101) is also called tetrachloroethylene (listed in 172.101). It may be useful to consult a chemist for all possible technical names a material can have. If your material is not listed by its technical name then ...

2. Look for the chemical family name. For example, pentyl alcohol is not listed but the chemical family name is: alcohol, n.o.s. (not otherwise specified). If the chemical family name is not listed then ...

3. Look for a generic name based on end use. For example, Paint, n.o.s. or Fireworks, n.o.s. If a generic name based on end use is not listed then ...

4. Look for a generic family name based on end use, For example, Drugs, n.o.s. or Cosmetics, n.o.s. Finally, if your material is not listed by a generic family name but you suspect or know the material is hazardous because it meets the definition of one or more hazard classes, then:

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5. You will have to go to the general hazard class for a proper shipping name. For example, Flammable Liquid, n.o.s., or Oxidizer, n.o.s.

5.3.2 Unknown Substances

For samples of hazardous substances of unknown content, select the appropriate transportation category according to the DOT Hazardous Materials Classification (Attachment A), a priority system of transportation categories.

The correct shipping classification for an unknown sample is selected through a process of elimination, utilizing Attachment A. Unless known or demonstrated otherwise (through the use of radiation survey instruments), the sample is considered radioactive and appropriate shipping regulations for "radioactive material" followed.

If radioactive material is eliminated, the sample is considered to contain "Poison A" materials (Attachment B), the next classification on the list. DOT defines "Poison A" as extremely dangerous poisonous gases or liquids of such a nature that a very small amount of gas, or vapor of the liquid, mixed with air is dangerous to life. Most Poison A materials are gases or compressed gases and would not be found in drum-type containers. Liquid Poison A would be found only in closed containers; however, all samples taken from closed drums do not have to be shipped as Poison A, which provides for a "worst case" situation. Based upon information available, a judgement must be made whether a sample from a closed container is a Poison A.

If Poison A is eliminated as a shipment category, the next two classifications are "flammable" or "nonflammable" gases. Since few gas samples are collected, "flammable liquid" would be the next applicable category. With the elimination of radioactive material, Poison A, flammable gas, and nonflammable gas, the sample can be classified as flammable liquid (or solid) and shipped accordingly. These procedures would also suffice for shipping any other samples classified below flammable liquids in the DOT classification table (Attachment A). For samples containing unknown material, categories listed below flammable liquids/solids on Attachment A are generally not used because showing that these materials are not flammable liquids (or

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solids) requires flashpoint testing (see Guideline FT-7.13), which may be impractical and possibly dangerous at a site. Thus, unless the sample is known to consist of material listed as less hazardous than flammable liquid (or solid) on Attachment A, it is considered a flammable liquid (or solid) and shipped as such.

For any hazardous material shipment, utilize the shipping checklist (Attachment C) as a guideline to ensure that all sample-handling requirements are satisfied.

5.4 PACKAGING AND SHIPPING OF SAMPLES CLASSIFIED AS FLAMMABLE LIQUID (OR SOLID)

5.4.1 Packaging

Applying the word "flammable" to a sample does not imply that it is in fact flammable. The word prescribes the class of packaging according to DOT regulations.

1. Collect sample in the prescribed container (see Guideline FT-7.06) with nonmetallic, Teflon-lined screw cap. To prevent leakage, fill container no more than 90% full. If an air space in the sample container would affect sample integrity, place that container within a second container to meet the 90% requirement.

2. Complete sample label and identification tag (see Guideline FT-7.05) and attach securely to sample container. (Sample ID tags are not required in Region II.)

3. Seal container and place in 2-mil thick (or thicker) polyethylene bag, one sample per bag. Position identification tag so that it can be read through bag. Seal bag.

4. Place sealed bag inside metal can and cushion it with enough noncombustible, absorbent material (for example, vermiculite or diatomaceous earth) between the bottom and sides of the can and bag to prevent breakage and absorb leakage. Pack one bag per can. Use clips, tape, or other positive means to hold can lid securely, tightly and permanently. Mark can as indicated in Paragraph 1 of Section 5.4.2, below.

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5. Place one or more metal cans (or single 1-gallon bottle) into a strong outside container, such as a metal picnic cooler or a DOT-approved fiberboard box. Surround cans with noncombustible, absorbent cushioning material for stability during transport. Mark containers as indicated in Paragraph 2 of Section 5.4.2.

5.4.2 Marking/Labeling

1. Use abbreviations only where specified. Place the following information, either-hand printed or in label form, on the metal can (or 1-gallon bottle):

   - Laboratory name and address.

   - "Flammable Liquid, n.o.s. UN1993" or "Flammable Solid, n.o.s. UN1325."

   Not otherwise specified (n.o.s.) is not used if the flammable liquid (or solid) is identified. Then the name of the specific material is listed before the category (for example, Acetone, Flammable Liquid), followed by its appropriate UN number found in the DOT hazardous materials table (49 CFR 172.101).

2. Place all information on outside shipping container as on can (or bottle), specifically:

   - Proper shipping name.

   - UN or NA number.

   - Proper label(s).

   - Addressee and sender.

Place the following labels on the outside shipping container: "Cargo Aircraft Only" and "Flammable Liquid" (or "Flammable Solid"). "Dangerous When Wet" label should be used if the solid has not been exposed to a wet environment. "Laboratory Samples" and "THIS SIDE UP" or "THIS END UP" should also be marked on the top of the outside container, and upward-pointing arrows should be placed on all four sides of the container.

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5.4.3 Shipping Papers

1. Use abbreviations only where specified. Complete the carrier-provided bill of lading and sign certification statement (if carrier does not provide, use standard industry form, see Attachment D). Provide the following information in the order listed (one form may be used for more than one exterior container).

   - "Flammable Liquid, n.o.s. UN1993" or "Flammable Solid, n.o.s. UN1325."
   - "Limited Quantity" (or "Ltd. Qty.").
   - "Cargo Aircraft Only."
   - Net weight (wt) or net volume (vol), just before or just after "Flammable Liquid, n.o.s." or "Flammable Solid, n.o.s.," by item, if more than one metal can is inside an exterior container.
   - "Laboratory Samples" (if applicable).

2. Include Chain-of-Custody Record, properly executed (see Guideline FT-7.05), in outside container.

3. "Limited Quantity" of "Flammable Liquid, n.o.s." is limited to one pint per inner container. For "Flammable Solid, n.o.s.", net weight of inner container plus sample should not exceed one pound; total package weight should not exceed 25 pounds.

5.4.4 Transportation

1. Transport unknown hazardous substance samples classified as flammable liquids by rented or common carrier truck, railroad, or express overnight package services. Do not transport by any passenger-carrying air transport system, even if they have cargo-only aircraft. DOT regulations permit passenger airline company cargo only aircraft, but difficulties with most suggest avoiding them. Instead, ship by airline carriers that only carry cargo.

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2. For transport by government-owned vehicle, including aircraft, DOT regulations do not apply. However, procedures described above, with the exception of execution of the bill of lading with certification, should still be used.

5.5 PACKAGING AND SHIPPING OF SAMPLES CLASSIFIED AS POISON "A"

This packaging, marking, labeling, and shipping method provides a worst-case procedure for materials classed as Poison A (49 CFR 173.328). In the absence of reliable data that exclude the possibility of the presence of Poison A chemicals or compounds (see Attachment B), these procedures must be followed.

5.5.1 Packaging

Applying the word "poisonous" to a sample does not imply that it is, in fact, poisonous, or how poisonous. It describes the class of packaging according to DOT regulations.

1. Collect samples in a polyethylene or glass container with an outer diameter narrower than the valve hole on a DOT specification #3A1800 or #3AA1800 metal cylinder. To prevent leakage, fill container no more than 90% full. Seal sample container.

2. Complete sample label and identification tag and attach securely to sample container. (Sample ID tags are not required in Region II.)

3. Attach string or flexible wire to neck of the sample container; lower it into metal cylinder partially filled with noncombustible, absorbent cushioning material (for example, diatomaceous earth or vermiculite). Place only one container in metal cylinder. Pack with enough absorbing material between the bottom and sides of the sample container and the metal cylinder to prevent breakage and absorb leakage. After the cushioning material is in place, drop the end of the string or wire into the cylinder valve hole.

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4. Replace valve, torque to 250 ft-lb (for 1-inch opening), and replace valve protector on metal cylinder, using Teflon tape.

5. Mark and label cylinder as described in Paragraph 1 of Section 5.5.2.

6. Place one or more cylinders in DOT-approved outside container.

7. Mark and label outside container and complete shipping papers as described below.

5.5.2 Marking/Labeling

1. Use abbreviations only where specified. Place the following information, either hand-printed or in label form, on the side of the cylinder or on a tag wired to the cylinder valve protector.

   - "Poisonous Liquid, n.o.s." or "Poisonous Gas, n.o.s. NA9035."
   - Laboratory name and address.
   - DOT label "Poisonous Gas" (even if sample is liquid) on cylinder.

2. Put all information on metal cylinder on outside container. Print "Laboratory Sample" and "Inside Packages Comply With Prescribed Specifications" on top and/or front of outside container. Mark "THIS SIDE UP" on top of container and upward-pointing arrows on all four sides.

5.5.3 Shipping Papers

1. Use abbreviations only as specified. Complete carrier-provided bill of lading and sign certification statement (if carrier does not provide, use standard industry form, see Attachment D). Provide the following information in the order listed. (One form may be used for more than one exterior container.)

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- "Poisonous Liquid, n.o.s. NA9035."
- "Limited Quantity" (or "Ltd. Qty.").
- Net weight (wt) or net volume (vol), just before or after "Poisonous Liquid, n.o.s.," of each cylinder, if more than one is inside the outer container.

2. Include a Chain-of-Custody Record, properly executed (see Guideline FT-7.05), in container or with cylinder.

3. Accompany shipping container to carrier and, if required, open outside container(s) for inspection.

5.5.4 Transportation

Transport unknown hazardous substance samples classified as Poison A only by ground transport or Government-owned aircraft. Do not use air cargo, other common-carrier aircraft, or rented aircraft.

5.6 TRANSPORT OF INVESTIGATION AND REMEDIATION WASTES

The packaging, marking, labeling and other shipping requirements will depend on the particular waste to be transported. Examples of wastes which may be generated during site investigations are decontamination or cleaning solutions, contaminated disposable items, test pit spoils, drilling cuttings or fluids and contaminated monitoring well discharges (see HS-1.06). Waste materials from remediation include excavation spoils, overpacked drums and discharges from drained lagoons or tanks.

In many cases, wastes generated during site investigations will be disposed of onsite. These relatively small volumes of waste will be dealt with as part of the waste to be cleaned up or isolated during remediation. This avenue should be pursued, if feasible, to avoid the inconvenience of transportation and disposal which are disproportionately expensive for small volumes. If such a solution is approved, materials should be properly bagged, drummed, covered, buried, or otherwise contained at the end of each day (see Guideline HS-1.06).

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Those materials which must be transported for treatment, storage, or disposal should be packaged, labeled and marked in accordance with applicable regulations.

Many wastes generated during site investigation and remediation activities will probably be adequately handled under the classification "ORM-E" (i.e., other regulated materials, type E). Types of wastes which would normally fall under this classification are contaminated disposable protective clothing and sampling equipment, spent soapy decontamination solutions and rinses, contaminated drilling cuttings or fluids and contaminated soils excavated during site investigations or remediation.

Spent solvents used for decontamination of sampling equipment (e.g., acetone or methanol) should be referenced by the actual product name. Liquids from drums or tanks should be specified as accurately as possible based on results of lab analysis or reliable records. If the liquid is known to be a solvent, organic liquid, or spent distillation bottoms, it should be referenced by its actual or generic name from the Hazardous Materials Table. In cases requiring emergency actions where the identity of a substance is not accurately known, place the substance in one of the general hazard classes in 49 CFR 173.2. The choice of class should be conservative; that is, use the highest priority class based on available information as described in Section 5.3.2 in this Guideline.

The following steps for preparing hazardous materials for shipment were extracted from the "Hazardous Materials Transportation Guide for Shippers" published by the U.S. DOT. References are to CFR Title 49.

1. <u>Determine the Proper Shipping Name</u>

   The shipper must determine the proper shipping name of the materials as listed in the Hazardous Materials Table, 172.101, Column (2).

2. <u>Determine the Hazard Class or Classes</u>

   a. Refer to the Table, 172.101, Column (3) and locate the hazard class of the material or follow the steps described in Section 5.3.2 of this Guideline.

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b. If more than one class is shown for the proper shipping name, determine the proper class by definition.

c. If the material has more than one hazard, classify the material based on the order of hazards in 173.2.

3. Select the Proper Identification Number

a. Refer to the Table, 172.101, Column (3a) and select the Identification Number (ID) that corresponds to the proper shipping name and hazard class.

b. Enter the ID Number(s) on the shipping papers and display them, as required, on packaging, placards, and/or orange panels.

4. Determine the Mode(s) of Transport to Ultimate Destination*

a. As a shipper, you must assure yourself that the shipment complies with the various modal requirements.

b. The modal requirements may affect the following:

(1) Packaging

(2) Quantity per Package

(3) Marking

(4) Labeling

(5) Shipping papers

(6) Certification

* For example, truck, rail or air.

5. Select the Proper Label(s) and apply as required

Required labels are based on the hazard class of the substance to be shipped. The Ebasco Hazardous Materials Transportation Guide contains information on selection of labels, marking of containers, completion of shipping forms and manifests, and placarding of vehicles. No placards are required on vehicles transporting ORM-E substances or limited quantities of any hazardous materials (e.g., hazardous samples as discussed in Section 5.4).

a. Refer to the Table, 172.101, Column (4) for required label(s).

b. For details in labeling refer to:

(1) Additional Labels, 172.402

(2) Location of Labels, 172.406

(3) Packaging (Mixed or Consolidated), 172.404(a) and (b)

(4) Packages Containing Samples, 172.402(h)

(5) Radioactive Materials, 172.403

(6) Authorized Label Modification, 172.405

6. Determine and Select the Proper Packagings

a. Refer to the Table, 172.101, Column (5a) for exceptions, and Column (5b) for authorized packagings. Consider the following when selecting an authorized container: Quantity per package; Cushioning material, if required; Proper closure and reinforcement; Proper pressure; Outage; etc., as required.

b. If packaged by a prior shipper, make sure the packaging is correct and in proper condition for transportation.

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7. Mark the Packaging (Including Overpacks)

   a. Apply the required markings (172.300); Proper shipping name and ID number, when required (172.301); Name and address of Consignee and Consignor (172.306).

   b. For details and other required markings, see 172.300 through 172.338.

8. Prepare Shipping Papers

   a. The basic requirements for preparing shipping papers include: proper shipping name; hazard class; ID number; total quantity; shipper's certification.

   b. Make all entries on the shipping papers, using the information required, and in proper sequence (172.202).

   c. For additional requirements, see 172.200 through 172.205.

9. Certification

   a. Each shipper must certify, by printing (manually or mechanically) on the shipping papers, that the materials being offered for shipment are properly classified, described, packaged, marked, and labeled, and are in proper conditions for transportation according to the applicable DOT Regulations (172.204).

   b. For surface shipment, see 172.204(a) and (b); for air shipments, see 172.204(c).

10. Loading, Blocking, and Bracing

    When loading hazardous materials into the transport vehicle or freight container, each package must be loaded, blocked, and braced in accordance with the requirements for the mode of transport.

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a. If the shipper loads the freight container or transport vehicle, the shipper is responsible for the proper loading, blocking, and bracing of the materials. (The packages must be properly labeled as to right side up and samples must be packed to avoid damage in case of overturning.)

b. If carrier personnel do the loading, the carrier is responsible.

11. Determine the Proper Placard(s)

Each person who offers hazardous materials for transportation must determine that the placarding requirements have been met.

a. For highway, unless the vehicle is already correctly placarded, the shipper must provide the required placard(s) and required identification number(s) (172.506).

b. For rail, if loaded by the shipper, the shipper must placard the rail car if placards are required. (172.508).

c. For air and water shipments, the shipper has the responsibility to apply the proper placards.

12. Hazardous Waste/Hazardous Substance

a. If the material is classed as a hazardous waste or hazardous substance, most of the above steps will be applicable.

b. Pertinent Environmental Protection Agency Regulations are found in the Code of Federal Regulations, Title 40, Part 262.

6.0 REFERENCES

1. U.S. Department of Transportation, 1983. Hazardous Materials Regulations, 49 CFR 171-177.

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2. Ebasco Services, Inc., 1985. Hazardous Materials Transportation Guide.

3. Program Guideline FT-7.05 - Sample Identification and Chain of Custody

4. Program Guideline FT-7.06 - Sample Preservation

5. Program Guideline FT-7.13 - Compatibility Testing

6. Program Guideline HS-1.06 - Control of Contaminated Material

7.0 ATTACHMENTS

Attachment A - DOT Hazardous Material Classification (49 CFR 173.2)

Attachment B - DOT List of Class "A" Poisons (49 CFR 172.101)

Attachment C - Hazardous Materials Shipping Checklist

Attachment D - Standard Industry Certification Form

Attachment E - U S EPA Region IV Shipment of Environmental Samples

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DOT HAZARDOUS MATERIAL CLASSIFICATION (49 CFR 173.2)

1. Radioactive material (except a limited quantity)
2. Poison A
3. Flammable gas
4. Nonflammable gas
5. Flammable liquid
6. Oxidizer
7. Flammable solid
8. Corrosive material (liquid)
9. Poison B
10. Corrosive material (solid)
11. Irritating material
12. Combustible liquid (in containers having capacities exceeding 110 gallons [416 liters])
13. ORM-B
14 ORM-A
15. Combustible liquid (in containers having capacities of 110 gallons [416 liters] or less)
16. ORM-E

DOT LIST OF CLASS "A" POISON (49 CFR 172.101)

Material	Physical State At Standard Temperature
Arsine	Gas
Bromoacetone	Liquid
Chloropicrin and methyl chloride mixture	Gas
Chloropicrin and nonflammable, nonliquefied compressed gas mixture	Gas
Cyanogen chloride	Gas (>13.1°C)
Cyanogen gas	Gas
Gas identification set	Gas
Gelatin dynamite (H. E. Germaine)	---
Grenade (with Poison "A" gas charge)	---
Hexaethyl tetraphosphate/compressed gas mixture	Gas
Hydrocyanic (prussic) acid solution	Liquid
Hydrocyanic acid, liquefied	Gas
Insecticide (liquefied) gas containing Poison "A" or Poison "B" material	Gas
Methyldichloroarsine	Liquid
Nitric oxide	Gas
Nitrogen peroxide	Gas
Nitrogen tetroxide	Gas
Nitrogen dioxide, liquid	Gas
Parathion/compressed gas mixture	Gas
Phosgene (diphosgene)	Liquid

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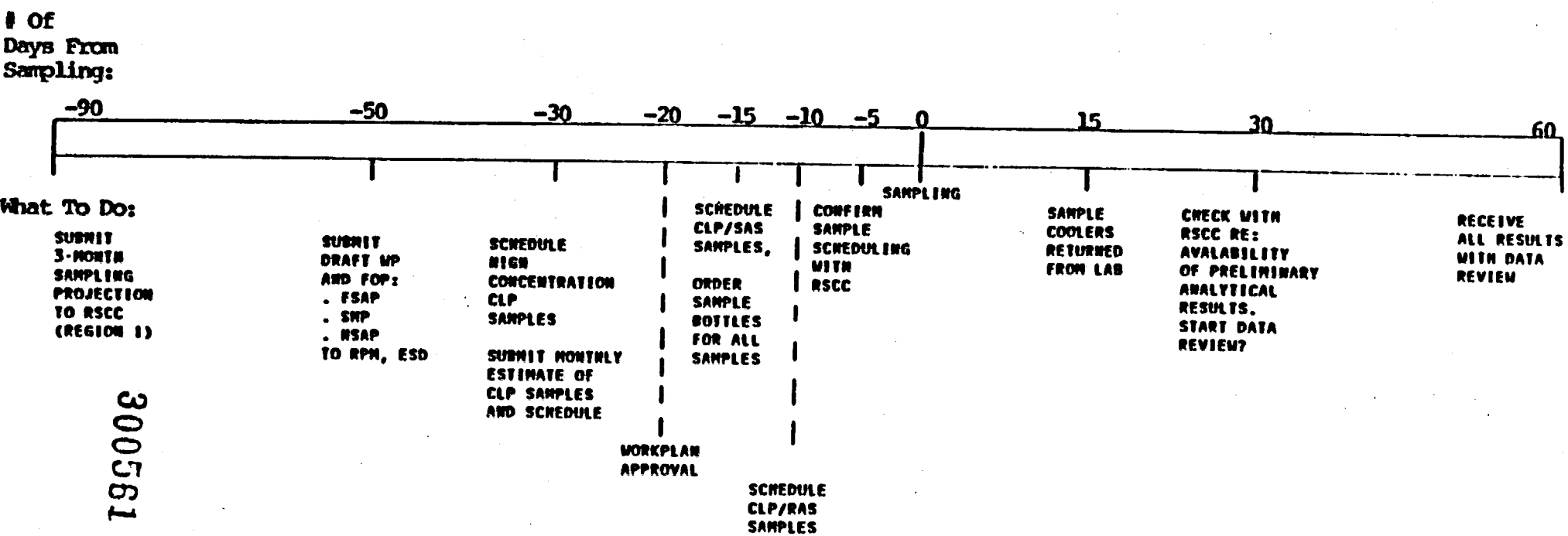

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ATTACHMENT A
FT-7.07, REV. 1

CLP SAMPLE SCHEDULING TIMELINE

PLANNED SAMPLING ACTIVITY REQUIRING CLP ANALYSES

Region _____ Site _____ Month/Year of Activity _____ Case _____

Sampling Organization _____ Regional Contact _____ Telephone _____ _____
(State, REM, FIT, etc.)

Type of Investigation _____ Activity Status _____
(RI/FS, Enforcement, etc.) (Definite, Conditional or Tentative)

Sampling Date(s) _____ Alternate Sampling Date(s) _____

Sample Shipment Date(s) _____ Alternate Shipment Date(s) _____

Routine Analytical Services Required	Media/Concentration									Total		
	Liquid or Water			Solid, Soil or Sediment			Other (SAS)					
	Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High
Full HSL Organics												
VOA Fraction Only												
Semi-VOA Fraction Only												
Pesticide/PCB Fraction Only												
Dioxin Only												
HSL Metals & Cyanide												
HSL Metals Only												

Special Analytical Services Required: Specify (Method, QA, Reporting Requirements to be Provided via SMO Client Request Form)

Submittal Status: _____ (Current, 1, 2 or 3 Month Projection)

Notification Status: _____ (Initial Notification or Resubmittal)

Resubmittal Status: _____ (Resubmittal With or Without Changes)

Submitted By: Date: Phone:

Approved By: Date:

Date Notification Received By SMO:

Date Laboratory(ies) Assigned:

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ATTACHMENT B
FT-7.04, REV. 1

HAZARDOUS MATERIALS SHIPPING CHECKLIST

Packaging

1. Check DOT 172.500 table for appropriate type of package for hazardous substance.
2. Check for container integrity, especially the closure.
3. Check for sufficient absorbent material in package.
4. Check for sample tags and log sheets for each sample, and chain-of-custody record.

Shipping Papers

1. Check that entries contain only approved DOT abbreviations.
2. Check that entries are in English.
3. Check that hazardous material entries are specially marked to differentiate them from any nonhazardous materials being sent using same shipping paper.
4. Be careful all hazardous classes are shown for multiclass materials.
5. Check total amounts by weight, quantity, or other measures used.
6. Check that any limited-quantity exemptions are so designated on the shipping paper.
7. Offer driver proper placards for transporting vehicle.
8. Check that certification is signed by shipper.
9. Make certain driver signs for shipment.

RCRA Manifest

1. Check that approved state/federal manifests are prepared.

2. Check that transporter has the following: valid EPA identification number, valid driver's license, valid vehicle registration, insurance protection, and proper DOT labels for materials being shipped.

3. Check that destination address is correct.

4. Check that driver knows where shipment is going.

5. Check that the driver is aware of emergency procedures for spills and accidents.

6. Make certain driver signs for shipment.

7. Make certain one copy of executed manifest and shipping document is retained by shipper.

overlying water samples should be collected at the specified sampling stations. If valid data are available on the distribution of the contaminant between the solid and aqueous phases it may be appropriate to sample only one phase, although this is not often recommended. If samples are collected primarily for monitoring purposes, consisting of repetitive, continuing measurements to define variations and trends at a given location, water samples should be collected at a pre-established and constant interval as specified in the work plan (often monthly or quarterly) and during droughts and floods. Samples of bottom material should be collected from fresh deposits at least yearly, and preferably during both spring and fall seasons.

The variability in available water-quality data should be evaluated before deciding on the number and collection frequency of samples required to maintain an effective monitoring program.

5.3 SURFACE WATER SAMPLE COLLECTION

5.3.1 Streams, Rivers, Outfalls and Drainage Features (Ditches, Culverts)

Methods for sampling streams, rivers, outfalls and drainage features at a single point vary from the simplest of hand sampling procedures to the more sophisticated multipoint sampling techniques known as the equal-width-increment (EWI) method or the equal-discharge-increment (EDI) methods (See below).

Samples from different depths or cross-sectional locations in the water course taken during the same sampling episode should be composited. However, samples collected along the length of the watercourse or at different times may reflect differing inputs or dilutions and therefore should not be composited. Generally, the number and type of samples to be taken depend on the river's width, depth, discharge and on the suspended sediment the river transports. The greater number of individual points that are sampled, the more likely that the composite sample will truly represent the overall characteristics of the water.

In small streams less than about 20 feet wide, a sampling site can generally be found where the water is well-mixed. In such cases, a single grab sample taken at mid-depth in the center of the channel is adequate to represent the entire cross-section.

For larger streams, at least one vertical composite should be taken with one sample each from just below the surface, at mid-depth, and just above the bottom. The measurement of DO, pH, temperature, conductivity, etc., shall be made on each aliquot of the vertical composite and on the composite itself. For rivers, several vertical composites should be collected.

5.3.2 Lakes, Ponds and Reservoirs

Lakes, ponds, and reservoirs have a much greater tendency to stratify than rivers and streams. The relative lack of mixing requires that more samples be obtained.

The number of water sampling sites on a lake, pond, or impoundment will vary with the size and shape of the basin. In ponds and small lakes, a single vertical composite at the deepest point may be sufficient. Similarly, the measurement of DO, pH, temperature, etc., is to be conducted on each aliquot of the vertical composite. In naturally-formed ponds, the deepest point may have to be determined empirically; in impoundments, the deepest point is usually near the dam.

In lakes and larger reservoirs, several vertical composites should be composited to form a single sample. These verticals are often taken along a transect or grid. In some cases, it may be of interest to form separate composites of epilimnetic and hypolimnetic zones. In a stratified lake, the epilimnion is the upper, warmer and less dense layer of lake water (above the thermocline) which is exposed to the atmosphere. The hypolimnion is the lower, "confined" layer which is only mixed with the epilimnion and vented to the atmosphere during seasonal "overturn" (when density stratification disappears). These two zones may thus have very different concentrations of contaminants if input is only to one zone, if the contaminants are volatile (and therefore vented from the epiliminion but not the hypolimnion), or if the epilimnion only is involved in short-term flushing (i.e., inflow from or outflow to shallow streams). Normally, however, a composite consists of several verticals with samples collected at various depths.

In lakes with irregular shape and with bays and coves that are protected from the wind, separate composite samples may be needed to adequately represent water quality since it is likely that only poor mixing will occur. Similarly, additional samples

should be taken where discharges, tributaries, land use characteristics, and other such factors are suspected of influencing water quality.

Many lake measurements are now made in-situ using sensors and automatic readout or recording devices. Single and multiparameter instruments are available for measuring temperature, depth, pH, oxidation-reduction potential (ORP), specific conductance, dissolved oxygen, some cations and anions, and light penetration (See Guideline FT-7.10, and Reference 4).

5.3.3 Estuaries

Estuarine areas are by definition zones where inland freshwaters (both surface and ground)) mix with oceanic saline waters. Estuaries are generally categorized into three types dependent upon freshwater inflow and mixing properties. Knowledge of the estuary type is necessary to determine sampling locations:

- Mixed estuary - characterized by the absence of a vertical halocline (gradual or no marked increase in salinity in the water column) and a gradual increase in salinity seaward. Typically this type of estuary is shallow and is found in major freshwater sheetflow areas. Being well mixed, the sampling location are not critical in this type of estuary.

- Salt wedge estuary - characterized by a sharp vertical increase in salinity and stratified freshwater flow along the surface. In these estuaries the vertical mixing forces cannot override the density differential between fresh and saline waters. In effect, a salt wedge tapering inland moves horizontally, back and forth, with the tidal phase. If contamination is being introduced into the estuary from upstream, water sampling from the salt wedge may miss it entirely.

- Oceanic estuary - characterized by salinities approaching full strength oceanic waters. Seasonally, freshwater inflow is small with the preponderance of the fresh-saline water mixing occurring near, or at, the shore line.

~~Sampling in estuarine areas is normally based upon the tidal phases, with samples collected on successive slack tides (i.e. when the tide turns). Estuarine sampling programs should include vertical salinity measurements at 1 to 5 foot increments coupled with vertical dissolved oxygen and temperature profiles. A variety of water sampling devices are used, but in general, the Van Dorn (or similar type) horizontal sampler is employed.~~

5.3.4 Sampling Equipment and Techniques

The selection of sampling equipment depends on the site conditions and sample type required. The most frequently used samplers are:

- open tube
- dip sampler
- weighted bottle sampler
- hand pump
- Kemmerer or Van Dorn Sampler
- Depth-Integrating Sampler

The dip sampler and the weighted bottle sampler are used most often.

The criteria for selecting a sampler include:

- Disposable and/or easily decontaminated.
- Inexpensive (if the item is to be disposed of).
- Ease of operation, particularly if personnel protection required is above level D.
- Nonreactive/noncontaminating - Teflon-coated, glass, stainless steel or PVC sample chambers are preferred (in that order).

Each sample (grab or each aliquot collected for compositing) should be measured for:

- specific conductance
- temperature
- pH (optional)
- dissolved oxygen (optional)

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as soon as it is recovered. These analyses will provide information on water mixing/stratification and potential contamination.

Dip Sampling

Water is often sampled by filling a container either attached to a pole or held directly, from just beneath the surface of the water (a dip or grab sample). Constituents measured in grab samples are only indicative of conditions near the surface of the water and may not be a true representaion of the total concentration that is distributed throughout the water column and in the cross section. Therefore, whenever possible one should augment dip samples with samples that represent both dissolved and suspended constituents and both vertical and horizontal distributions.

Weighted Bottle Sampling

A grab sample can also be taken using a weighted holder that allows a sample to be lowered to any desired depth, opened for filling, closed, and returned to the surface. This allows discrete sampling with depth. Several of these samples can be combined to provide a vertical composite. Alternatively, an open bottle can be lowered to the bottom and raised to the surface at a uniform rate so that the bottle collects sample throughout the total depth and is just filled on reaching the surface. The resulting sample using either method will roughly approach what is known as a depth-integrated sample.

A closed weighted bottle sampler consists of a stoppered glass or plastic bottle, a weight and/or holding device, and lines to open the stopper and lower or raise the bottle. The procedure for sampling is:

1. Gently lower the sampler to the desired depth so as not to remove the stopper prematurely (watch for bubbles).

2. Pull out the stopper with a sharp jerk of the sampler line.

3. Allow the bottle to fill completely, as evidenced by the cessation of air bubbles.

4. Raise the sampler and cap the bottle.

5. Decontaminate the outside of the bottle. The bottle can be used as the sample container (as long as original bottle is an approved container).

Hand Pumps

Hand pumps may operate by peristaltic, bellows, diaphragm, or siphon action. Hand pumps which operate by a bellow, diaphragm, or siphon action should not be used to collect samples which will be analyzed to volatile organics because the slight vacuum applied may cause loss of these contaminants. To avoid contamination of the pump, a liquid trap consisting of a vacuum flask or other vessel to collect the sample should be inserted between the sample inlet hose and the pump.

Tubing used for the inlet hose should be nonreactive (preferably teflon). The tubing and liquid trap must be thoroughly decontaminated between uses (or disposed of after one use).

When sampling, the tubing is weighted and lowered to the desired depth. The sample is then obtained by operation of the pump, and subsequently transferred from the trap to the sample container.

Kemmerer/Van Dorn Samplers

If samples are desired at a specific depth, and the parameters to be measured do not require a Teflon coated sampler, a standard Kemmerer or Van Dorn sampler may be used. The Kemmerer sampler is a brass cylinder with rubber stoppers that leave the ends open while being lowered in a vertical position to allow free passage of water through the cylinder. The Van Dorn sampler is plastic and is lowered in a horizontal position. In each case a "messenger" is sent down the line when the sampler is at the designated depth, to cause the stoppers to close the cylinder, which is then raised. Water is removed through a valve to fill sample bottles.

Depth-Integrated Sampling

Depth integration is used to collect a water and suspended material sample, in direct proportion to relative velocity at

each increment of depth. This means that the volume of water and suspended material must enter the sample bottle at a rate proportional to the velocity of the flow passing the intake of the sampler. If a depth-integrating sampler is lowered from the surface to the bed and back at the same rate, and presuming that the sampler is not overfilled during the course of the sampling operation, each increment of flow in that vertical is sampled proportionately to the velocity.

One method of collecting depth-integrated samples is the equal-width-increment (EWI) technique. Samples are taken at several equally spaced verticals across the stream, with the transit rate of the sampler, that is the velocity at which the sampler is passed through the water column, the same in all verticals. The samples collected in each vertical are then composited into a single sample representative of the entire flow in the cross section. Since the volume collected in each vertical sample will be directly proportion to depth and velocity at the vertical location, the composite sample of the water-sediment mixture flowing in the cross section will be discharge-weighted.

In the equal-discharge-increment (EDI) technique, the positions of sampling verticals across the stream are based on incremental discharges rather than width (i.e., deeper or higher-velocity areas of the stream cross-section are sampled at a closer spacing). This method provides the most accurate measure of total discharge of the contaminant for streams which are not well mixed; however, it requires knowledge of the cross-sectional stream flow distribution.

The EDI method has these advantages: variable transit rates may be used because samples can be composited in proportion to known stream flow distribution, fewer verticals need to be sampled, and cross-section discharge information is obtained. The primary disadvantage of the method is that the streamflow distribution in the cross section must be known or measured each time before sampling.

The EWI method has these advantages: discharge measurements are not needed, the technique is learned easily, and the technique is applicable where cross-sectional stream flow distribution varies because of shifting beds or other causes. The main disadvantages

are that the procedure is time consuming for large streams and does not provide quantitative information on cross-sectional discharge since this parameter does not need to be measured for the EWI method. Furthermore, the EWI method requires sampling at equally spaced verticals and use of identical transit rates within each vertical.

Because these multi-point sampling techniques can become very time-consuming and expensive, an alternate method often used involves sampling at the quarter points or other equal intervals across the width of the stream. Composites of individual samples collected at the quarter points can be fairly representative, providing the stream cross section is properly located.

Several depth-integrating samplers specifically designed and suitable for collecting representative samples are available contact: Engineer-in-Charge, Federal Inter-Agency Sedimentation Project, St. Anthony Falls Hydraulic Laboratory, Hennepin Island and 3rd Ave, SE, Minneapolis, MN 55414; see also Reference 4 of this guideline). In shallow streams and wetlands that can be waded, the US DH-48 suspended-sediment sampler can be used. The US DH-59 suspended-sediment sampler was designed to be suspended by a hand-held rope in streams too deep to be waded. The US D-49 suspended-sediment sampler has also been used for many years to collect depth-integrated samples in large streams and rivers. It accommodates a 473-ml bottle and has a choice of nozzles (3.2-mm, 4.8-mm, and 6.4-mm in diameter) to control the rate of inflow of the water-sediment mixture. The D-49 sampler, which weighs about 27 kg, is suspended on a cable and operated with a reel attached to a boom. The US D-74 sampler is a modified D-49 sampler that accommodates either a 473-ml or 946-ml bottle. The US D-74 AL sampler is also a modified D-49 sampler, but is cast from aluminum and weighs approximately 13.6 kg. This sampler can be used with a handline in slower moving streams. The US DH-76 sampler is a modified DH-59 sampler that accommodates a 946-ml bottle and is available in the regular or trace-metal series. A new sampler, designated DH-80, accommodates either a 473-ml or 946-ml Mason jar. The intake nozzle with air exhaust ports is a single-piece head molded from polypropylene. Contaminated heads can be replaced quickly and easily. For further information on these samplers, see Reference 4, Chapter 3.

~~Because of the number and diversity of analyses which may be performed on collected surface water or water-sediment mixtures, a sample splitter will often be required. A churn splitter is a practical means for splitting composited samples into representative subsamples, as described in Reference 4 (Chapter 3).~~

5.4 SEDIMENT SAMPLING

5.4.1 General

Sediment samples are usually collected at the same verticals at which water samples were collected. If only one sediment sample is to be collected, the site should be approximately at the center of water body. This is particularly true for reservoirs that are formed by the impoundment of rivers or streams. Generally, the coarser grained sediments are deposited near the headwaters of the reservoir. Bed sediments near the center will be composed of fine-grained materials which may, because of their lower porosity and greater surface area available for adsorption, contain greater concentrations of contaminants. The shape, flow pattern, bathymetry (depth distribution), and water circulation patterns must all be considered when selecting sediment sampling sites. In streams, areas likely to have sediment accumulation (bends, behind islands or boulders, quiet shallow areas or very deep, low-velocity areas) should be sampled while areas likely to show net erosion (high-velocity, turbulent areas) and suspension of fine solid materials should be avoided.

Chemical constituents associated with bottom material may reflect an integration of chemical and biological processes. Bottom samples reflect the historical input to streams, lakes, and estuaries with respect to time, application of chemicals, and land use. Bottom sediments (especially fine-grained material) may act as a sink or reservoir for adsorbed heavy metals and organic contaminants (even if water column concentrations are below detection limits). It is therefore important to minimize the loss of low-density "fines" during any sampling process.

5.4.2 Sampling Equipment and Techniques

A bottom-material sample may consist of a single scoop or core or may be a composite of several individual samples in the cross

section. Sediment samples may be obtained using on-shore or off shore techniques.

When boats are used for sampling, life preservers must be provided and two individuals must undertake the sampling. An additional person should remain on-shore in visual contact at all times.

The following samplers may be used to collect bottom materials:

- scoop sampler
- core samplers
- hand operated gravity corers
- dredge samplers

Scoop Sampler

A scoop sampler consists of a pole to which a jar or scoop is attached. The pole may be made of bamboo, wood or aluminum and be either telescoping or of fixed length. The scoop or jar at the end of the pole is usually attached using a clamp.

If the water body can be sampled from the shore or if it can be waded, the easiest and "cleanest" way to collect a sediment sample is to use a scoop sampler. This reduces the potential for cross-contamination. This method is accomplished by reaching over or wading into the water body and, while facing upstream (into the current), scooping the sample along the bottom in the upstream direction. It is very difficult not to disturb fine-grained materials of the sediment-water interface when using this method.

Core Samplers

Core samplers are used to sample vertical columns of sediment. They are useful when a historical record of sediment deposition is desired, for they preserve the sequential layering of the deposit. Coring devices are particularly useful for sediments because the "shock wave" created by descent is minimal, thus the fines of the sediment-water interface are not disturbed. Also

5.1.2 Principles of Equipment Operation

Use of pH papers for pH measurement relies on a chemical reaction caused by the acidity or basicity of the solution with the indicator compound on the paper. Depending on the indicator and the pH range of interest, a variety of different colors can be used. Typical indicators are weak acids or bases, or both. Process chemistry and molecular transformations leading to the color change are variable and complex.

Use of a pH meter relies on the same principle as other ion-specific electrodes. Measurement relies on establishment of a potential difference across a glass or other type of membrane in response to hydrogen ion concentration across that membrane. The membrane is conductive to ionic species and, in combination with a standard or reference electrode, a potential difference proportional to hydrogen ion concentration can be generated and measured.

5.1.3 Equipment

The following equipment is needed for taking pH measurements:

1. Accumet 150 portable pH meter, or equivalent.

2. Combination electrode with polymer body to fit the above meter (alternately a pH electrode and a reference electrode can be used if the pH meter is equipped with suitable electrode inputs.

3. pH indicator paper, such as Hydrion or Alkacid, to cover the pH range 2 through 12.

4. Buffer solutions of pH 4,7 and 10, or other buffers which bracket the expected pH range.

Because of the diversity of pH meters currently available on the market, the investigator has the option of selecting the unit that best meets his investigative needs and field limitations. Digital meters are preferred, as opposed to deflection meter outputs, because of the relative ease in reading response for in-situ measurements.

5.1.4 Measurement Techniques for Field Determination of pH

1. pH Meter

The following procedure is used for measuring pH with a pH meter:

a. The instrument and batteries should be checked and calibrated in the laboratory prior to initiation of the field effort.

b. The accuracy of the buffer solutions used for field and laboratory calibration should be checked. Buffer solutions need to be changed due to degradation upon exposure to the atmosphere. (The date of preparation of each buffer should be included on the bottle label.)

c. Immerse the tip of the electrodes in water overnight. If this is not possible due to field conditions, immerse the electrode tip in water for at least an hour before use. The electrode tip may be immersed in a rubber or plastic sack containing buffer solution for field transport or storage. This is not applicable for all electrodes as some must be stored dry.

d. Make sure all electrolyte solutions within the electrode(s) are at their proper levels and that no air bubbles are present within the electrode(s).

e. Immerse the electrode(s) in a pH-7 buffer solution.

f. Adjust the temperature compensator to the proper temperature (on models with automatic temperature adjustment, immerse the temperature probe into the buffer solution). Alternately, the buffer solution may be immersed in the sample and allowed to reach temperature equilibrium before equipment calibration. It is best to maintain buffer solution at or near expected sample temperature before calibration.

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g. Adjust the pH meter to read 7.0.

h. Remove the electrode(s) from the buffer and rinse well with demineralized water. Immerse the electrode(s) in pH-4 or 10 buffer solution (depending on the expected pH of the sample) and adjust the slope control to read the appropriate pH. At least three successive readings during calibration, one minute apart, should be within ±0.1 pH unit. For best results, the standardization and slope adjustments should be repeated at least once daily before use. In Region IV the meter shall be checked against the buffers before each reading.

i. Immerse the electrode(s) in the unknown solution, slowly stirring the probe until the pH stabilizes. Stabilization may take several seconds to minutes. If the pH continues to drift, the sample temperature may not be stable, a chemical reaction (e.g., degassing) may be taking place in the sample, or the meter or electrode may be malfunctioning. This must be clearly noted in the logbook.

j. Read and record the pH of the solution, after adjusting the temperature compensator to the sample temperature. pH should be recorded to the nearest 0.1 pH unit. Also record the sample temperature.

k. Rinse the electrode(s) with demineralized water.

l. Keep the electrode(s) immersed in water when not in use.

The sample used for pH measurement should never be saved for subsequent conductivity or chemical analysis. All pH electrodes leak small quantities of electrolytes (e.g., sodium or potassium chloride) into the solution. Precipitation of saturated electrolyte solution, especially at colder temperatures, or in cold water, may result in slow electrode response. Any visual observation of conditions which may interfere with pH measurement, such as oily materials, or turbidity, should be noted.

2. pH Paper

Use of pH paper is very simple and requires no sample preparation, standardization, etc. pH paper is available in several ranges, including wide-range (indicating approximately pH 1 to 12), mid-range (approximately pH 0 to 6, 6 to 9, 8 to 14) and narrow-range (many available, with ranges as narrow as 1.5 pH units). The appropriate range of pH paper should be selected. If the pH is unknown the investigation should start with wide-range paper.

A drop of sample is placed on the pH paper using a glass or plastic rod or dropper. The color of the wetted paper is then compared to a color chart supplied with the pH paper to determine the sample pH.

5.2 MEASUREMENT OF SPECIFIC CONDUCTANCE

5.2.1 General

Conductance provides a measure of dissolved ionic species in specific water and can be used to identify the direction and extent of migration of contaminants in groundwater or surface water. It can also be used as a measure of subsurface biodegradation or to indicate alternate sources of groundwater contamination.

Conductivity is a numerical expression of the ability of a water sample to carry an electric current. This value depends on the total concentration of the ionized substances dissolved in the water and the temperature at which the measurement is made. The mobility of each of the various dissolved ions, their valences, and their actual and relative concentrations affect conductivity.

It is important to obtain a specific conductance measurement soon after taking a sample, since temperature changes, precipitation reactions, and absorption of carbon dioxide from the air all affect the specific conductance.

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5.2.2 Principles of Equipment Operation

An aqueous system containing ions will conduct an electric current. In a direct-current field, the positive ions migrate toward the negative electrode, while the negatively charged ions migrate toward the positive electrode. Most inorganic acids, bases and salts (such as hydrochloric acid, sodium carbonate, or sodium chloride, respectively) are relatively good conductors. Conversely, organic compounds such as sucrose or benzene, which do not disassociate in aqueous solution, conduct a current very poorly, if at all.

A conductance cell and a Wheatstone Bridge (for the measurement of potential difference) may be used for measurement of electrical resistance. The ratio of current applied to voltage across the cell may also be used as a measure of conductance. The core element of the apparatus is the conductivity cell containing the solution of interest. Depending on ionic strength of the aqueous solution to be tested, a potential difference is developed across the cell which can be converted directly or indirectly (depending on instrument type) to a measurement of specific conductance.

5.2.3 Equipment

The following equipment is needed for taking specific conductance measurements:

1. YSI Model 33 portable conductivity meter, or equivalent

2. Probe for above meter

A variety of conductivity meters are available which may also be used to monitor salinity and temperatures. Probe types and cable lengths vary, so equipment may be obtained to meet the specific requirement of the sampling program.

5.2.4 Measurement Techniques for Specific Conductance

The steps involved in taking specific conductance measurements are listed below:

1. Check batteries and calibrate instrument before going into the field.

2. Immerse the electrode in water overnight. If this is not possible due to field conditions, immerse the electrode at least one hour before use.

3. Calibrate the instrument between each measurement or groups of closely spaced measurements. Potassium chloride standard solutions with a specific conductance closest to the values expected in the field should be used. Attachment A may be used for guidance.

4. Rinse the cell with one or more portions of the sample to be tested.

5. Immerse the electrode in the sample and measure the conductivity.

6. Read and record the results in a field logbook. Adjust the temperature setting to the sample temperature.

7. Repeat the procedure with fresh sample until reproducible (i.e., +/- 5%) results are obtained. (Region IV - duplicate field analyses should agree within ± 10%)

If the specific conductance measurements become erratic, or inspection shows that any platinum black has flaked off the electrode, replatinization of the electrode is necessary. See the manufacturer's instructions for details.

Note that specific conductance is occasionally reported at temperatures other than ambient.

5.3 MEASUREMENT OF TEMPERATURE

5.3.1 General

In combination with other parameters, temperature can be a useful indicator of the likelihood of biological action in a water sample. It can also be used to trace the flow direction of contaminated groundwater (see FT-6.09). Temperature measurements should be taken in-situ, or as quickly as possible in the field. Collected water samples may rapidly equilibrate with the temperature of their surroundings.

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5.3.2 Equipment

Temperature measurements may be taken with alcohol-toluene, mercury filled or dial-type thermometers. In addition, various meters such as specific conductance or dissolved oxygen meters, which have temperature measurement capabilities, may also be used. Using such instrumentation along with suitable probes and cables, in-situ measurements of temperature at great depths can be performed.

5.3.3 Measurement Techniques for Water Temperature

If a thermometer is used on a collected water sample:

1. Rinse the thermometer with a portion of the collected sample.

2. Immerse the thermometer in the sample until temperature equilibrium is obtained (1-3 minutes). To avoid the possibility of contamination, the thermometer should not be inserted into samples which will undergo subsequent chemical analysis.

3. Record values in a field logbook.

If a temperature meter or probe is to be used, the instrument should be calibrated according to the manufacturer's recommendations and a National Bureau of Standards (NBS) certified thermometer or one that is traceable to NBS certification before field use. Cross-checks and duplicate field analyses should agree within ±0.5 degrees C. A cross-check with a calibrated NBS certified thermometer shall be made at least semi-annually.

5.4 MEASUREMENT OF DISSOLVED OXYGEN CONCENTRATION

5.4.1 General

Dissolved oxygen (DO) levels in natural water and wastewater depend on the physical, chemical and biochemical activities in the water body. Conversely, the growth of many aquatic organisms as well as the rate of corrosivity, are dependent on the dissolved oxygen concentration. Thus, analysis for dissolved oxygen is a key test in water pollution and waste treatment process control. If at all possible, DO measurements

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5. Record the dissolved oxygen content and temperature of the sample in a field logbook.

6. Recalibrate the probe when the membrane is replaced, or as needed. Follow the manufacturer's instructions. Duplicate analyses should agree within ± 0.1 mg/l.

Note that in-situ placement of the probe is preferable, since sample handling is not involved. This however, may not always be practical. Be sure to record whether the liquid was analyzed in-situ, or if a sample was taken.

Special care should be taken during sample collection to avoid turbulence which can lead to increased oxygen solubilization and positive test interferences.

5.5 MEASUREMENT OF OXIDATION-REDUCTION POTENTIAL

5.5.1 General

The oxidation-reduction potential (ORP) provides a measure of the tendency of organic or inorganic compounds to exist in an oxidized state. The technique therefore provides evidence of the likelihood of anaerobic degradation of biodegradable organics or the ratio of activities of oxidized to reduced species in the sample.

5.5.2 Principles of Equipment Operation

When an inert metal electrode, such as platinum, is immersed in a solution, a potential is developed at that electrode depending on the ions present in the solution. If a reference electrode is placed in the same solution, an ORP electrode pair is established. This electrode pair allows the potential difference between the two electrodes to be measured and will be dependent on the concentration of the ions in solution. By this measurement, the ability to oxidize or reduce species in solution may be determined. Supplemental measurements, such as dissolved oxygen, may be correlated with ORP to provide a knowledge of the quality of the solution, water, or wastewater.

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5.5.3 Equipment

The following equipment is needed for measuring the oxidation-reduction potential of a solution:

1. Accumet 150 portable pH meter or equivalent, with a millivolt scale.

2. Platinum electrode to fit above pH meter.

3. Reference electrode such as a calomel, silver-silver chloride, or equivalent.

5.5.4 Measurement Techniques for Oxidation-Reduction Potential

The following procedure is used for measuring oxidation-reduction potential:

1. The equipment should be calibrated and have its batteries checked in the laboratory before going to the field.

2. Check that the platinum probe is clean and that the platinum bond or tip is unoxidized. If dirty, polish with emery paper or, if necessary, clean the electrode using aqua regia, nitric acid, or chromic acid, in accordance with manufacturer's instructions.

3. Thoroughly rinse the electrode with demineralized water.

4. Verify the sensitivity of the electrodes by noting the change in millivolt reading when the pH of the test solution is altered. The ORP will increase when the pH of the test solution decreases and the ORP will decrease if the test solution pH is increased. Place the sample in a clean glass beaker and agitate the sample. Insert the electrodes and note the ORP or millivolt reading. Add a small amount of a dilute NaOH solution and note the value of the ORP. If the ORP drops sharply when the caustic is added, the electrodes are sensitive and operating properly. If the ORP increases sharply when the caustic is added, the polarity is reversed and must

be corrected in accordance with the manufacturer's instructions. If the ORP does not respond as above when the caustic is added, the electrodes should be cleaned and the above procedure repeated.

5. After the assembly has been checked for sensitivity, wash the electrodes with three changes of water or with a flowing stream of water from a wash bottle. Place the sample in a clean glass beaker or sample cup and insert the electrodes. Set temperature compensator to the sample temperature. Provide adequate agitation throughout the measurement period. Read the millivolt potential of the solution, allowing sufficient time for the system to stabilize and reach temperature equilibrium. Measure successive portions of the sample until readings on two successive portions differ by no more than 10 mV. A system that is very slow to stabilize properly will not yield a meaningful ORP. Record all results in a field logbook, including ORP (to nearest 10 mV), sample temperature and pH at the time of measurement.

5.6 SPECIFIC ION ELECTRODE MEASUREMENTS

5.6.1 General

Use of specific ion electrodes can be beneficial in the field for determining the presence and concentration of dissolved inorganic species which may be associated with contaminant plumes or leachate. Thus, electrodes can be used for rapid screening of water quality and determination of water migration pathways.

This guideline provides generic information for specific ion electrodes commonly used in groundwater quality monitoring programs and describes the essential elements of a field investigation program. Analytical methods using some specific ion electrodes have not been approved by the USEPA. In addition, calibration procedures and solutions, interferences and conditions and requirements for use for various electrodes vary greatly. Consequently, review of manufacturer's literature is mandatory prior to use.

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affected by exposure to light. All samples are to be cooled to 4 degrees Celsius; those containing residual chlorine will also be preserved with 0.008% $Na_2S_2O_3$ (Sodium Thiosulfate). The holding time for extraction is seven (7) days. Complete analysis must take place within 40 days after extraction.

5.1.2 Soil/Sediment Samples

Soil and sediment samples are collected using conventional sampling techniques and equipment. In areas where a highly compacted material such as asphalt covers the soil to be sampled, the overburden is to be broken and removed, using picks and shovels, until a one-foot square area is cleared. All holes are backfilled after sample collection.

Before the sample is placed in its container, it is homogenized using a stainless steel spoon and mixing bowl, or a blender with a one quart stainless steel cup. If a blender is used, the following steps are taken:

1. Take sample to blending area.

2. Pulse blender approximately 30 times, inverting and shaking the cup at frequent intervals.

3. Allow dust to settle for two to five minutes.

TCDD analysis requires one full 4 oz., or one 8 oz. glass jar.

Prior to filling, each sample jar is placed inside a clean plastic baggie held secure with a rubber band. Stainless steel scoops or spoons are used to tranfer the homogenized sample to the jar. After filling and capping, the baggie and rubber band are removed, the jar is spray rinsed inside with 1,1,1-Trichloroethane, if visual contamination is present, and the sample jar is placed in a clean baggie. Samples are stored away from light at 4 degrees Centigrade.

5.1.3 Wipe Samples

Wipe samples are often collected to determine the extent of surface contamination. The following procedures will be

implemented when collecting wipe samples for BNAE pesticides and arsenic ~~TCDD~~ analysis (OSHA, 1984):

1. Using clean gloves, preload vials with appropriate filters. The type of filter will depend on the type of analysis to be performed. Glass fiber filters are to be used with HPLC or GC analysis; paper filters are used with any other analysis. The glass fiber filters will be used to collect the BNAE pesticide samples. The paper filters will be used to collect the arsenic samples.

2. Prepare a rough drawing of each of the locations to be sampled.

3. Withdraw filter from vial. Solvents such as hexane, methanol and isopropyl alcohol are often used to wet the filter before wiping. These also depend on the analysis to be performed. In some cases, distilled, deionized water is used. A 1:4 solvent mixture (acetone/Hexane) will be used to wet the filters for BNAE pesticide samples. Deionized water will be used for the arsenic samples.

4. Wipe a 4-square inch (100-square centimeter) area.

5. Fold the filter with the exposed area in, fold again, place in vial and cap the vial. It is especially important that the sampler change gloves between samples.

6. Include at least one blank filter treated in the same manner, excluding wiping, for each sampled area.

5.2 SAMPLE DOCUMENTATION

In order to track each sample through shipping and analysis, the following documents will be prepared:

- Sample Labels and Identification Tags: One per sample bottle. (See Guideline FT-7.05).

- ~~Dioxin Shipment Records: One for each sample shipment (up to 24 samples) to an individual laboratory. (See Attachment A).~~

- Chain-of-Custody Records and Seals: See Guideline FT-7.05.

- Airbills: One for each shipment to an individual laboratory.

In addition, a field log book will be kept by the sampling team leader. The log book will include daily entries describing all site and sampling activities.

5.3 SAMPLE PACKAGING AND SHIPPING

In most cases, samples collected for TCDD analysis are to be shipped as high-hazard samples. See Guideline FT-7.07 and Attachment B, for proper high-hazard packaging and shipping procedures.

5.4 DECONTAMINATION

All sampling equipment is to be decontaminated as follows:

1. Alconox and potable water wash.
2. Potable water rinse.
3. Alcohol rinse.
4. 1,1,1-Trichloroethane rinse.
5. Air dry.

A sample of the 1,1,1-Trichloroethane must be submitted as a rinsate sample. A volume of 6 oz. is to be collected in an 8-oz. glass jar.

All wastes are to be containerized and properly labeled.

6.0 REFERENCES

Guideline FT-7.08 - Surface Water and Sediment Sampling

Guideline FT-7.02 - Groundwater Sample Acquisition

Guideline FT-7.03 - Soil Water and Rock Sample Acquisition

Guideline FT-7.05 - Sample Identification and Chain-of Custody

5.7 CONTAINER SAMPLING

5.7.1 Equipment

1. Personal protection equipment.

2. 500 ml, wide-mouth amber glass bottle with teflon cap liner.

3. Uniquely numbered sample identification labels and tags (see Guideline FT-7.04) filled out and affixed to sample containers before sampling commences.

4. 4-ft. x 3/4-in. ID glass sampling thief.

5. Remotely operated opening device (see Section 5.5).

6. One gallon covered cans half-filled with absorbent (for off-site shipment only).

5.7.2 Sampling Procedures

All drums and mechanical equipment should be grounded prior to the commencement of sampling. If the bung or container lid can be removed, sample contained liquids using a glass thief, which shall then be broken and discarded within the barrel. A barrel that has a badly rusted bung, or that cannot be sampled as above, shall be safely entered with a hydraulic penetrating device operated remotely (see Section 5.5). All openings shall be plugged except during sampling operation.

The steps to be followed in sampling are as follows:

1. Record any markings, special drum conditions, and type of opening in the field notebook, on the sample log sheet, and, later, on the Chain-of-Custody form. Locate the general area on a sketch of the site.

2. Stencil an identifying number on the drums and record in logbook. Consult the sampling plan for identifications.

3. Make certain that the drum/container is set on a firm base, preferably in a fully upright position.

2. If the Site Manager and HSO approve the handling of these containers, they shall be handled with extreme caution. Until otherwise categorized, they shall be considered explosive or shock sensitive wastes. Initial handling shall be by a grappler unit constructed for explosive containment. Drums shall be palletized and overpacked if required prior to transport to the Lab Pack staging area for sorting, identification, repacking and/or stabilization.

3. Prior to handling or transportating Lab Packs from the existing drum area, personnel working in the immediate area shall be removed to a safe distance. Continuous contact with the communication base shall be maintained until handling or transporting operations are complete. An audible siren signal system, similar to that employed in conventional blasting operations will be used to signify the commencement and cessation of Lab Pack handling or transporting activities.

5.6.6 Air Reactive Wastes

1. If the presence of an air reactive substance is verified or even suspected, the material should be immediately segregated and transported to a separate high hazard interim storage and disposal area.

2. Air reactive wastes may be discovered during opening or sampling operations. Air reactive substances normally require special packaging. They may be stored under water or some other liquid to minimize air contact. They may also be found in sealed ampoules, corrugated drums, stainless steel canisters, or specially lined drums.

5.6.7 Gas Cylinders

1. Gas cylinders, when encountered, should be stored and disposed of on a special case basis depending on the integrity of the cylinders and type of substance they are expected to contain.

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4. Open the drum/container as described in Section 5.5 and Attachment A.

5. Insert glass tubing almost to the bottom of the drum or until a solid layer is encountered. About 1 ft. of tubing should extend above the drum.

6. Allow the waste in the drum to reach its natural level in the tube. Then cap the top of the sampling tube with a tapered stopper, ensuring liquid does not come into contact with stopper.

7. Carefully remove the capped tube from the drum and insert the uncapped end in the sample container. Do not spill liquid on the outside of the sample container. Release the stopper and allow the glass thief to drain completely into the sample container.

8. Deliver 100 to 250 ml of the sample (the sampling plan will specify the amount) to a clean, wide-mouth, 500-ml (1-pt) glass sample jar. If the sample is not free flowing and is taken through a bung opening, repeated sampling may be necessary.

9. Place the used sampling tube, along with paper towels or waste rags used to wipe up any spills, into an empty metal barrel for subsequent disposal. If glass tubing has been used, it may be broken and left inside the drum being sampled.

10. Cap the sample container tightly and place prelabeled and tagged sample container in a carrier.

11. Replace the bung or lids or place plastic over the drum/container.

12. Measure the sample for radioactivity and record results in a field notebook. If the meter readings exceed 10 mR/hr, notify the FOL immediately.

13. Fill out Chain-of-Custody Record (see Guideline FT-7.05) and carefully pack samples (see Guideline FT-7.07). The finished package will be padlocked or custody-sealed for shipment to the laboratory. The preferred procedure includes the use of a custody seal across filament tape

that is wrapped around the package at least twice. The custody seal (paper, plastic, or metal) is then folded over and stuck to itself so that the only access to the samples is by cutting the filament tape or breaking the seal to unwrap the tape. The seal is signed before the package is shipped.

14. Complete the appropriate traffic report. Drum samples are always considered to be high-hazard samples.

5.7.3 Sample Preservation and Packing Procedures for Drummed Waste Samples

1. No preservatives shall be used.

2. Place sample in a ziplock plastic bag.

3. Place each bagged container in a 1-gallon covered can containing absorbent packing material. Place lid on can.

4. Mark the sample identification number on the outside of the can.

5. Arrange for the appropriate transportation mode consistent with the type of hazardous waste involved (see Guideline FT-7.07).

5.8 RESEALING AND SITING CONTAINERS

All containers opened for sampling need to be resealed to prevent the escape of vapors and possible reactions from rainwater, air and so on. The resealing methods will depend on the opening methods used and include the following.

1. Replacing the bung, screw cap, etc.

2. Replacing the lid and retaining ring.

3. Placing the drum in an overpack (larger drum) when it cannot be resealed by any other method.

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4. If a hole is drilled, use of a special rubber or plastic plug. A drum bonnet should be used to ensure that rainwater does not seep around the plug.

It is important to note that these resealing methods are for the purpose of preventing leakage from the container while it is in storage on the site. If the container is to be moved off the site, DOT regulations regarding transportation of drums must be complied with (see Guideline FT-11.02). These will generally require more rigorous sealing procedures.

Once the drum is sampled and resealed, it should be left where it cannot react with other containers on the site. For a small number of drums, the storage areas may be the staging and opening area. In any event, the sampled drums should be placed in an area away from other groups of containers on the site. The reason is that slowly progressing chemical reactions can start when a container is opened and the contents exposed to air or the disturbance caused by handling the drum. Such a reaction could take hours or even days to occur. Another reason for the segregation and identification of drums for recovery is for use as evidence.

5.9 PUBLIC EVACUATION/ALERT CONSIDERATION

5.9.1 General

The potential need for evacuation of the site and surrounding area must be considered when the Site Operations Plan and Health and Safety Plan are developed. The HASP should describe the conditions requiring evacuations and the parties responsible for issuing and enforcing an evacuation order. Several site-specific factors influence the need for, and the extent of, the evacuation or alerting of the nearby off-site public. These factors include the following:

1. Proximity of residences, shopping or other commercial or business areas, factories, highways, railroads, and airfields or other transportation routes that may have to be evacuated. This information will be available from the background review and preliminary site inspections.

1.0 PURPOSE

The purpose of this guideline is to provide reference information regarding sampling of liquid or solid materials from tanks by methods which do not require tank entry..

2.0 SCOPE

This guideline covers tank inspection and sampling techniques for use in assessing the condition and, contents of tanks. This guideline does not address actual entry for internal inspection or sampling which strict requires Health and Safety protocols during this potentially hazardous activity (this protocol is described in Guideline HS-1.03).

3.0 DEFINITIONS

None.

4.0 RESPONSIBILITIES

Site Manager - Responsible to assure that the need for tank sampling is well justified and that the sampling techniques chosen are adequate to obtain a representative sample and prevent significant spills and atmospheric releases.

Field Operations Leader - Responsible for implementing the FSAP and for overseeing the sampling effort in the field.

Health and Safety Officer - Responsible for developing the safety-related procedures for tank entry and sampling and for asuring their correct implementation in the field.

5.0 GUIDELINES

5.1 ACCESS FOR SAMPLING

If possible, tanks will be opened and sampled from the top. The physical size, shape, construction material and location of access will determine the best method of opening and sampling. In some cases, (for example, if the tank is being sampled from a valve at the bottom of the tank) it may be necessary to have

spill response personnel on-site in case of an accidental release.

When liquids are contained in sealed vessels, gas vapor pressures build up, sludges settle out, and density layering develops. The potential for explosive reactions or the release of noxious gases when containers are opened requires considerable safeguards. The vessels should be opened with extreme caution. Preliminary sampling of any headspace gases may be warranted. As a minimum, a preliminary check with an explosimeter or an organic vapor analyzer will determine levels of personnel protection and may be of aid in selecting a sampling method.

5.2 TANK SAMPLING

At least two persons must always perform tank sampling: one should collect the actual samples and the other should stand back, usually at the head of the sample part access stairway and observe, ready to assist or call for help. If the walls or roof of the tank corroded, the samplers should not attempt to climb up the outside of a tank, but instead an aerial lift should be used to gain access to the sampling hole.

The sampling of tanks is similar to the sampling of drums (see Guideline FT-11.01). The techniques for sampling are the same, except sampling equipment may need to be longer to give a representative sample of deep tanks. Steps to be followed in tank sampling include the following:

1. Record the tank's condition, markings, opening or valve types, and approximate size in gallons in the site logbook (see Guideline FT-13.01) and on the sample log sheet (see Guideline FT-7.04). Note the tank location on the site sketch.

2. Attach an identification number to the tank using a stencil or weatherproof tag. Number succeeding tanks consecutively. Record the numbers in the site logbook.

3. Determine whether the tank contents are stratified by inserting a long plastic or glass tube sampler, withdrawing it, and examining the tube contents. Samples of stratified contents can be taken using a bomb, weighted bottle, or a Kemmerer sampler. For a description of these methods, see Attachment A of this Guideline. If a composite sample is desired, take one

sample each for the upper, middle and lower sections of the tank or for each identified layer, and composite them in one container.

NOTE: If a reaction is observed when the glass tube is inserted (violent agitation, fumes, light, etc.) the investigators should leave the area immediately. If the glass tube becomes cloudy or smokey after insertion into the tank, the presence of hydrofluoric acid is indicated and a comparable length of rigid plastic tubing should be used.

4. If contents of the tank are homogenous, a sample may be taken using glass tubes. See Attachment B for details of this procedure.

5. After collecting the sample in the appropriate container(s),add preservative required (see Guideline FT-7.06), secure the lid, and attach a label and identification tag (see Guideline FT-7.05). Tape the lid. Fill out the appropriate sample log sheet and traffic report (see Guideline FT-7.04) and Chain of Custody Record (see Guideline FT-7.05).

5.3 SAMPLE PACKAGING AND SHIPPING

Many samples collected from storage tanks will be shipped as high-hazard samples. See Guideline FT-7.07 for the proper methods of shipment.

6.0 REFERENCES

Guideline HS-1.03 - Confined Space/Limited Egress (CS/LE)

Guideline FT-7.04 - Management of Sampling and Preparation of Required Forms

Guideline FT-7.05 - Sample Identification and Chain-of Custody

Guideline FT-7.06 - Sample Preservation

Guideline FT-7.07 - Sample Packaging and Shipping

Guideline FT-11.01 - Drum Opening and Sampling

Guideline 7.0 ATTACHMENTS

ATTACHMENT A - Methods of Sampling Stratified Contents of Tanks (7 sheets)

B - Collection of Liquid Containerized Wastes Using Glass Tubes

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METHODS OF SAMPLING STRATIFIED CONTENTS OF TANKS

1. Sampling Using The Bacon Bomb Sampler

Discussion

The Bacon Bomb (Figure A-1) is designed for the withdrawal of samples by the "thief" method from various levels within a storage tank. It consists of a cylindrical body with an internal tapered plunger that acts as a valve to admit the sample. A line attached to the top of the plunger is used to open and close the valve. A removable top cover provides a point of attachment for the sample line and has a locking mechanism to keep the plunger closed after sampling. The Bacon Bomb is usually constructed of chrome-plated brass and bronze with a rubber O-ring acting as the plunger sealing surface. Stainless steel versions are also available. The volumetric capacity is 8, 16, or 32 oz. (236, 473, or 946 ml).

Uses

The Bacon Bomb is a heavy sampler suited best for viscous materials held in large storage tanks or in lagoons. If a more non-reactive sampler is needed, the stainless steel version should be used or any of the samplers could be coated with Teflon.

Sampling Method

1. Attach the sample line and the plunger line to the sampler.
2. Measure and then mark the sampling line at the desired depth for sampling.
3. Gradually lower the sampler by the sample line until the desired level is reached.
4. When the desired level is reached, pull up on the plunger line and allow the sampler to fill before releasing the plunger line to seal off the sampler.
5. Retrieve the sampler by the sample line, being careful not to pull up on the plunger line and thereby prevent accidental opening of the bottom valve.
6. Rinse or wipe off the exterior of the sampler body.
7. Position the sampler over the sample container and release its contents by pulling up on the plunger line.
8. Thoroughly decontaminate the sampler prior to next use.

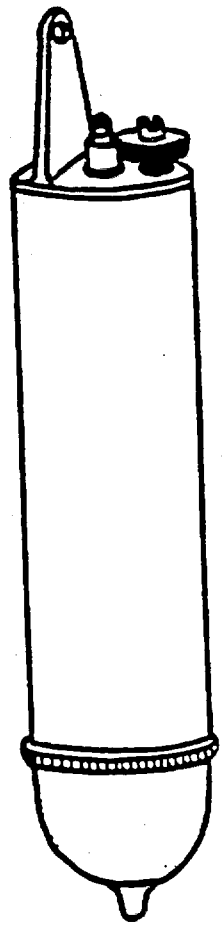

FIGURE A-1. BACON BOME SAMPLER

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2. Discussion

The weighted bottle sampler consists of a glass bottle, a weight sinker, a bottle stopper, and a line for opening the bottle and lowering and raising the sampler during sampling (Figure A-2). There are variations of this sampler, as illustrated in the American Society of Testing and Materials (ASTM) methods D 270 and E 300. This sampler can be either fabricated or purchased commercially.

Uses

Weighted bottle samplers are used to sample liquids at depth. These samplers are difficult to use in very viscous liquids. In addition, the outside of the bottle is exposed to the waste. This is undesirable if the bottle is used as the sample container. An alternative to the weighted bottle sampler is the Kemmerer bottle.

Sampling Method

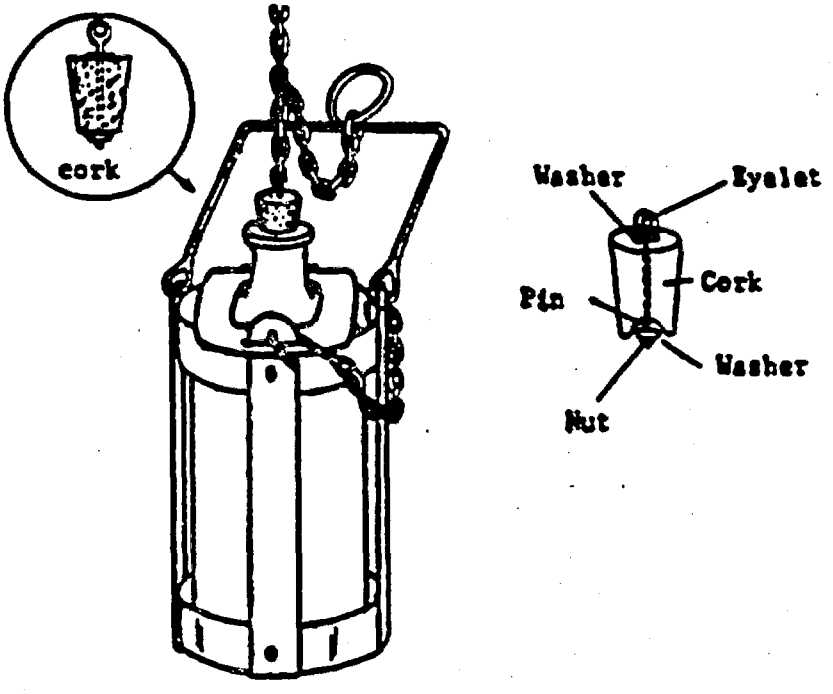
1. Gently lower the sampler into the liquid to the desired depth so as not to remove the stopper prematurely.

2. Pull out the stopper with a sharp jerk of the sampler line.

3. Allow the bottle to fill completely, as evidenced by the cessation of air bubbles.

4. Raise the sampler and cap the bottle.

5. The bottle can be used as the sample container, but it must be thoroughly decontaminated.



1000-ml (1-quart) weighted bottle catcher

FIGURE A-2. WEIGHTED BOTTLE SAMPLER

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3. COLLECTION OF SAMPLES FROM DEPTH WITH A KEMMERER BOTTLE

The Kemmerer bottle is a messenger-activated sampling device (see Figure A-3). In the open position, liquid flows easily through the device. Once lowered to the desired depth, a messenger is dropped down the sample line, tripping the release mechanism and closing the bottle. In the closed position, the bottle is sealed, both on top and bottom, from any additional contact with the liquid column and the sample can be retrieved.

Most commercially-available Kemmerer bottles are of brass or plastic construction. Modification of existing systems with non-reactive materials such as Teflon, glass or stainless steel, would only be partially successful due to the complicated machining necessary for the release mechanism. Other modifications, such as a stoppered bottom drain, are simpler and useful in minimizing sample disturbance during transfer to the appropriate containers.

Uses

The Kemmerer bottle is currently the most practical method of collecting discrete, at-depth samples from vessels. The application is limited, however, by the incompatibility of various construction materials with some analytical techniques. Proper selection, i.e., all metal assemblies for organic analysis, or all plastic assemblies for trace element analysis, will overcome this deficiency.

Sampling Method

1. Inspect Kemmerer bottle for thorough cleaning and ensure that sample drain valve is closed (if bottle is so equipped).

2. Measure and then mark sample line at desired sampling depth.

3. Open bottle by lifting top stopper-trip head assembly.

4. Gradually lower bottle until desired level is reached (predesignated mark from Step 2).

5. Place messenger on sample line and release.

6. Retrieve sampler; hold sampler by center stem to prevent accidental opening of bottle stopper.

7. Rinse or wipe off exterior of sampler body (wear proper gloves and protective clothing).

8. Recover sample by grasping lower stopper and sampler body with one hand (gloved), and transfer sample by either (a) lifting top stopper with other hand and carefully pouring contents into sample bottles, or (b) holding drain valve (if present) over sample bottle and opening valve.

9. Allow sample to flow slowly down side of sample bottle with minimal disturbance.

10. Preserve the sample, if necessary, as per guideline FT-7.06.

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