140289

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

January 29, 1999

Mr. Clifford Kirchof, Jr.
RMT, Inc.
11811 Interstate Highway 10 East, Suite 450
Houston, TX 77029-1954

Re: North Penn Area 12 Superfund Site
Administrative Order for Remedial Design and Remedial Action
Docket No. III-98-078-DC
Remedial Design Work Plan Approval/Modification

Dear Mr. Kirchof:

EPA has reviewed the revised Remedial Design Work Plan ("RD Work Plan") that was submitted by RMT, Inc. on January 19, 1999 on behalf of Schlumberger, Inc. EPA has found the revised work plan to be acceptable with the exception of one deficiency found on page 7 of Appendix A, Field Sampling Plan. In order to cure the deficiency, EPA hereby approves with modification the RD Work Plan in accordance with Section XIII.C of the Administrative Order for Remedial Design and Remedial Action, Docket No. III-98-078-DC. The RD Work Plan is modified by deleting the phrase "unless purge parameters suggest no change in stability after the midpoint of purge volume" from item 4 under the heading "For Wells Purged With High-Flow Pumps". This modification is made to make the well purging procedures consistent with current EPA well purging procedures and policies.

The next activities required to be completed in accordance with the Project Schedule contained in the approved RD Work Plan are listed below:

- Preparation and submittal of the Water Line Final Design by **February 15, 1999.**
- Preparation and submittal of the Groundwater Treatment System Preliminary Design by **March 31, 1999.**
- Completion of Pre-Design sampling by **March 31, 1999.**
- Completion of the Groundwater Reinjection Evaluation and submittal of report by **April 30, 1999.**
- Completion of Preliminary Natural Attenuation Evaluation and submittal of report by **May 31, 1999.**

If you should have any questions or if you would like to further discuss this matter, please do not hesitate to call me at (215) 814-3198.

Sincerely,

Patrick McManus

Patrick McManus
Remedial Project Manager

cc: Barbara Rudnick, 3HW43
Natalie Katz, 3RC22
Tim Cherry, PADEP
Dan Oman, RMT
Drew Diefendorf, RMT
Brian Curtis, Schlumberger

RMT INC.

North Penn Area 12
Superfund Site

Worcester Township,
Montgomery County, Pennsylvania

Remedial Design Work Plan

Prepared by:
RMT, Inc., Michigan
January 1999

NORTH PENN AREA 12 SUPERFUND SITE
WORCESTER TOWNSHIP,
MONTGOMERY COUNTY, PENNSYLVANIA

REMEDIAL DESIGN WORK PLAN

PREPARED FOR:

SCHLUMBERGER RESOURCE MANAGEMENT SERVICES, INC.

(SCHLUMBERGER INDUSTRIES, INC.)

January 1999

APPROVED
AS FINAL

~~1/26/99~~
Signature Date
AS MODIFIED by LETTER TO RMT 1/29/99

Clifford E. Kirchof, Jr. /PHO
Clifford E. Kirchof, Jr.
Project Coordinator

Daniel E. Oman /PHO
Daniel E. Oman, P.E.
Project Manager

RMT, INC., MICHIGAN
1143 HIGHLAND DRIVE, SUITE B - 48108-2237
P.O. BOX 991 - 48106-0991
ANN ARBOR, MI
734/971-7080 - 734/971-9022 FAX

Final Rev.01

Table of Contents

List of Tables

List of Figures

List of Appendices

Section 1
Introduction

On September 30, 1997, the United States Environmental Protection Agency (USEPA) issued its Record of Decision (USEPA 1997a) for the North Penn Area 12 Superfund Site (Site). This document set for the Agency's rationale and selected remedy for addressing affected groundwater at the site. The Record of Decision for the Site is based on the findings of the Remedial Investigation/Feasibility Study (RI/FS) conducted by CH2M HILL and comprises one of the primary reference documents that will be used during both Remedial Design (RD) and Remedial Action (RA).

On July 22, 1998, USEPA issued an Administrative Order for Remedial Design and Remedial Action (USPEA 1998 Administrative Order) under the Section 106A of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). This Administrative Order outlines the work for the RD/RA.

The Record of Decision (ROD), issued at the completion of the Remedial Investigation/Feasibility Study (RI/FS) (USEPA 1996) (USEPA 1997), and the Administrative Order establish levels of constituents detected in the groundwater and soils at the Site that present a risk to human health.

As presented in the USEPA ROD, the objectives of the RD/RA are to:

- Prevent exposure or potential exposure to groundwater that contains chemicals of concern at the site at concentrations above the Maximum Contaminant Levels (MCLs) which are the cleanup goals for the site.
- Use remedial technologies to reduce concentrations of site chemicals of concern to levels that are below the MCLs.

A variety of remedies that address the remedial action objectives were presented in the FS. The following remedy was selected in the ROD for the site by USEPA.

- A groundwater extraction and treatment system will be installed at this site.
- A study will be conducted to determine what, if any, remedial measure(s) (including natural attenuation or modification of the extraction system) may be needed or is technically practicable to reduce site-related VOCs to MCL concentrations within a reasonable time frame.
- An alternative water supply will be extended to provide public water to residents whose wells have been adversely affected or could potentially be adversely affected by groundwater VOC from the site.

- Long term groundwater monitoring will be conducted to evaluate the performance of the groundwater extraction and treatment system and to ensure that all affected and potentially affected residents are provided public water.

Schlumberger Resource Management, Inc. (Schlumberger) is one of the four respondents listed on the Administrative Order. This document represents the first deliverable of the Remedial Design Process.

Section 2
Background Summary

The information contained in this Section was obtained from the North Penn Area 12 Superfund Site ROD (USEPA 1997a).

2.1 Site Description

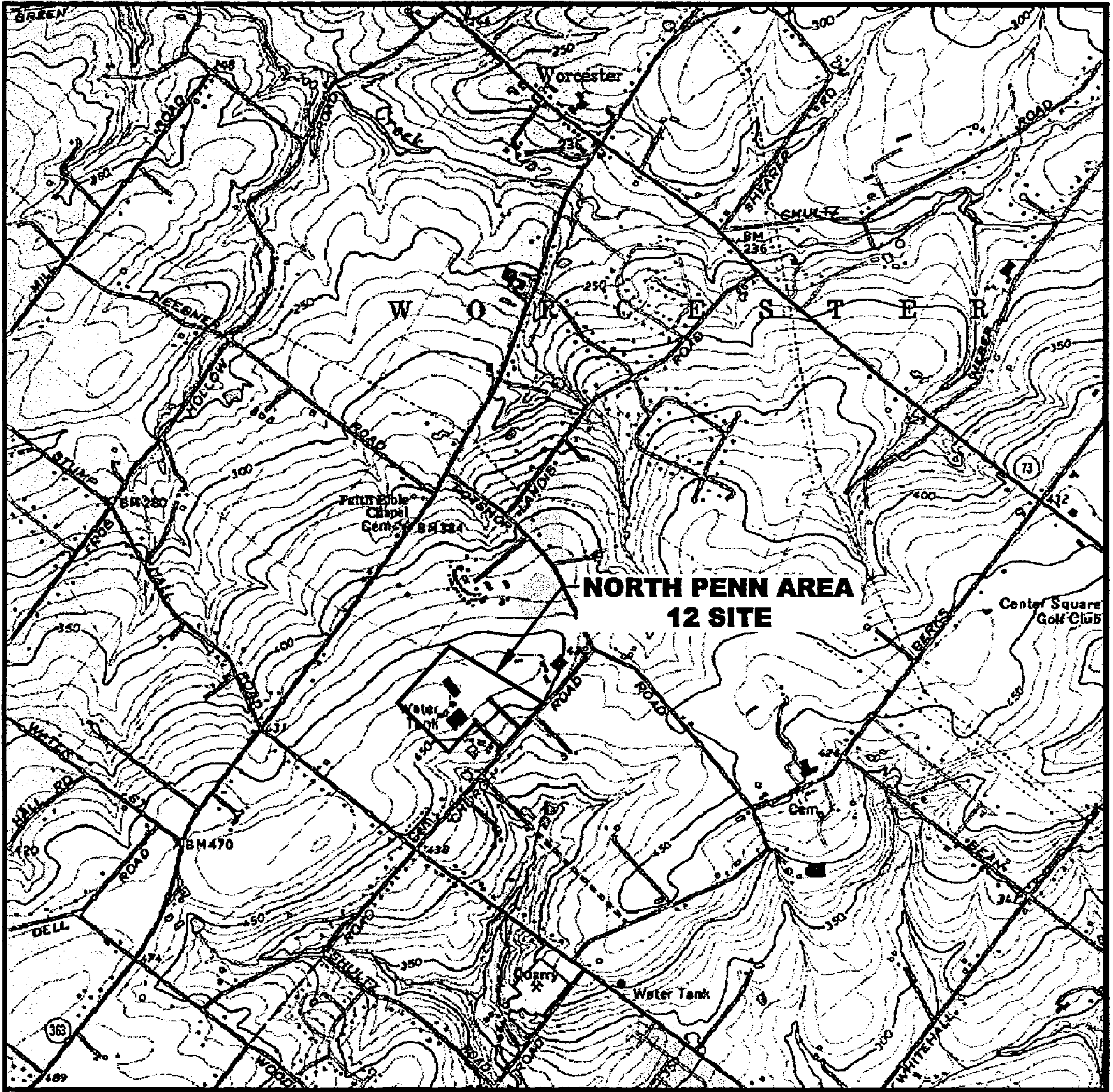
The North Penn Area 12 Site includes the former Transicoil facility, which occupies approximately 25 acres on Trooper Road in Worcester Township, Montgomery County, Pennsylvania (Figure 1). The former Transicoil facility had been used for industrial and manufacturing activities from approximately 1952 to 1991. Activities included the manufacturing of electric motors for use by the aerospace industry. As part of the manufacturing operations, trichloroethene (TCE), 1,1,1-trichloroethane (1,1,1-TCA) and possibly other solvents were used to degrease parts and equipment.

Adjacent to the former Transicoil facility is the former Control facility for a Nike Missile Battery installation (PH-191) that had been operated by the U.S. Army (Figure 2). The former Nike control facility property was used by the Army from 1954 to 1968 and was located on approximately 12 acres of land. Both TCE and 1,1,1-TCA were used and disposed of at the former Nike Control facility between 1954 and 1968. In 1975, about 9 acres of the property were donated to Worcester Township and is now maintained as a park known as Nike Park. The remaining portion of the property was assigned to the Commonwealth of Pennsylvania, and is currently operated by Montgomery County as a rehabilitation center for the handicapped known as the Center Point Training Center.

2.2 Site History

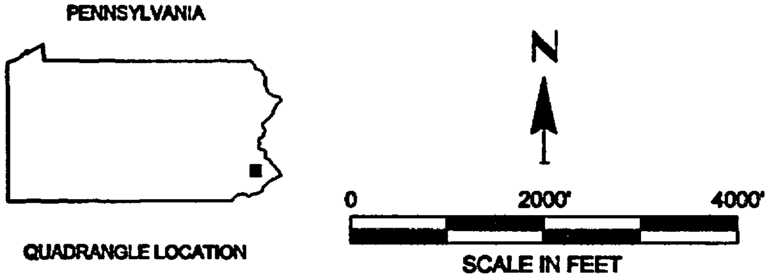
Sampling of soil and groundwater at the Transicoil facility in 1979, carried out by the Pennsylvania Department of Environmental Protection (PADEP) (then the Pennsylvania Department of Environmental Resources), indicated the presence of TCE and 1,1,1-TCA in groundwater below both the Transicoil property and in several surrounding properties' wells. Investigation of contamination at the Transicoil facility and in the surrounding area has been conducted on several occasions since that time. An investigation in 1980 included: sampling near a buried waste solvent tank; sampling of the contents of the waste solvent tank; sampling from underground septic system distribution boxes; and soil sampling in the septic system drain field area. Groundwater in two monitoring wells was also monitored for one year.

RMT COMPUTER AIDED DESIGN AND DRAFTING



SOURCE:

BASE MAP DEVELOPED FROM THE LANDSDALE, PENNSYLVANIA 7.5 MINUTE U.S.G.S. TOPOGRAPHIC QUADRANGLE MAP, DATED 1966, PHOTOREVISED 1983.



RMT INC.
MICHIGAN

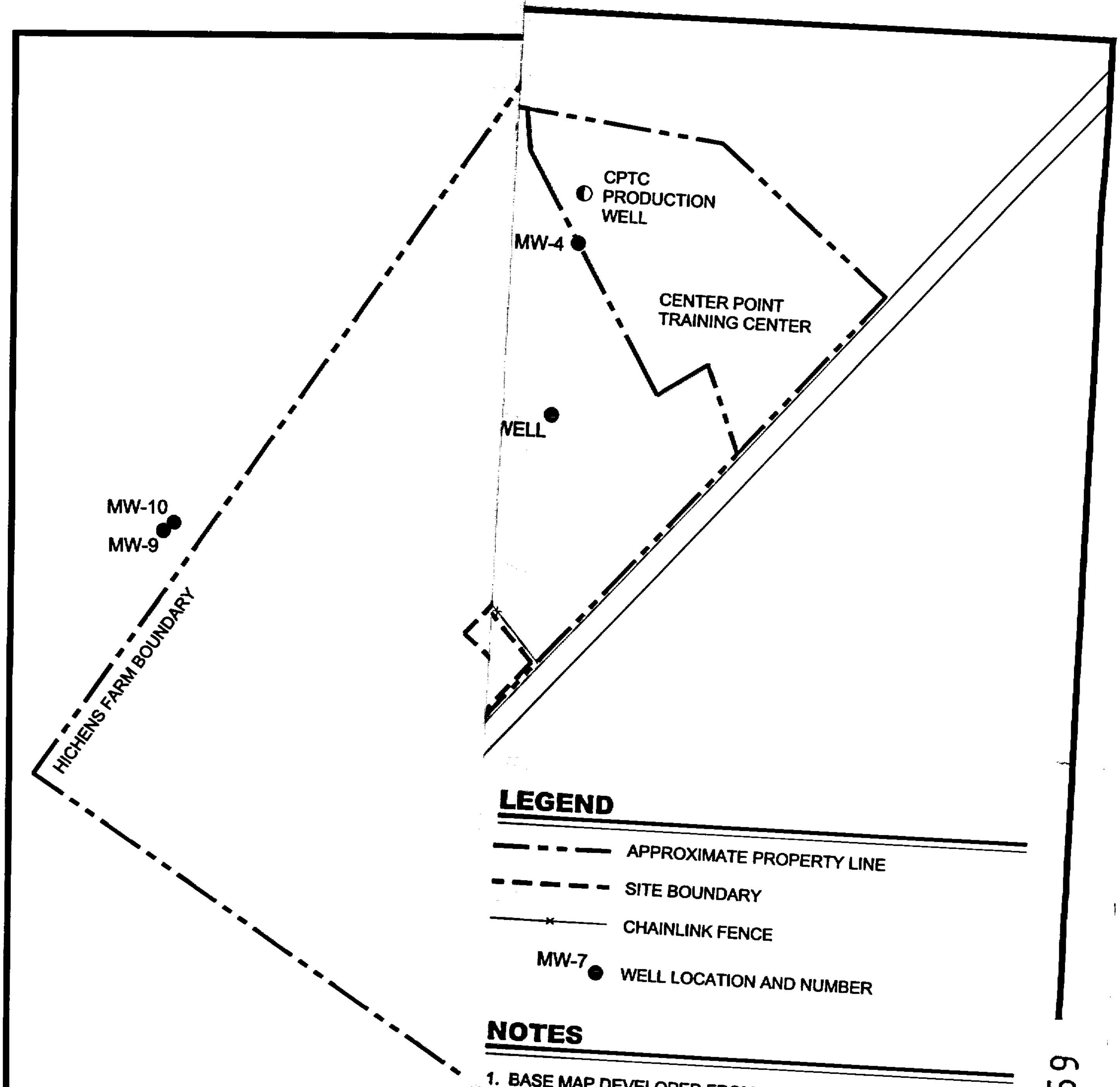
NORTH PENN AREA 12
REMEDIAL DESIGN WORK PLAN
WORCESTER TOWNSHIP, PENNSYLVANIA

SITE LOCATION MAP

DRAWN BY:	SJL
APPROVED BY:	DO
PROJECT NUMBER:	70924.01
FILE NUMBER:	0101.DWG
DATE:	JANUARY 1999

FIGURE 1

PLOT DATA
Drawing Name: J:\70924\01\0101.dwg
Operator Name: LUCIDOS
Scale: 1=1
Dwg Size: 106624 Bytes
Plot Date: Friday, January 15, 1999
Plot Time: 11:15.2194 AM
Attached Xref's: No Xref's Attached



LEGEND

— - - —	APPROXIMATE PROPERTY LINE
— — — —	SITE BOUNDARY
——×——	CHAINLINK FENCE
MW-7 ●	WELL LOCATION AND NUMBER

NOTES

1. BASE MAP DEVELOPED FROM SITE PLAN PREPARED BY CH2M HILL, INC. DRAWING NO 49771017, DATED 31-MAY-1996.

NORTH PENN AREA 12
REMEDIAL DESIGN WORK PLAN
WORCESTER TOWNSHIP, PENNSYLVANIA

SITE FEATURES MAP

DRAWN BY:	SJL	PROJECT NUMBER:	70924.01
CHECKED BY:	DO	FILE NUMBER:	0202.DWG
APPROVED BY:		DATE:	JANUARY 1999

RMT INC., MICHIGAN

1143 HIGHLAND DRIVE, SUITE B
ANN ARBOR, MI. 48108-2237

P.O. BOX 991 48106-0991
PHONE: 734-971-7080
FAX: 734-971-9022

FIGURE 2

PLOT DATA

Drawing Name: J:\70924\01\0202.dwg
Operator Name: LUCIDOS
Scale: 1"=200'

Dwg Size: 358836 Bytes
Plot Date: Friday, January 15, 1999
Plot Time: 11:18.3221 AM
Attached Xref's: No xref's Attached.

In January 1987, the Transicoil property was proposed for inclusion on the National Priorities List. A soil-gas survey was completed on the Transicoil facility in 1988. A consent agreement between USEPA and two potentially responsible parties (PRPs), Transicoil, Inc. and Eagle-Picher Industries, Inc. ("Transicoil/Eagle-Picher") was executed in 1989 and led to the initiation of a Remedial Investigation/Feasibility Study (RI/FS) at the Site. The RI/FS work plan was submitted to USEPA Region III on May 18, 1990. USEPA subsequently approved the work plan and the field work was started.

A soil-gas survey conducted by Transicoil/Eagle-Picher in 1990 as part of the RI/FS indicated elevated levels of volatile organic compounds (VOCs) near Building No.2 and the drum storage areas. Levels of TCE and 1,1,1-TCA were very low, although significant concentrations of vinyl chloride, a TCE and 1,1,1-TCA degradation product, was detected. A hydrogeologic study was conducted in July and August 1988, and indicated the presence of a TCE plume that seemed to be moving from east to west. Twelve monitoring wells were installed on and near the Transicoil property between 1988 and 1990. Residential wells near the former Transicoil facility were sampled in 1990 and again in 1991. During the residential well sampling, 13 home wells were found to contain TCE above the safe drinking water Maximum Contaminant Level (MCL) of 5 parts per billion (ppb). Transicoil/Eagle-Picher agreed, under an amendment to the approved RI/FS work plan, to install and maintain carbon filtration systems on those home wells, that exceeded the 5 ppb MCL for TCE.

All ongoing RI/FS activities were halted on January 7, 1991, when Transicoil/Eagle-Picher filed for relief under Chapter 11 of the bankruptcy code. At the time of the bankruptcy filing, the RI/FS field investigation activities were in progress and no draft or final documents or reports had been prepared. In accordance with the consent agreement, USEPA Region III assumed responsibility for funding, management, and completion of all remaining RI/FS activities. The tasks to be completed included air monitoring, soil sampling, surface water and sediment sampling, residential well sampling, monitoring well installation, groundwater sampling, geophysical logging, packer testing, pump testing, water level monitoring, wetlands assessment, and preparation of all associated reports and documents.

As a result of residential well sampling conducted in 1995 by USEPA, additional residential wells were found to be contaminated with TCE above the 5 ppb MCL for TCE. USEPA subsequently issued an order to four PRPs that required the installation and maintenance of carbon filtration systems on residential wells found to have concentrations of TCE above the MCL. Periodic sampling of over 100 residential wells near the Site was also required to ensure that TCE levels in residential water supplies would be maintained at safe levels. Fourteen additional home wells have been provided carbon filters in accordance with the 1995 order.

2.3 Site Characteristics

Details on site characteristics can be found in the RI/FS and ROD. The following is a brief summary of relative information.

Physiography

The North Penn Area 12 site is in the Triassic Lowland Section of the Piedmont Physiographic Province. It has a surface elevation of approximately 480 ft above mean sea level. The northern part of the site drains via several unnamed tributaries of Zacharias Creek; to the Schuylkill River, and ultimately into the Delaware River. The southern part of the site is drained by unnamed tributaries of Stoney Creek.

Bedrock Geology

The site is in the Triassic Newark Basin, and lies within the outcrop belt of the Lockatong and Brunswick formations. The younger Brunswick Formation is on the order of 9,000 ft thick and consists of thin, discontinuous beds of shale interbedded with mudstone and siltstone. Depths to bedrock range from 3 to 12 feet.

Approximately 2,000 feet thick, the underlying Lockatong consists of massive beds of argillite interbedded with thin beds of shale and siltstone. More resistant to erosion, the Lockatong is a low ridge former.

The Brunswick and Lockatong formations dip to the northwest and the north at the average angle of about 20 degrees and strike approximately northeast-southwest. A well-developed system of nearly vertical joints is found in these bedrock units. The predominate set strikes north-northeast, while the others strike northwest and east-northeast. Fractures were confirmed in most wells, most commonly within 100 ft of the ground surface. This is well-demonstrated in wells MW-1, MW-3, MW-9, T-3, T-5, T-6, and the Training Center well. Shallow wells (<100ft), MW-2 and MW-6 through MW-8, also demonstrated the presence of fractures in the upper 100 ft of the subsurface. On-site fractures were observed to be frequently vertical, while some were approximately horizontally and may represent bedding plane partings. Many of these bedding plane partings appear to be open continuously.

Hydrogeology

The hydrogeology of the site is an anisotropic and heterogeneous system in which groundwater occurrence and flow direction is complex. The primary porosity of fractured rock is very low, and most groundwater is found in the secondary porosity of joints and bedding plane partings. Groundwater in the shallow saturated zone of the Lockatong generally is under unconfined (water-table) conditions. Groundwater in the deeper zone is probably confined, resulting in local artesian conditions. The site appears to be a groundwater-recharge area, where its location along the ridge acts as a groundwater divide. Depth to groundwater is approximately 60 ft. The hydraulic gradient slopes to the north to northwest and suggests a potential down-dip flow component. Most of the residential wells in the area are located north and west of the site; pumping from these residential wells is expected to increase the local hydraulic gradient and enhance groundwater flow northwest from the study area.

2.4 Nature and Extent of Contamination

Air

Volatilization of VOCs to the atmosphere is not a significant risk at the Site due to the relatively low levels in the soil. Air monitoring surveys conducted in 1995 found no detections of VOCs attributable to the Site. No site-related metal contamination was identified as risk associated with wind erosion and dust from construction is considered to be comparable to that from other uncontaminated locations near the Site.

Soil Contamination

Soil gas samples collected in 1990 showed a maximum vinyl chloride concentration of 325 ppb and a maximum TCE concentration of 14 ppb southeast of the parking lot and in the septic drain field. One month later, however, samples showed very little VOC detected and vinyl chloride was detected in only one sample at 3 μg/kg in the septic drain field. Soil sampling conducted by USEPA in 1994 also showed very low concentrations of VOCs. Comparisons of soil VOC levels with levels that could pose a risk to human health did not show any VOCs of potential concern in the soil. Therefore, no soil remediation was required.

Results of 1994 USEPA sampling for inorganics suggest that the concentrations of arsenic, beryllium, and manganese observed in soil at the site are considered to be naturally occurring and are not considered to be a result of activities at the Site. Therefore, no remediation for inorganics in soil was required.

Surface Water

Surface-water samples were collected in March 1995 from ponds, a spring, and in creeks at locations representing areas that could potentially be affected by the Site and areas not affected by the Site. No VOCs or semi-volatile organic compounds (SVOCs) were detected in any surface water samples.

Surface-Water Sediment

Sediment samples were collected in March 1995 from the same five locations sampled for surface water. The inorganic elements arsenic, beryllium, and lead were detected in sediment samples but, with the exception of lead, were below the lowest toxicological screening levels for sediments. Lead is not considered to be Site-related and no clear path exists for surface-water drainage from the Site to the area where the highest lead levels were found.

On-Site Groundwater

Groundwater samples were collected by Transicoil in August 1988 and by USEPA in March 1995 from production and monitoring wells (MWs) installed on the Transicoil property, the former Nike property, and adjacent properties. TCE and tetrachloroethene (PCE) were found at levels exceeding drinking water standards in some samples. In addition, 1,1,1-TCA, 1,1-dichloroethene (1,1-DCE), Freon-113, and arsenic were detected. The highest levels of VOCs in 1995 were detected in MW-3 and MW-1 (TCE at 88 ppb, PCE at 3 ppb; and TCE at 380 ppb, PCE at 25 ppb, respectively); both are located northwest and downgradient of the septic drain field. Wells in the southeastern part of the Site had very low levels of VOCs.

Levels of TCE over time appear generally to be decreasing in both production monitoring wells T-3 and T-5. Samples from MW-1 through MW-5 also show a decrease in TCE concentration between 1988 and 1995. Although these data indicate that high concentrations near the Transicoil property are dissipating, the more recent data from T-6, indicated that this well had a concentration of TCE which was higher in 1995 than it had been in the past sampling episodes (100 ppb in 1995 compared to 33 ppb in 1988). The concentration of 1,1,1-TCA decreased between 1988 and 1995 in all wells sampled.

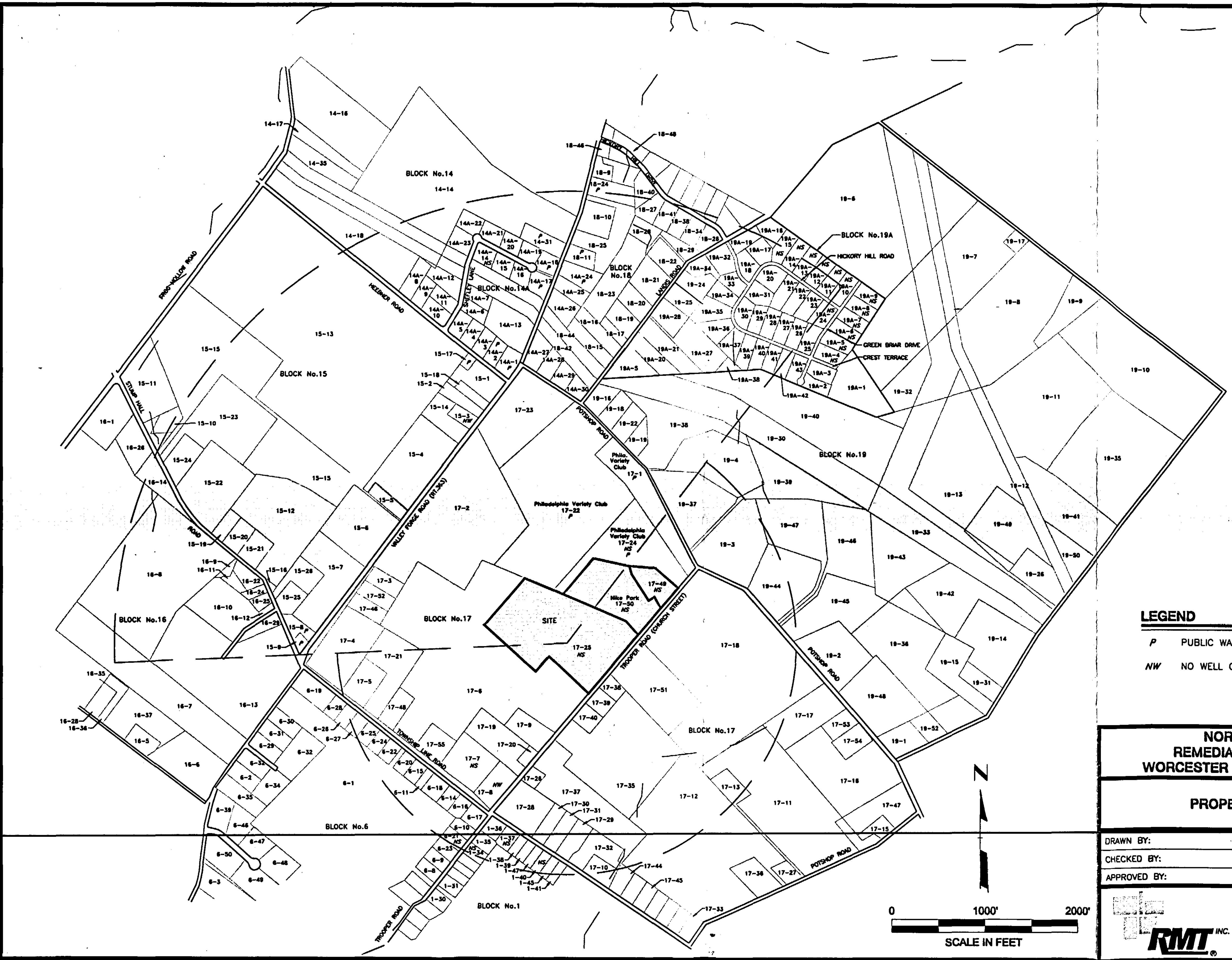
Groundwater in Residential Wells

Several residential wells surrounding the Transicoil property have detectable levels of TCE, 1,1,1-TCA, Freon-113, and other chlorinated organic compounds. These wells are primarily located to the west, northwest, and northeast of the Transicoil property, although five wells to the southwest and southeast of the property also showed low detectable levels of contamination. Most of the TCE detections are located northwest of the Transicoil property, in Blocks Number 15 and 17 on either side of Valley Forge Road (see Figure 3). Two adjacent wells (Lots 17-46 and 17-52, located approximately 1,500 feet west-northwest of the Transicoil property,) were found to have TCE concentrations of 200 ppb and 180 ppb, respectively in January 1995 and concentrations of 130 ppb and 120 ppb, respectively in November 1995. One residential well located further west of the Transicoil property site (Lot 15-10) was found to have 40 ppb of TCE. In addition, TCE levels in excess of MCLs also were found north of the Transicoil property in Block 14A, with concentrations in adjacent lots along Heebner Road ranging from 8 to 24 ppb.

Some residential wells also had detectable levels of Freon-113 (for which no published standard is available) and of 1,1,1-TCA. Levels of 1,1,1-TCA were well below MCL for drinking water in all residential wells sampled. The concentration pattern for Freon-113 and 1,1,1-TCA generally paralleled that of TCE, although concentrations of these compounds were significantly lower than those of TCE. Chloroform was detected in some residential wells containing other VOCs. Estimated chloroform levels, which generally were below quantitative detection limits, were slightly higher than the level that poses a potential risk to human health (0.15 ppb).

Contaminant levels in residential wells varied over time. Two wells (17-46 and 17-52), which were found to have the highest levels during the 1995 sampling event, had levels twice as high in 1990. The data generally indicated that high levels of VOCs at the Site may be gradually decreasing.

PLOT DATA
Drawing Name: J:\70924\01\0205.dwg
Operator Name: LUCIDOS
Scale: 1"=1000'
Dwg Size: 606679 Bytes
Plot Date: Friday, January 15, 1999
Plot Time: 11:16.1450 AM
Attached Xref's: No xref's Attached.



LEGEND

P PUBLIC WATER

NW NO WELL ON SITE

NORTH PENN AREA 12
REMEDIAL DESIGN WORK PLAN
WORCESTER TOWNSHIP, PENNSYLVANIA

PROPERTY LOCATION MAP

DRAWN BY:	SJL	PROJECT NUMBER:	70924.01
CHECKED BY:	DO	FILE NUMBER:	0205.DWG
APPROVED BY:		DATE:	JANUARY 1999

RMT INC., MICHIGAN

1143 HIGHLAND DRIVE, SUITE B
ANN ARBOR, MI. 48108-2237
P.O. BOX 991 48106-0991
PHONE: 734-971-7080
FAX: 734-971-9022

FIGURE 3

2.5 Recommended Remedial Alternative

According to the ROD the selected remedy for the site consists of the following five components:

1. A groundwater extraction and treatment system utilizing either an air stripper with vapor phase carbon or a liquid phase carbon adsorption unit will be constructed. The treated groundwater will be reinjected into the ground by injection wells, and infiltration bank, or spray irrigation, if it can be demonstrated that such reinjection can be accomplished without adversely impacting the ability of the pumping system to contain the existing contamination from migrating from the former Transicoil property portion of the site. If reinjection is not feasible, then the treated water will be discharged to a tributary to Stoney Creek.
2. Since there is some indication, however, that natural attenuation may be a viable remedy for the extended plume, a study will be conducted during the pre-design, design, or implementation of the extraction system to determine what, if any, remedial measure(s) (including natural attenuation or modification of the extraction system) may be needed or is technically practicable to reduce site-related contaminants to MCL concentrations within a reasonable time frame. Implementation of any selected measure(s) may require an Explanation of Significant Differences determination or an Amendment to the ROD.
3. The public water supply will be extended to provide public water to residents whose wells have been adversely affected or could potentially be adversely affected by groundwater contamination from the site.
4. Long-term groundwater monitoring will be conducted to evaluate the performance of the groundwater extraction and treatment system and to ensure that all affected and potentially affected residents are provided public water.
5. Institutional controls that will prohibit the use of groundwater on the former Transicoil property, and restrict the use of site-related contaminated groundwater as a drinking water supply source will be implemented.

Section 3
Supplemental Project Activities

3.1 Site Monitoring Plans

3.1.1 Pre-design Sampling and Analysis Plan

Establishment of Baseline Conditions

On-site wells have not been sampled since 1995. To re-establish baseline conditions on site and to verify source area and plume concentrations related to the former Transicoil operations an initial resampling of on-site wells will be performed during the Preliminary Design phase of the RD/RA program. One round of samples will be collected from existing monitoring wells MW-1, 2, 3, 4, 5, 7, 8, 9,10, 11 and 12, and the three on-site production wells T-3, T-5, and T-6 as shown on the Sampling Location Plan (Figure 4). Monitoring well MW-6 and the Nike Park well will not be sampled due to apparent obstructions in those wells as reported during previous investigations. The Training Center Well is being sampled as part of the residential well monitoring program.

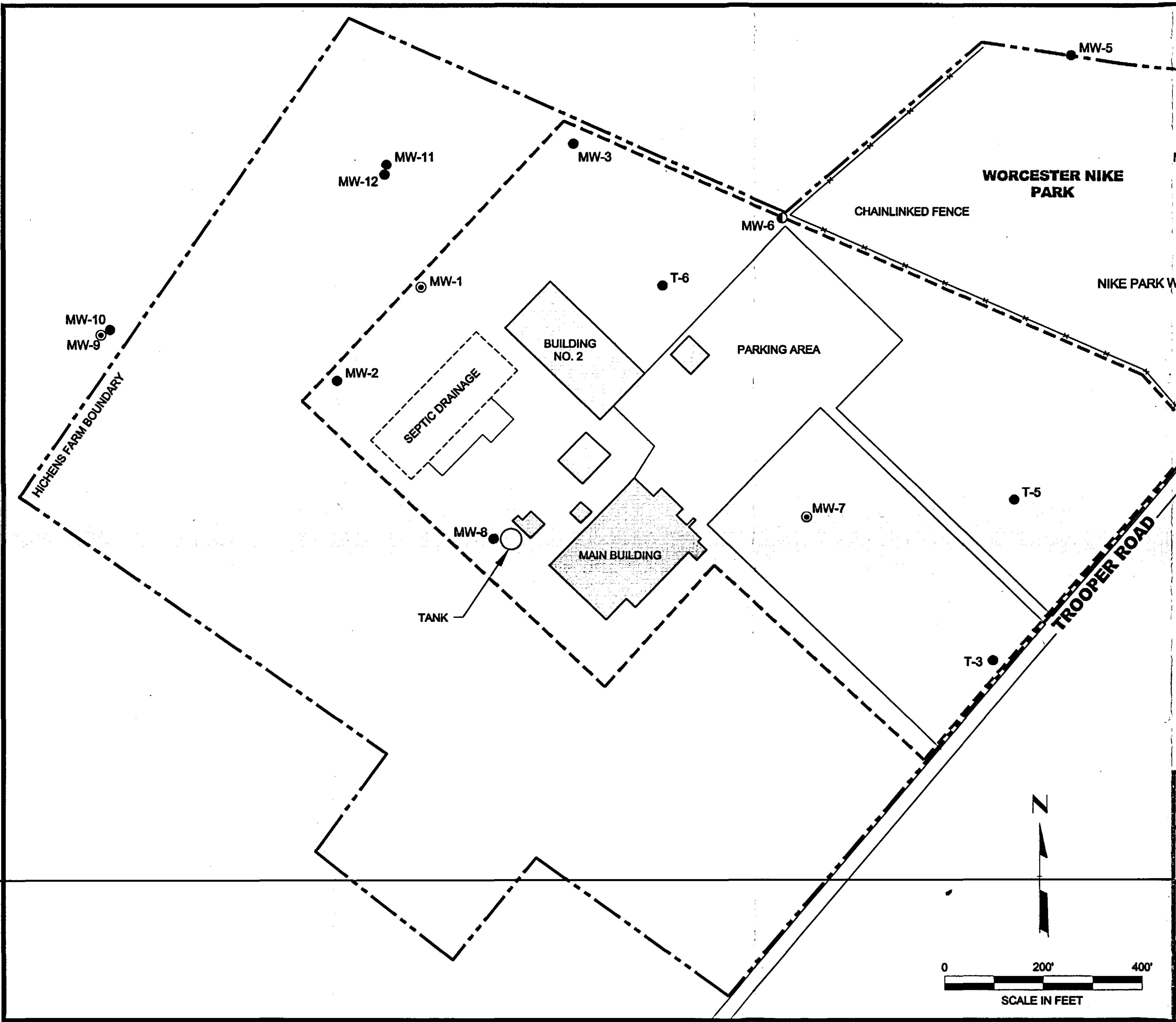
Prior to collection of samples a condition inspection of the wells will be made and a report form (F-184) as shown in Attachment 3 will be completed as outlined in the Field Sampling Plan (FSP), included as Appendix A of this Work Plan. Water levels will then be obtained in accordance with procedures outlined in the FSP. A piezometric surface map will be prepared covering the site and compared to previous groundwater data.

Because of potentially high volumes of purge water (up to 10,000 gallons) that could be derived from conventional 3-volume high-rate purging methods, low-flow purge and sampling methods as described on the FSP have been proposed for this and subsequent monitoring programs. These methods yield more consistent and accurate results and have been previously approved and recommended by the USEPA.

All samples will be collected, handled and analyzed in accordance with the FSP, included in Appendix A, and the Quality Assurance Project Plan (QAPP) included in Appendix B. All Samples will be field analyzed for pH, Eh, specific conductance, dissolved oxygen and turbidity and then submitted for laboratory analysis for low level VOCs, Freon 113, and extractable gases.

PLOT DATA
Drawing Name: J:\70924\01\0203.dwg
Operator Name: LUCIDOS
Scale: 1"=200'

Dwg Size: 343847 Bytes
Plot Date: Monday, January 18, 1999
Plot Time: 11:34.4015 AM
Attached Xref's: No xref's Attached.



LEGEND

- — - - — APPROXIMATE PROPERTY LINE
- — — — — SITE BOUNDARY
- ——×—— CHAINLINK FENCE
- MW-3 ● WELL TO BE SAMPLED FOR VOCs
- MW-1 ◉ WELL TO BE SAMPLED FOR VOCs AND NATURAL ATTENUATION CRITERIA
- MW-6 ◐ EXISTING WELL <u>NOT</u> TO BE SAMPLED

NOTES

1. BASE MAP DEVELOPED FROM SITE PLAN PREPARED BY CH2M HILL, INC. DRAWING NO 49771017, DATED 31-MAY-1996.

NORTH PENN AREA 12
REMEDIAL DESIGN WORK PLAN
WORCESTER TOWNSHIP, PENNSYLVANIA

PRE-DESIGN GROUNDWATER
SAMPLING LOCATIONS

DRAWN BY:	SJL	PROJECT NUMBER:	70924.01
CHECKED BY:	DO	FILE NUMBER:	0203.DWG
APPROVED BY:		DATE:	JANUARY 1999

RMT INC., MICHIGAN

1143 HIGHLAND DRIVE, SUITE B
ANN ARBOR, MI. 48108-2237

P.O. BOX 991 48106-0991
PHONE: 734-971-7080
FAX: 734-971-9022

FIGURE 4

After the analytical data have been validated the data set will be evaluated to determine current or baseline contaminant concentrations within the area of the former Transicoil property. As part of the evaluation, a comparison of current baseline concentrations of TCE and daughter compounds will be made with previous findings. These will be summarized in tabular form as well as on iso-concentration maps.

The findings, including well conditions, water levels and analytical results will be submitted to the USEPA Region III as part of the Pre-Final Design package for review. Given the 60-day time frame for field and laboratory activities only the validated laboratory results will be submitted with the Preliminary Design.

Preliminary Geochemical Assessments

The potential for chemical precipitation and biofouling related to well injection, as well as groundwater treatment, should be addressed prior to final design. If it is determined that clogging of injection well screens, infiltration media or treatment system may be a problem, the designs may have to be altered or augmented. In addition, while evaluation of natural attenuation or need for other additional treatment methods of the off-site plume is planned for a later phase, many of the analytical requirements for performing an analysis of natural attenuation are similar to those needed to assess the remediation design. It therefore would be practical to gather additional analytical data as part of the pre-design sampling episode. It is not the intent of this preliminary natural attenuation evaluation to supplant natural attenuation characterization of the off-site plume.

While the potential exists for natural attenuation processes such as biodegradation and adsorption to take place in bedrock aquifers, the potential is not as great as in unconsolidated formations, particularly where organic carbon may be more abundant.

When biodegradation takes place it is common for biotic and abiotic dechlorination activity to take place in proximity to the source of contamination, particularly where shallow soil bacteria and other nutrients are present. Therefore, in order to make an initial assessment of natural attenuation, it is planned to obtain additional on-site groundwater samples. Should natural attenuation appear active, then modifications to or augmentation of the on-site collection and treatment system will be considered in the remedial design.

Rather than sample all 15 on site wells, four monitoring wells as presented in Table 1 and indicated on Figure 4 have been selected for sampling. The criteria for selection of these wells have been based on locations relative to the previous determination of TCE concentrations and as stated in the table.

Table 1
Monitoring Wells and Selection Criteria for Use in Preliminary Natural Attenuation Assessment

MW - 7	Low TCE detects, and generally upgradient and/or up-plume from apparent source area. May serve as "background" chemistry.
MW - 1	High TCE detect, immediately downgradient of apparent source area. May serve as baseline source chemistry.
MW - 9	Moderate TCE detect, further downgradient of apparent source. May serve as potential degradation measurement point.
MW - 4	Moderate TCE detect, adjacent to other apparent source. May serve as potential degradation measurement point.

These wells will be sampled for analytes indicative of natural attenuation based on analytes used as natural attenuation screening criteria as outlined by Wiedemeier et.al. (1996) with the Air Force Center For Environmental Excellence (AFCEE) and the USEPA (1996b, USEPA/600/R-96/087); analytes necessary to evaluate biofouling and mineralization within injection well screens, the formation or within the treatment system; and as outlined in Table 2 below. Some of these analytes will be measured in the field as noted in the FSP.

Table 2
Analytical Criteria for Evaluating Natural Attenuation and Fouling

Oxygen	pH	BTEX
Nitrate	Temperature	TCE
Iron (II)	Carbon Dioxide	cis-1,2-DCE
Sulfate	Alkalinity	Vinyl Chloride
Sulfide	Hardness	Chloroethane
Methane	Chloride	1,1-DCE
Eh	Hydrogen	Ethane/Ethene

After receipt of analytical data from the laboratory, the data will be validated and subsequently evaluated. The analytical data will be compared with any previous analytical results to see if aquifer conditions appear relatively stable and how much variability may exist in on-site geochemistry. Depending on any apparent potential chemical or biochemical fouling suggested by these geochemical considerations, design revisions may have to be made regarding selection or rejection of any or all injection systems, or potential injection system maintenance requirements. In addition, if geochemical evaluations indicate significant design limitations, then additional groundwater modeling efforts may be required to modify the capture zone of the extraction system using various injection alternatives.

Any design changes warranted by potential biofouling or precipitation problems will be noted in the Pre-Final Design. These effects will also be addressed in the Draft Operations and Maintenance Plan.

Analytical data relating to natural attenuation will be compared to screening criteria for natural attenuation assessment of chlorinated solvents as outlined by Wiedemeier et.al. (1996) and the USEPA (1996b, USEPA/600/R-96/087). Some of these criteria, such as daughter compounds and chlorine, are direct indicators of dechlorination, while others, such as Eh, sulfide, hydrogen may indicate the potential for reductive pathways. The results from these analyses should indicate whether or not natural attenuation process appear active on-site. While negative on-site results might rule out natural attenuation near the source, micro environments not detectable by the on-site monitors may exist that would enhance off-site natural attenuation.

The results are not indications of natural attenuation resulting from dilution and dispersion. The results of the investigation will, however, prove useful in an initial determination of off-site natural attenuation potential by biologic and abiotic activity and provide a basis for further evaluation during development of Long-term and Performance Monitoring Plans, as well as during detailed evaluation of off-site plume remediation. This additional off-site evaluation will include natural attenuation and will be initiated within six months of the implementation of the on-site remedial action.

3.1.2 Design Sampling and Analysis

The initial sampling and analysis as outlined above will be the first round of sampling and analysis of the Site Monitoring Program to be carried out during the Remedial Design Phase. It is anticipated that this sampling will include all on-site monitoring and production wells and that the analyses to be performed will include water levels, the field stabilization parameters, and CLP analysis of VOCs, as noted above and in the FSP.

Initially the frequency of additional sampling rounds will be quarterly to coincide with wet and dry seasons of the year. This will enable comparison of seasonal extremes on the water table as well as any seasonal plume perturbation or variation in concentrations. This frequency will be re-evaluated after the first year of sampling with a revised schedule being proposed based on the consistency or trend in results.

During installation and testing of the extraction wells, it is anticipated that VOC concentrations in the pumped and selected on-site monitoring wells would be monitored using a field GC/MS. The results would be used as a comparative baseline for performance monitoring, as well as to optimize the final well locations and pumping rates. Details of sampling locations and methodologies will be included in the Remedial design.

3.2 Evaluation of Groundwater Recovery System

3.2.1 Requirements

The ROD requires installation of a groundwater extraction system to collect contaminated groundwater from beneath the Transicoil portion of the Site; treatment of the groundwater to remove VOCs; and reinjection of the treated water into the ground, if feasible, by injection wells, an infiltration bank or by spray irrigation. If reinjection is found to be not feasible, surface-water discharge of the treated water will be included in the design in accordance with the requirements of the ROD. Reinjection will be accomplished only if it can be demonstrated that it will not adversely impact the capture zone of the former Transicoil portion of the Site. The feasibility of injection was not thoroughly evaluated prior to this remedial design phase. Thus, reinjection of treated groundwater will be evaluated during the pre-design phase.

3.2.2 Approach

Compliance with the requirements of the ROD within the allotted time frame will be accomplished in a manner that necessitates some modification of the tasks outlined in the ROD. For instance, installation of the extraction system monitoring wells would best be accomplished during installation of that system, however, planning of monitoring, well layouts needs to be accomplished during the design phase. Also, while it is assumed that the current extraction/injection plan is hydrological correct, the previous modeling efforts require design verification, particularly to evaluate effects of the capture zone and reinjection system. This may be more critical, should geochemical analyses of pre-design groundwater samples indicate limitation or necessary design changes to the reinjection plan.

During the pre-design phase, results of water-level elevations and laboratory analyses will be used to update the conceptual model of groundwater contamination beneath the site. This update will consist of water table elevations and distribution of TCE in the groundwater. The ModFlow model obtained from USEPA will be used to optimize the design of the extraction system and address the feasibility of the reinjection system. More effective variations in configuration other than those presented in the Feasibility Study may be possible. The modeling analysis will focus on how the configuration can best be optimized to provide the greatest effectiveness in minimizing releases from the site. The Final Design report will include input arrays and assumptions used in modeling interpretations for the final design.

Section 4
Remedial Design Activities

4.1 Design Objectives

The objective of remedial design is to prepare site-specific, construction-level design documents to accomplish the remedial objectives stated in the Record of Decision and summarized in Section 2 of this Workplan. The remedial design will include the following:

- life-cycle cost considerations such as,
    - system flexibility
    - system reliability to minimize O&M costs
    - automated system controls to minimize operator oversight requirements
    - minimization of long-term chemical treatment costs
    - selection of construction materials for durability and cost efficiency
- construction of site access and site security measures,
- installation of utilities to support the remediation systems,
- efficient utilization of groundwater extraction and treatment systems through a detailed understanding of site hydrogeology,
- evaluation of the feasibility of reinjection of treated groundwater and design of the reinjection system if appropriate,
- design of surface-water discharge system, if reinjection is found to be inappropriate,
- conservative air stripper design to adequately remove less-volatile constituents of concern,
- design of air emissions control system, and
- development of cost-effective procedures for verification of performance standards.

4.2 Design Elements

The proposed remedy for North Penn Area 12 Superfund Site consists of the following design elements:

1. A groundwater extraction and treatment system which uses either an air stripper with vapor phase carbon or a liquid phase carbon adsorption unit. The treated groundwater will be reinjected into the ground by injection wells, an infiltration bank, or spray irrigation, assuming such reinjection is feasible. If reinjection is not feasible, the treated groundwater will be discharged to a tributary of Stoney Creek.

2. An extension of public water supply will be provided to residents whose private wells have been adversely affected, or could potentially be adversely affected by groundwater contamination from the site.
3. A long term groundwater monitoring program to evaluate the performance of the groundwater extraction and treatment system and to ensure that all affected and potentially affected private well owners are provided public water.

The two major engineering design components of the proposed remedy include the groundwater extraction and treatment system, and the extension of public water supply to affected or potentially affected residents. It is Schlumberger's intent to place these two design components on separate tracks. The groundwater extraction and treatment system will go through the classic Remedial Design phases as outlined in the Consent Order (*i.e.*, preliminary design, intermediate design, etc.). However, the extension of the public water supply will go through an expedited design process.

Schlumberger has been in contact with the North Penn Water Authority (Water Authority) to determine whether the Water Authority should perform both the design and the construction of the water main extension. The reasons for this are; 1.) the vast majority of affected or potentially affected residents are located within the Water Authority's service area, 2.) once the water main is constructed, it will ultimately become the responsibility of the Water Authority and, 3.) the time frame required to implement this aspect of the ROD can be significantly reduced by allowing the Water Authority to perform the construction. By the reducing the time necessary to implement this portion of the ROD, private residents of the area will have access to public water much sooner. This will also reduce Schlumberger's private well sampling requirements. For these reasons, Schlumberger intends to submit only a final design for this aspect of the ROD. Details as to how this will be accomplished and the schedule for preparation of the final design will be presented in Section 5 and Section 6 of this Work Plan.

The items described in Section 4.2.1 through 4.2.9 constitute the primary components in the development of the plans and specifications deliverables.

4.2.1 Design Criteria Discussion

The design criteria discussion details the basis of design for the remediation system and related appurtenances. This design criteria discussion will be done as part of the preliminary design phase. Information and data collected during the North Penn Area 12 RI/FS and some of the supplemental project activities described in Section 3 of this Workplan will be used to develop the criteria. Applicable regulatory requirements will also be examined to determine possible limitations. Specific design criteria will be developed for the following remedial action components:

- Access roads, utilities, and security systems.
- Groundwater extraction system design features including specific well depths, well spacing intervals, required pumping rates, pump sizes, power requirements, and pipe sizes/types.
- Air stripper system design features including maximum flow rates, constituent concentrations, effluent limitations, and permit requirements, if necessary.
- Air emission control treatment system design features including discharge limitations and permit requirements, as required.
- Treated groundwater reinjection system design features including method of reinjection (injection wells, infiltration bank, or spray irrigation)measures taken to minimize fouling, etc., assuming reinjection is feasible.
- Options for addressing possible NPDES permitting requirements for discharge of treated groundwater should groundwater reinjection prove infeasible.
- Disposal and handling requirements for on-site generated wastes, sludge's, and drill cuttings.
- Identification of affected and potentially affected residences to be serviced by public water.
- Notification of service offering to potentially affected resident including a right-of-entry agreement to be signed by the resident permitting access for construction, as well as for pre-construction condition videotaping or photography of premises and structure.
- Layout and sizing of public water supply to service affected and potentially affected residents.
- Utility provision for construction, including power and water supplies.
- Preparation of work completion forms and obtaining of signed property owner acceptance of work.
- Traffic control protocols during construction.

4.2.2 Process Flow Diagram/Process and Instrumentation Diagram

Following preparation of the system design criteria, a process flow diagram (PFD) will be prepared to schematically depict the various treatment system components for each of the remediation processes. The PFD is the most basic project design drawing and reflects the relationships between the various components of the system.

The PFD serves as the basis for the Process and Instrumentation Diagram (P&ID). The P&ID shows the relationship between all equipment in the treatment process including monitoring and control devices. This drawing provides the basis for future development of system controls necessary to balance system interactions.

4.2.3 General Arrangement Drawings

General arrangement drawings are prepared in concert with the P&IDS. These drawings communicate approximate physical locations of the treatment system components in relation to one another. The drawings will establish the location of the treatment system relative to pertinent site features.

4.2.4 Sequence of Operations

The Sequence of Operations will be prepared by process engineers to communicate to the various design disciplines, the intent and purpose of the remediation system. The Sequence of Operations will consist of a description of the treatment processes to be used during the remediation.

4.2.5 Equipment List

A detailed list of the required equipment, appurtenances will be compiled. This information will be used to develop technical specifications and design drawings for the treatment systems. Special or unusual items required for proper system interaction will be identified during this phase, as well as critical path fabrication and delivery schedules.

4.2.6 Engineering Design

Using the information developed during the previous phases, specific engineering design activities will begin. The initial design work will begin with the development of preliminary submittals to the USEPA and culminate with the submittal of the Final Remedial Design package.

Engineering design features will include the following:

- Process engineering to establish the required unit operations, material balances, and flow rates.
- Civil engineering design, which will include site clearing/grading plans; utilities; site security; general facility layout; access roads; underground piping; pipe layout and profile plants, pump and pipe sizing, design, and selection; site drainage design; and erosion control measures. This will include the definition of easements required for construction.
- Structural engineering design, which will include air stripper and off-gas treatment system and a metals removal system design.
- Electrical engineering design, which will include providing power supply to the various treatment units, pumping systems and other equipment controls.

These detailed design plans will form a significant portion of the Pre-final and Final Design submittal to the USEPA.

4.2.7 Technical Specifications

A set of project specifications will be developed to supplement the design drawings. Project specifications provide additional details regarding specific construction materials and procedures to be used during the project.

4.2.8 Construction Cost Estimates

Industry-accepted standards will be used to develop an opinion of the probable costs associated with the proposed construction activities. The design drawings and project specifications will be used to develop quantities. Unit prices for the cost estimate will be obtained from published and/or local sources of information.

4.2.9 Construction Schedule

A construction schedule will be developed based on standard construction practices. The construction schedule will indicate and reflect the staged development of the project implementation to ensure that each system is properly interfaced with related systems.

Section 5
Remedial Design Deliverables

All planned deliverables prepared as part of the Remedial Design Phase will be distributed as follows:

- Five (5) copies to USEPA Region III
    - Patrick M McManus
      Remedial Project Manager
      U.S. Environmental Protection Agency
      Region III
      841 Chestnut Building
      Philadelphia, PA 19107
- Two (2) copies to Pennsylvania Department of Environmental Protection
    - Timothy Cherry
      Project Officer
      Pennsylvania Department of Environmental Protection
      Hazardous Sites Cleanup Program
      Lee Park, Suite 6010
      555 North Lane
      Conshohocken, PA 19428
    - Craig Olewiler
      Solid Waste Program Specialist
      Pennsylvania Department of Environmental Protection
      Bureau of Land Recycling and Waste Management
      Hazardous Sites Cleanup Program
      RCSOB, 400 Market Street
      P.O. Box 8471
      Harrisburg, PA 17105-8471

5.1 Preliminary Design Submittal

Within 60 days after USEPA approves this RD Work Plan, Schlumberger will submit a Preliminary Design for the groundwater extraction and treatment portion of the remedy. The preliminary design submittal begins with initial design of the remedy and ends at the completion of approximately 30 percent of the total design effort.

5.1.1 Additional Data Results

Unvalidated data gathered from the first round of groundwater monitoring conducted at the site will be submitted as part of the Preliminary Design. Validated data will be submitted within three weeks of receipt by RMT of the complete laboratory data package. Details of the proposed sampling phase were presented in Section 3.1 of this Work Plan.

5.1.2 Design Criteria Report

The Preliminary Design will include a discussion of the design criteria. This design criteria discussion will detail the basis for the design of all facilities at the site. Specific information in this discussion will include:

- Groundwater Quality Results,
- Pretreatment requirements,
- Treatment schemes,
- Influent/effluent water quality measurements/estimates,
- Influent/effluent flow rates,
- Materials and equipment,
- Performance standards, and
- Long-term monitoring requirements.

5.1.3 Preliminary Plans and Specifications

Preliminary drawings and sketches of the proposed remedial design systems will be submitted along with an outline of the proposed technical specifications, including performance standards and ARARs.

5.1.4 Draft Project Delivery Strategy

The Preliminary Design will include a strategy for delivering the project. The project delivery strategy will focus on the management approach to the implementation of Remedial Action and shall address such issues as procurement methods, contracting strategies, phasing alternatives, and contractor and equipment availability concerns.

5.1.5 Preliminary Construction Schedule

A preliminary construction schedule for the remedial action phase of this project will be developed as part of the Preliminary Design submittal. This preliminary construction schedule will cover all construction activities and will cover implementation of all remedial action activities. Start/Finish dates for all critical tasks will be presented along with major milestones and the projection date for the Remedial Action. The preliminary construction schedule will be developed in a Gantt chart format.

5.2 Supplemental Design Activities

During the Preliminary Design phase supplemental activities will be initiated to evaluate the feasibility of groundwater reinjection and to make a preliminary assessment of the potential for natural attenuation. The results will be used in preparation of the Pre-Final Design and in later evaluations for long-term monitoring and off-site plume considerations. Evaluation of off-site plume remediation including natural attenuation will be initiated within six months of implementing the on-site remedial action.

5.3 Pre-Final Design

Within ninety (90) days after USEPA approves the Preliminary Design, Schlumberger will submit a Pre-Final Design package. This submittal represents about 90 percent of the total design effort. Comments from USEPA on the Preliminary Design submittal will be addressed in the Pre-Final Design.

5.3.1 Pre-Final Design Plans, Specifications, and Schedules

A revised set of plans, specifications and construction schedules representing Pre-Final Design level of effort (90 percent of the total design) will be prepared as part of this phase of the remedial design.

5.3.2 Draft Operation and Maintenance Plan

A Draft Operation and Maintenance (O&M) Plan will be developed for the groundwater extraction system during this phase of the remedial design. Basically the Draft O&M Plan will specify the operation procedures and maintenance requirements of the groundwater extraction system so that the system operation meets the performance standards. At a minimum, the influent and effluent of the groundwater extraction and treatment system will be sampled twice per month for VOCs. The duration of O&M for the system is anticipated at this time to be 30 years. However the USEPA in conjunction with the Commonwealth of Pennsylvania will evaluate the need for continued O&M of the system every five years from the initiation of the remedial action as required by the 5-year statutory review provision of Section 121 of CERCLA.

This plan will likely include the following information:

- Equipment start-up and operator training data,
- Description of normal operations and maintenance activities,
- Description of potential operating problems
- Description of routine monitoring and laboratory testing,
- Description of alternate Operations and Maintenance options,

- Facility Health and Safety Plan,
- Description of equipment,
- Required records and reports.

5.3.3 Draft Construction Quality Assurance Plan (CQAP)

A Draft Construction Quality Assurance Plan will be developed to ensure that the completed Remedial Action meets or exceeds all design criteria, plans and specification, and performance standards. Specifically, the CQAP will address:

- The quality control organization,
- The name, qualifications, duties, authorities, responsibilities of each QA team member.
- A description of the constriction monitoring methods. This will include personnel and/or laboratory certifications,
- A schedule of QA functions,
- Reporting procedures and reporting format for QA/QC activities, and
- A list of distinct tasks having specific control requirements.

5.3.4 Draft Sampling and Analysis (S&A) Plan

A draft sampling and analysis plan will be developed during this phase of the remedial design. The plan will cover two areas of performance monitoring:

1. System Design Performance

The focus of this part of the SAP will be on the evaluation of the performance of the installed groundwater extraction and treatment system toward achieving the remedy performance standard of minimizing further releases of contaminants from beneath the former Transicoil site. One of the components of this plan will be the installation of additional monitoring wells as outlined in Section VII.A.2 and Figure 6 of the ROD. One monitoring well at the site (MW-6) was damaged during the RI phase and has been proposed for replacement. Schlumberger will evaluate the usefulness of this proposed replacement well as well as the configuration of additional planned monitoring wells as part of the draft SAP.

2. Long-Term Performance

The focus of this part of the SAP will be on the performance of the overall remedy in reducing with time the concentration of VOCs in the plume to below MCLs. Schlumberger will evaluate the overall groundwater monitoring system and will propose to USEPA which wells should be sampled to effectively monitor the performance of the groundwater extraction and treatment system on the off-site plume. Results of long-term monitoring will be used to assess the effects of on-site extraction treatment as well as those of natural attenuation or other influences in reducing the contaminant concentrations in the off-site plume.

5.3.5 Draft Site Health and Safety Plan

A draft Site Health and Safety Plan will be prepared as part of this design phase. The plan will conform to both OSHA and USEPA requirements including 29 CFR 1910.120 and the guidance entitled Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. This Health and Safety Plan will cover the anticipated remedial action activities at the site which would include, construction of the groundwater extraction and treatment system, the construction of the public water main and laterals to service the individual residences, and performance monitoring.

5.3.6 Draft Contingency Plan

A Draft Contingency Plan will be prepared as part of this design phase. This plan will include a provision for air monitoring during any soil excavation activities, such as well drilling, to minimize impacts to the public should VOC levels exceed threshold values. According to the Administrative Order, this plan will also contain a Spill Prevention Control and Countermeasure Plan (SPCC) if applicable. At the present time it is not anticipated that such a plan will be necessary.

5.3.7 Draft Permitting Requirements Plan

Although permits themselves are not required to implement the remedial action, Schlumberger will be required to meet the substantive requirements of a number of state and federal regulations during the implementation of the remedy as outlined in the ROD. A plan will be developed to demonstrate compliance with those requirements.

5.4 Final Design

Within thirty (30) days after USEPA approves the Pre-Final Design, Schlumberger will submit a Final Design for the groundwater extraction and treatment system. This Final Design will address all of USEPA's comments on the Pre-Final Design.

The Final Design will include the following elements:

- Final Plans, Specifications, and Schedules
- Final O&M Plan

- Final CQAP
- Final Sampling and Analysis Plan
- Final Health & Safety Plan
- Final Contingency Plan
- Final Permitting Requirements Plan
- Design Analysis Report (containing all of the design calculations)

The Final Design Submittal will include the following certification statement:

"Except as provided below, I certify that the information contained in or accompanying this Remedial Design Work Plan is true, accurate, and complete.

As to those portions of this Remedial Design Work Plan, for which I cannot personally verify their accuracy, I certify under penalty of law that this Remedial Design Work Plan and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Signature: ______________________

Name: ______________________

Title: ______________________

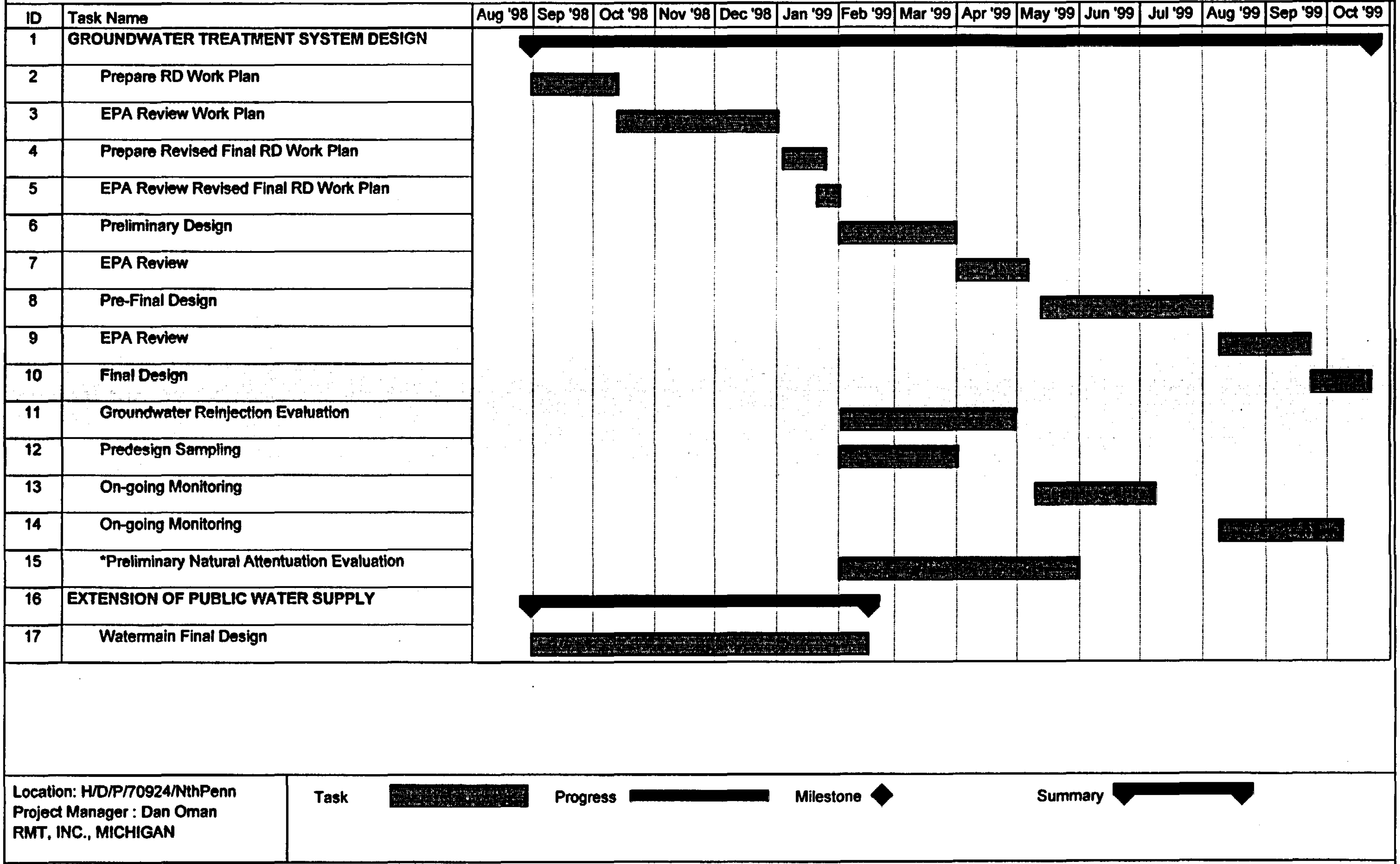
As discussed in Section 4.2, Schlumberger plans to implement the public water supply portion of the remedy in an expedited fashion. The remedial design for the public water supply will be done by the North Penn Water Authority (Water Authority), and RMT. They will skip all the preliminary phases of design and will prepare the final design plans in order to expedite the process.

The final design plans will contain the information necessary for USEPA to conduct a technical review, including the above certification statement. However, it is assumed that USEPA's primary review responsibility concerning this portion of the remedy will be to make sure that the main is properly located and will ultimately be acceptable to the Water Authority. Since the Water Authority will be undertaking the design and possibly the construction, USEPA's review burden will be significantly reduced. At the present time it is anticipated that this final design can be completed by January 1999.

Section 6
Remedial Design Project Schedule

The critical path schedule for the remedial design portion of this project is shown in Figure 5. This schedule covers those major tasks required to prepare the deliverables described in Section 5 of this RD Workplan. It reflects the execution of the preliminary, intermediate, and pre-final/final design phases identified in the Administrative Order. This schedule will become part of the North Penn Area 12 Remedial Design Workplan upon approval by USEPA.

NORTH PENN AREA 12 SUPERFUND SITE
REMEDIAL DESIGN PROJECT SCHEDULE



Location: H/D/P/70924/NthPenn
Project Manager : Dan Oman
RMT, INC., MICHIGAN

* Off-site plume Natural Attenuation Evaluation to be scheduled during implementation of on-site remedial action.

FIGURE 5

Section 7
Project Management

7.1 Project Team

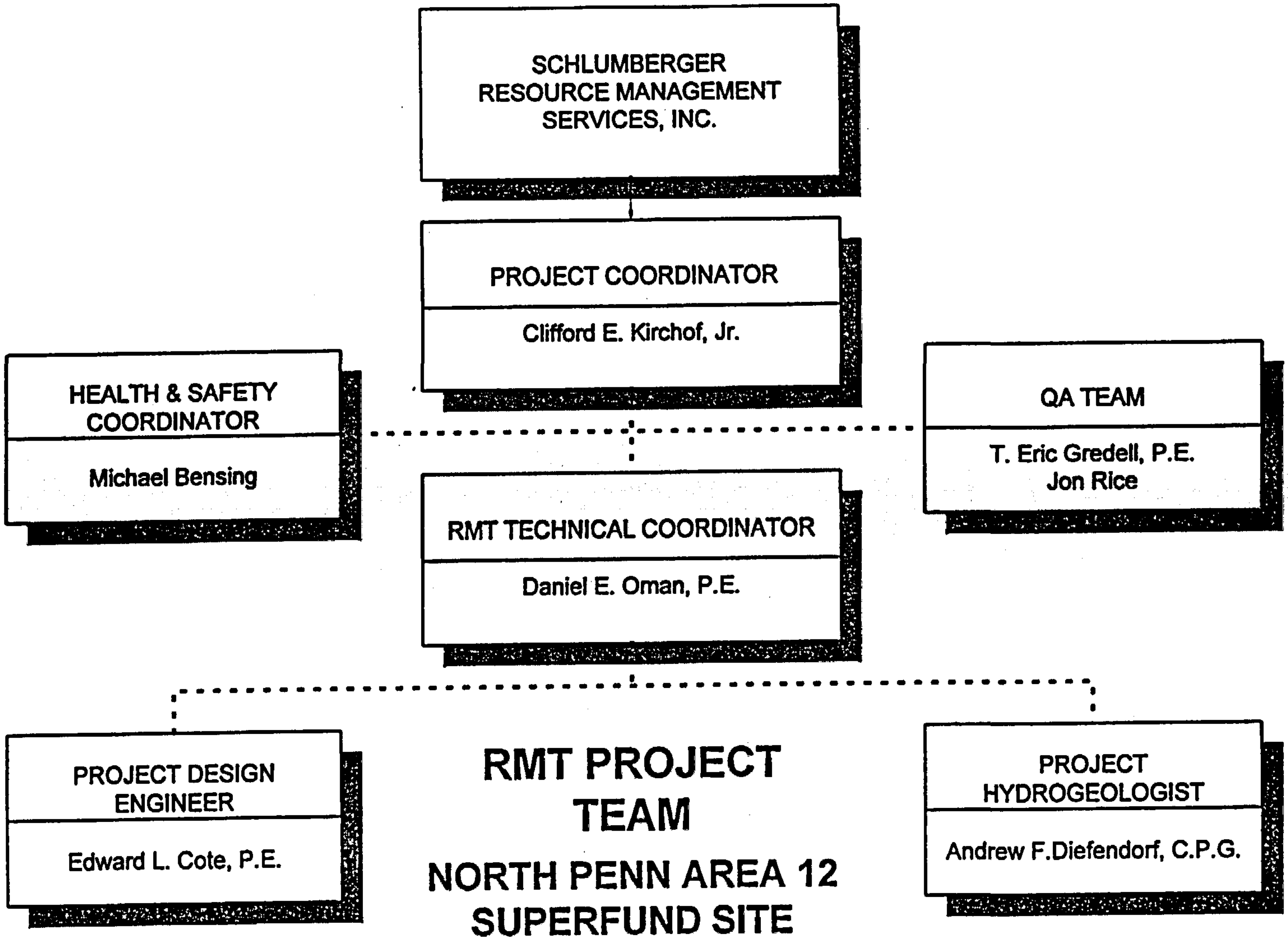
During the North Penn Area 12 Remedial Design, RMT will utilize both a Project Coordinator (PC) and a Technical Coordinator (TC). RMT's Project Coordinator will be Mr. Clifford E. Kirchof, Jr. Mr. Kirchof will provide senior oversight of the project team and maintain overall responsibility for the project. He will also serve as a point of contact for USEPA and Schlumberger's needs and concerns.

RMT's Technical Coordinator will be Mr. Daniel E. Oman, P.E., who is a Vice President at RMT. Mr. Oman will be responsible to the Project Coordinator for technical, regulatory, and financial aspects of the project. In addition, the Technical Coordinator will address routine project functions and activities.

7.2 Quality Management

At RMT, project management, quality assurance, and quality control are all integral parts of the project from the initial field work, through conceptual design, and on to final design deliverables. As technical specialists are appointed to the project task force from their respective resource department, these individuals utilize internal technical standards which are intended to guide their work and ensure that the necessary quality assurance/quality control procedures established for each design task are followed.

The Project Coordinator and the Technical Coordinator play a key role in the QA/QC process at RMT. Their role in QA/QC is multi-faceted and vital to the overall success of the project. The PC/TC serves as RMT's front-line technical and regulatory representative to both Schlumberger and USEPA. From this key position, the PC/TC are responsible to ensure that both QA and QC considerations are addressed. RMT's PC/TC are responsible for ensuring that a QA/QC Plan is filled out for all projects prior to their initiation. The QA/QC Plan is prepared and circulated to all assigned staff.



RMT PROJECT TEAM

NORTH PENN AREA 12 SUPERFUND SITE

REMEDIAL DESIGN

Worcester Township
Montgomery County, PA
FIGURE 6

RMT's QA reviewers are selected from experienced senior design/regulatory professionals who are knowledgeable with all aspects of the required project tasks. QA reviewers are knowledgeable of the project tasks, but are unrelated to the overall project team. In this manner, QA reviewers are able to provide the necessary checks and balances and a third party perspective that is essential if the final work product is to be of a uniform level of quality and consistency.

The QA reviewers for the North Penn Area 12 Remedial Design are identified on Figure 6. These individuals include Mr. Jon Rice (Hydrogeology), and Mr. T. Eric Gredell, P.E. (Design Engineering). Each of these individuals has special talents and skills which will capably support project needs.

7.3 Meetings

All project meetings will be jointly agreed upon and coordinated by the USEPA, Schlumberger and RMT. Due to the nature of this project, we anticipate that the majority of the review and comment process will be conducted by mail. However, in cases where a meeting is deemed appropriate, the USEPA is requested to coordinate such requests directly through either Schlumberger or the Project Coordinator.

Section 8
References

USPEA 19971a. North Penn Area 12 Superfund Site Record of Decision. Worchester Township, Montogomery County, Pennsylvania. September 30, 1997.

USPEA 1998. Administrative Order for Remedial Design and Remedial Action. North Penn Area 12 Superfund Site. Docket No. III-98-078-DC. Philadelphia, Pennsylvania. July 22, 1998.

USEPA 1996. North Penn Area 12 Remedial Investigation Report, Work Assignment No. 36-3LW5. Prepared by CH2M Hill. Philadelphia, Pennsylvania. January 1996.

USEPA 1996b. Bioscreen Natural Attenuation Decision Support User's Manual Version 1.3. united States Environmental Protection Agency. EPA/600/R-96/087. Washington, D.C.

USEPA 1997b. North Penn Area 12 Feasibility Study Report, Work Assignment No. 36-3LW5. Prepared by CH2M Hill. Philadelphia, Pennsylvania. February 1997.

Wiedemeier, T.H., M.A. Swanson, D.A. Montoux, E.K. Gordon, J.J. Wilson, B.H. Wilson, D.H. Kampbell, J.E. Hansen, P. Haas, and F.H. Chapelle. 1996. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater. Air Force Center for Environmental Excellence, Brooks Air Force Base. San Antonio, TX.

Appendix A
Field Sampling Plan

APPENDIX A

PRE-DESIGN
FIELD SAMPLING PLAN

NORTH PENN AREA 12 SUPERFUND SITE
WORCESTER TOWNSHIP,
MONTGOMERY COUNTY, PENNSYLVANIA

January 1999

Table of Contents

List of Tables

List of Figures

List of Attachments

Section 1
Introduction

1.1 General

This Pre-Design Field Sampling Plan (FSP) specifies field activities and sampling protocols to be carried out during the Pre-Design phase of the Remedial Design for the North Penn Area 12 Site. The plan will be implemented in accordance with protocols outlined in the QAPP and the Site Safety Plan. Detailed discussion on the site history, groundwater contaminant conditions and requirements of the ROD and Administrative Order can be found in the text of the Work Plan.

1.2 Scope of Field Sampling Plan

During the Pre-Design phase of this RD/RA program, one round of groundwater samples will be collected from the existing site monitoring wells. The scope of work to accomplish this sampling includes the following tasks:

1. Well Inventory Survey
2. Groundwater Level Monitoring
3. Installation of Dedicated Low-Flow Sampling pumps
4. Purging of Wells
5. Collection of Samples; and
6. Handling, and shipping of samples

It is also intended that this phase of sampling will initiate quarterly monitoring of VOCs to be carried out throughout the period of Remedial Design and Action activities. It is anticipated that Additional Sampling will be conducted during the Remedial Action to facilitate installation and operation of the groundwater collection and injection system. Long-term groundwater monitoring of selected wells will also be conducted to evaluate the performance of the groundwater extraction and treatment system and to ensure that all affected and potentially affected residents are provided public water. The objectives, scope and procedures for those sampling episodes will be provided in Addenda to this FSP and QAPP.

Section 2
Groundwater Sampling Plan

2.1 Objectives & Goals

The objectives of this Sampling Plan are to provide groundwater data to (1) identify any changes in groundwater quality and levels since the last monitoring episode in 1995, (2) to provide additional information necessary to evaluate the collection, treatment and injection system, and (3) to develop a preliminary assessment of potential natural attenuation of contaminants.

The objectives of the groundwater sampling techniques and protocols described below are to provide water quality data representative of the system or aquifer being sampled, while reducing potential bias from related equipment (*i.e.*, pumps, piping, holding tanks, bailers, sample bottles, etc.).

2.2 Field Tasks

2.2.1 Well Survey

Prior to installation of any pumps or collection of samples an initial well survey will be performed to evaluate the condition of the on-site wells all of which have not been sampled for over three years. The well survey will include all wells listed in Table 1 and will include verification of well condition, access and other information necessary to plan for sampling pump installation and sampling logistics. A Well Inspection Report forms as included in Attachment 3 to this FSP will be completed for each well.

2.2.2 Groundwater Level Measurements

Groundwater Level Measurements to determine the static water elevation (SWE). Except as a separate groundwater level measurement event, the static water level (SWL) will be measured prior to purging and sampling or installation of any sampling or other device in the well at each groundwater sampling location. All on-site static water level measurements will be obtained on the first day of the sampling event or within a 24-hour period except as described in the following section. The measurement will be obtained no longer than 24 hours prior to purging the groundwater monitor well. Each well should have a permanent reference point on the top of the well casing, designated top-of-casing (TOC), from which all water level measurements will be taken.

Table 1
Summary of Well Construction Data, Purge Volumes and Sampling Details
North Penn Area 12 FSP

Well	Top of Casing (ft Msl)	Ground Elevation (ft msl)	Depth of Well (ft btc)	Length of Surface Casing (ft)	Open/ Screened Interval Length (ft)	Top of Open/ Screened Interval (ft msl)	Bottom of Open/ Screened Interval (ft msl)	Well Diameter (inches)	3 Purge Volumes (gal)	Sequence of Sampling	Sampling Pump Settings (ft btc)
MW-1*	468.81	466.49	122	20.5	102	446	345	6	210	9	95
MW-2*	473.33	471.01	110	23	87	448	361	6	191	6	91
MW-3*	463.59	461.93	160	20	140	442	302	6	359	7	102
MW-4*	457.72	455.76	110	34.3	76	421	346	6	217	5	82
MW-5*	463.59	460.86	160	30	130	431	301	6	378	2	81
MW-7	459.55	458.07	95	42	20	383	363	4	mp	lfs	ds (84)
MW-8	474.91	473.8	72	35	20	422	402	4	mp	lfs	ds (65)
MW-9	462.91	461.77	124	21	20	358	338	4	mp	lfs	ds (114)
MW-10	462.88	461.49	154	134	20	327	307	4	mp	lfs	ds (145)
MW-11	459.81	459.23	106	20	20	373	353	4	mp	lfs	ds (96)
MW-12*	460.09	458.94	202	117	85	342	257	8	973	1	120
T-3*	439.18	442.64	308	45	263	398	135	6	1076	3	100
T-5*	446.43	449.82	137	21	116	426	313	6	401	4	100
T-6*	470.78	470.25	913	21	892	449	443	6	3224	8	100

Notes:
*Well was completed as an open borehole without the use of any screen
msl=with respect to mean sea level
btc=below top level of casing
Table adapted from 1996 RI Report, Table 3-3, by CH2M Hill

mp = micropurge
lfs = low-flow sampling, no sequential sampling required
ds = dedicated sampling equipment; intake depth in parenthesis

The reference point has been surveyed to the nearest 0.01 ft. and referenced to mean sea level (MSL) and will be verified in Task 1 above.

The measurement should be taken using an electronic water level meter capable of an accuracy of +/– 0.01 feet. A meter with a semi-round tip will be utilized to assist in getting the probe beyond the depth of dedicated pump tubing. The meter will be decontaminated prior to each measurement. Minimum contact of the tape and probe/sounder and the water in the well is required to decrease the potential for cross contamination. Disposable latex gloves will be used while determining the SWL.

Prior to collecting the measurement, field personnel will verify the location of the measuring point on the well cap. Measurements will be obtained at this location. The probe will be slowly lowered into the well until the sounder beeps or the LED becomes illuminated. The measurement will be read from the tape to the nearest 0.01 foot increment and recorded on the field notes and the Water Level Data form provided in Attachment 3. This measurement is SWL as measured in feet below the TOC measuring point.

The static water elevation (SWE) will then be calculated to the nearest 0.01 foot by utilizing the following equation:

$$SWE = TOC - SWL$$

Where: SWE = Static Water Elevation (ft MSL)
TOC = Top of Casing Elevation (ft MSL)
SWL = Static Water Level, Depth to Water below TOC (ft)

Unless installed in a flush-mount protective cover, the expandable plastic cap or galvanized screw-on cap will have a vent in order to allow for natural fluctuations in groundwater levels within the well casing between sampling events and ensure representative groundwater elevations are obtained prior to purging the well.

2.2.3 Installation of Dedicated Low-Flow Purging and Sampling Equipment (Monitoring Wells MW-7, -8, -9, -10 and -11)

Traditionally, three to five well volumes of water are purged from a well prior to sample collection to remove stagnant water in the well casing and ensure collection of a sample representative of formation water. A relatively new approach, called low-flow purging or micro-purging, focuses on removal and sampling of groundwater that enters the well screen without removal of stagnant water located above the pump in the well casing. The low-flow purging approach can effectively reduce the volume of contaminated water generated during the purging process. Because of the depth (72 to 913 feet) and diameter (4 to 8 inches) of the wells that presently exist on-site, a large volume (approximately 10,000 gallons) of contaminated purge water would be generated during the well purging process. Installation of the low-flow sampling equipment will also minimize sample turbidity, thereby allowing for the collection of groundwater samples that are most representative of *in situ* flow conditions.

Monitoring Wells MW-7 through MW-11 will be outfitted with low-flow dedicated Micro-Purge® bladder pumps manufactured by QED. Bladder pumps were selected over other types of sampling pumps because of their demonstrated ability to decrease sample turbidity, and because their use typically yields more representative samples than the traditional purging and sampling methods. Additionally, bladder pumps are recognized as the best overall sampling devices for both inorganic and organic constituents as discussed in the 1996 RCRA Groundwater Monitoring Draft Technical Guidance document. The equipment specifications for the pumps are presented in Attachment 1 to this plan.

The bladder pumps use timed on/off cycles of compressed air to alternately squeeze the flexible bladder that displaces water out of the pump, and release it to allow the pump to refill by submergence. This minimizes disturbances that could affect sample chemistry and prevents contact between the pump drive air and the sample. Bladder pumps are constructed of PVC materials with PTFE bladders. Teflon®-lined polyethylene tubing was used for air supply and sample discharge.

Each pump will be pre-cleaned by QED and laboratory-certified to be free of volatile organic compounds, acid extractables, and base neutral compounds. Bladder pumps and associated well cap, fittings, tubing, *etc.* will be completely assembled by QED and placed in sealed packages for delivery to, and installation at, the North Penn Area 12 Site. RMT representatives will remove the sampling equipment from the sealed packages and immediately lower the pump assembly down the well casing. Lowering of the pump assembly into the well will be done carefully to ensure that the pump assembly does not contact the ground or other sources of potential contamination.

The height of the water column within the well casing is the critical factor for operation of bladder pumps and Micro-Purge® sampling equipment. Because the water column is utilized to collapse the bladder which allows the pump to fill, sufficient submergence is critical in the pumps operation and the time that is required to sample the well. The amount of water estimated to be present in the wells during low water levels will be evaluated to determine the appropriate type of pump for the specific application and the design installation depth. Providing there are no design or installation limitations, placement of the pump inlet location will be made relative to the preferred stratigraphic monitoring zones. For example, it may be beneficial to place the pump inlet adjacent to fractures that could potentially expedite lateral migration of potential constituents of concern. It is currently assumed the larger pumps (QED Model P1101) will be specified. The larger pumps are capable of operating over a wider range of purge rates. The P1101 pump is approximately 3.3 feet in length without the inlet screen, and approximately 4 feet with the inlet screen.

2.2.4 Purging Procedures

Monitor wells will be purged to remove a sufficient volume of water to provide for collection of a representative groundwater sample. Procedures for purging these monitor wells are as follows:

For Wells With Dedicated Low-Flow Equipment:

1. Locate the air compressor/controller downwind of the monitor well being sampled.
2. Attach the air supply line from the compressor/controller to the air inlet fitting on the well cap.
3. Remove the sample discharge tubing from the storage hole in the well cap; inspect the sample discharge tubing for visible signs of wear, dirt, or contamination; and replace with new, clean tubing as necessary. Attach the sample discharge tubing to the pump outlet fitting on the well cap.
4. Connect the discharge tubing to the flow-through cell. A flow-through cell will be utilized to monitor in-line water quality parameters. Parameters to be monitored include Eh, pH, specific conductance, and temperature. Turbidity will be measured from the flow-through cell discharge.
5. Start the compressor/controller, and begin purging in accordance with the manufacturer's specifications under low-flow conditions (*i.e.*, < 0.5 L/min) causing minimum water level drawdown. Monitor drawdown on a frequent basis (approximately every 1 to 5 minutes) and adjust purge rates accordingly to minimize drawdown.
6. Measure and record the volume of water purged and the purge rates frequently (*i.e.*, every 3-5 minutes), and obtain and record measurements for Eh, pH, turbidity, specific conductance, and temperature. The frequency for collecting field readings is contingent upon the actual flow rate at which the well is being purged and will be increased as purge rates decrease. Also include observations regarding odor, color, turbidity, *etc*. Field forms for these measurements are included in the Appendix.

7. Stabilization is achieved after all parameters have equilibrated for at least three consecutive readings. To document that the flow through cell is not buffering the field measurements and creating false indication of stabilization, equilibration will be verified by obtaining additional measurements of the field parameters directly from the pump discharge hose water stream before entrance into the flow-through cell. These field measurements will be compared to those obtained during utilization of the flow-through cell. The stabilization effort will be different for each monitor well. However, in general, stabilization should be within 0.1 SU for pH, 3 percent for specific conductance, and 10 percent for turbidity (if higher than 5 NTUs) or, turbidity will be considered stabilized when three consecutive readings of turbidity are observed below 5 NTUs.
8. Stabilization efforts will be recorded and utilized as reference during future sampling events. If parameter stabilization criteria are determined to be too stringent, upon implementation of this program, modifications will be proposed.
9. All purge waters and associated decontamination waters will be collected in suitable containers, and delivered to a central handling facility for final disposition.
10. Operation and calibration of field equipment used for measuring static water elevation, turbidity, pH, specific conductance, and temperature will be conducted in accordance with the procedures outlined in Attachment 2.

For Wells Purged With High-Flow Pumps:

1. For wells without dedicated low-flow pumps a temporary electrical submersible pump will be installed to an intake depth of 120 feet or 10 feet above the bottom of the well, whichever is the lesser.
2. The pump generator will be operated down-wind of the well head.
3. Discharge water will be sampled at the beginning, mid point and prior to completion of the required purge volume and tested using the probes from the flow cell as noted above. Readings will be recorded to document the stability of water quality conditions.
4. The wells will be purged of a minimum of three volumes of water in accordance with the volumes listed in Table 1, unless purge parameters suggest no change in stability after the midpoint of purge volume.
5. All discharge waters will be collected in portable water tanks for transport to a central handling facility.
6. Upon removal of the purge pump from the well all fluids remaining in the pump and attached hosing will be drained into the purge-water tank. The pump and discharge hose will then be purged with a minimum of ten gallons of water pumped through the hose to the purge-water tank.
7. To further minimize the potential for cross contamination of wells from purging and sampling the wells will be sampled in the order from lowest to highest TCE level based on 1995 sampling and in accordance with Table 1.

2.2.5 Collection of Samples

Locations of monitor wells to be sampled are shown on Figure FSP 1, and well depths for existing wells and other pertinent well information are provided in Table 1. Groundwater samples will be tested for the parameters listed on Table 2. Wells without dedicated bladder pumps will be sampled using a temporary pump installed to the depth indicated on Table 1. After purging the appropriate volume based upon the measured stabilized readings, the wells will be sampled utilizing the following procedures:

For VOCs and Inorganics:

1. Precautions will be taken to ensure that equipment does not come in contact with potential sources of contamination. No vehicle engines should be running during purging and sampling. The compressor/controller will be downwind of the groundwater monitor well being sampled.
2. Obtain and record final readings of the field parameters from the in-line flow-through cell. Disconnect the flow-through cell from the sample discharge tubing and collect an additional reading of the field parameters directly from the pump discharge tubing.
3. Prepare bottles by writing the date, the sampler's name, and the time of day in the sampler section.
4. Adjust the pump flow rate to 500 ml/min or the stabilized flow rate for the well (whichever is less).
5. Fill the sample bottles taking care not to allow the pump discharge tubing to contact the sample bottles or any potential source of contamination. Details on bottles, sizes and preservatives are included in the QAPP Section 4.
6. Collect non-filtered samples directly into pre-preserved sample bottles from the pump discharge tubing in a manner that prevents excessive agitation and aeration.
7. Upon filling all of the sample bottles, obtain and record final readings of pH, specific conductivity, temperature, and turbidity to demonstrate that stabilization has been maintained throughout the sampling process. For the wells indicated also obtain at this time D. O. and Eh readings and collect and analyze for Natural Attenuation Criteria listed in Table 2 using the Field Kits as described in Attachment 2.
8. When sampling for parameters requiring filtration, insert an in-line filtration cartridge/capsule into the end of the pump discharge tubing. Fill the pre-preserved bottles with water discharged from the in-line filtration cartridge.
9. When sampling for volatile organic constituents (VOCs), the flow rate when filling the VOC vials will be decreased to less than 100 ml/min after clearing the pump tubing of groundwater purged at higher flow rates.

10. If flow of water from the pump is suspended by sampling personnel, for any reason, subsequent to stabilization and during the sampling process, samplers will obtain and record measurements of pH, specific conductance, temperature, and turbidity to demonstrate that stabilized conditions remain. If readings indicate non-stabilized values, additional purging will be necessary to obtain stabilization prior to resuming sample collection.

For Gaseous Extraction Samples:

1. Prior to well purging and sample collection, the groundwater recharge rate should be determined. In the event that the groundwater recharge rate is so slow that the minimum flow rate of 100 ml/min cannot be maintained for 30 minutes without drawing the water level below the top of the well screen, samples for hydrogen should not be collected. Once purging has begun, no metallic objects (to include a water level indicator) should come in contact with the water due to a reaction between water and certain metals that produce hydrogen.
2. Purge the well as specified for VOC sampling above.
3. Connect the flow through cell provided by Microseeps, to the effluent side of the pump, check to make sure that stopcocks are open on both ends of the cell, and position the cell vertically so that the outlet of the cell is on top. Activate the pumps so that the flow rate is about 100 ml/min and fill the cell completely with water, eliminating all bubbles.
4. With the pump operating, position the cell so that it is lying on its side with the septum port on top, then raise the influent end of the cell to about a 30 degree angle. Wait five minutes.
5. Inject the bubble. A laboratory-grade inert gas has been supplied by Microseeps in a 250 ml serum vial labeled "Gas Supply for Bubble". Each vial contains a sufficient positive pressure of inert gas for 3 bubbles. 40 milliliters of the gas will be injected into the bulb through the septum in the body of the cell. This injection will be made only after the supplied syringe has been purged with approximately 20 ml of the inert gas. After purging, draw 45 ml of the inert gas into one of the 60 ml syringes, place the needle tip onto (but not into) the septum in the gas sampling bulb. Adjust the volume of the inert gas in the syringe to 40 ± 1 milliliters; plunge the needle through the septum, and inject the entire 40 milliliters of inert gas into the sampling bulb, displacing 40 milliliters of water.
6. Continue pumping at 100-600 ml/min for 30 minutes to allow the water to equilibrate with the bubble.
7. Collect the sample. Draw 15 ml of inert gas from the serum vial into the syringe and place the needle onto (but not into) the septum on the sampling cell. Expel the gas and immediately plunge the needle through the septum into the cell. Withdraw 20 ml of sample gas into the syringe (taking care not to draw water) and withdraw the needle. Immediately place the needle onto (but not into) the septum on the 20

ml sample vial, adjust the syringe to exactly 15 ml, plunge the needle through the septum on the sample vial, and inject the entire 15 ml into the vial.

For In-Field Colorometric Analysis:

Approximately 100 ml should be collected in a field flask prior to analyses. The CHEMets® Kits contain individual 25 ml cups for the analysis.

2.3 Sample Handling and Shipment

2.3.1 Sample Identification

Groundwater samples will be collected from on-site former production wells, and monitoring wells during the Pre-Design Phase. Later during the Remedial Action and during Long-term and Performance Monitoring extraction wells and residential wells will be added to the sampling programs. A sample numbering system will be used to distinguish between the various types of wells. This system will provide a tracking procedure to allow retrieval of information about a particular well type or sample and assure that each sample is uniquely numbered. A one or two digit prefix will identify the type of well sampled, followed by the number of the well. Sampling dates and times will be recorded to distinguish between samples collected from the same well. The prefixes used for on-site wells are described below.

■ MW	Monitoring Well
■ T	Former Production Well
■ CPTC	Center Point Training Center Well
■ RW	Residential Well
■ EW	Extraction Well

2.3.2 Sample Containers and Preservation

Sample containers will be provided by the laboratories. Appropriate preservatives will be added to the bottles prior to sample collection. For each group of ten samples or less, a preservation check will be performed. One prepared but unused VOA bottle will be selected at random for every 10 VOA samples collected and a duplicate sample obtained, and field checked with pH paper. For other analytes, preservative checks will be made by pH paper test in the field for each analyte suite per every five samples. Information regarding the sample containers, preservatives, sample volumes, and holding times to be followed are provided in Section 4 of the QAPP.

Table 2
Analytical Parameters

Schedule Of Sampling & Analytical Parameters

	Samples for Field Analyses for		Samples for Laboratory Analyses for	
Well Number	**Purge Stability(1)**	**Natural Attenuation and Design(2)**	**Baseline Monitoring(3)**	**Natural Attenuation and Design(4)**
MW-1	✓	✓	✓	✓
MW-2	✓		✓	
MW-3	✓		✓	
MW-4	✓		✓	
MW-5	✓		✓	
MW-7	✓	✓	✓	✓
MW-8	✓		✓	
MW-9	✓	✓	✓	✓
MW-10	✓		✓	
MW-11	✓	✓	✓	✓
MW-12	✓		✓	
T-3	✓		✓	
T-5	✓		✓	
T-6	✓		✓	

Analyses in the field Include:

(1) For Purge Stability:
Temperature, Conductivity, Eh, pH, and Turbidity and Dissolved Oxygen using a YSI low-flow cell and appropriate YSI probes.

(2) For Natural Attenuation Criteria:
Total & Ferric Iron, and ammonia using CHEMets® Test Kits.

Note: One aliquot will be collected and submitted to the laboratory for confirmation of total iron and ammonia.

Laboratory Analyses Include:

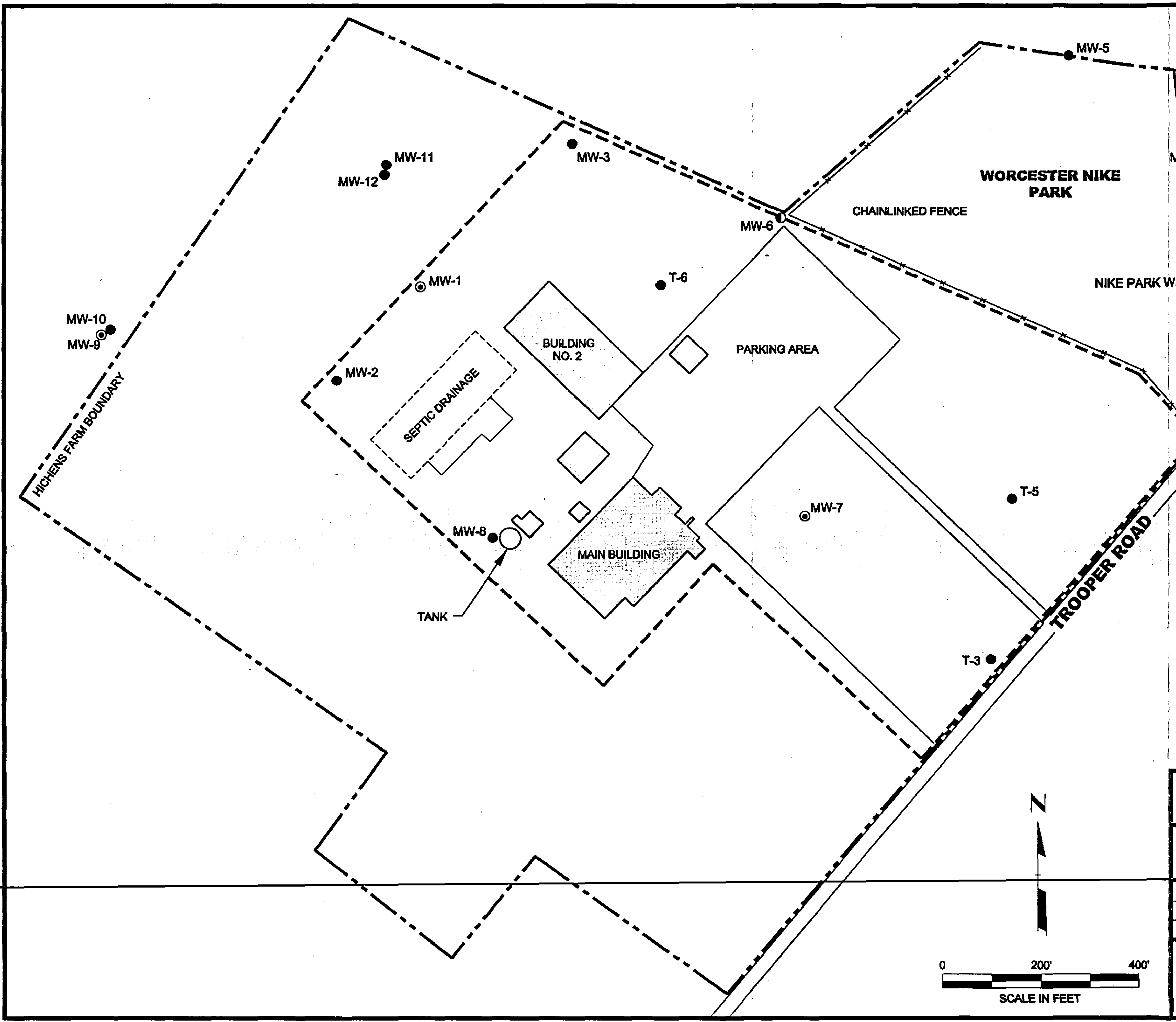
(3) For Baseline Monitoring:
Low-level VOCs and Freon 113

(4) For Natural Attenuation and Design Criteria:
Nitrate, Chloride, Sulfate, Sulfide, Alkalinity, Hardness
Gaseous Extractions for: Hydrogen, Methane, Nitrogen and Carbon Dioxide

Note: One aliquot will be collected and submitted to the laboratory for confirmation of total iron and ammonia

PLOT DATA
Drawing Name: J:\70924\01\0204.dwg
Operator Name: LUCIDOS
Scale: 1"=200'

Dwg Size: 349069 Bytes
Plot Date: Monday, January 18, 1999
Plot Time: 11:36.0759 AM
Attached Xref's: No xref's Attached.



LEGEND

- · · — APPROXIMATE PROPERTY LINE
- - - SITE BOUNDARY
—×— CHAINLINK FENCE
MW-3 ● WELL TO BE SAMPLED FOR VOCs
MW-1 ◉ WELL TO BE SAMPLED FOR VOCs AND NATURAL ATTENUATION CRITERIA
MW-6 ◐ EXISTING WELL NOT TO BE SAMPLED

NOTES

1. BASE MAP DEVELOPED FROM SITE PLAN PREPARED BY CH2M HILL, INC. DRAWING NO 49771017, DATED 31-MAY-1996.

NORTH PENN AREA 12
REMEDIAL DESIGN WORK PLAN
WORCESTER TOWNSHIP, PENNSYLVANIA

SAMPLING LOCATIONS

DRAWN BY:	SJL	PROJECT NUMBER:	70924.0
CHECKED BY:	DO	FILE NUMBER:	0204.DWG
APPROVED BY:		DATE:	JANUARY 1999

RMT INC., MICHIGAN
1143 HIGHLAND DRIVE, SUITE B
ANN ARBOR, MI. 48108-2237
P.O. BOX 991 48106-0991
PHONE: 734-971-7080
FAX: 734-971-9022

FIGURE FS-1

2.3.3 Sample Labeling

A sample label will be attached to each bottle before sampling. Information will be entered onto the sample label using indelible ink. Information to be provided on sample labels is described in Section 5 of the QAPP and includes:

- Project number
- Sample location
- Sample type
- Sample date
- Collection time

Copies of laboratory sample labels from Lancaster Labs and Microseeps are included in Attachment 3 of this FSP. Note that the Microseeps Labels are plain blanks. Labels of the size shown in Attachment 3 must be used.

2.3.4 Field Custody Procedures

A sample container is under custody in the field if one of the following conditions exist:

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

Chain-of-custody forms track the possession of samples from the time of collection to receipt by the laboratory. Field personnel will record the sample number, date and time of sample collection (except for duplicate samples), sampling personnel, type of sample, type of analyses to be performed, containers filled, and preservatives used on the chain-of-custody form. The date and time of collection of duplicate samples are recorded in the field notebook, but not on sample labels or chain-of-custody forms in order to keep the identity of the duplicate sample concealed from the laboratory. Transfer of custody of the samples from one person to another is documented on the chain-of-custody form. If samples are shipped by common carrier to the laboratory, the carrier name and shipping number are included in the chain-of-custody form. The original form will accompany the samples to the laboratory; a copy of the form will be placed in the project file. Additional sample custody procedures are described in Section 5 of the

QAPP. Copies of the chain-of-custody forms from Lancaster Labs and Microseeps are included in Attachment 3 of this FSP.

2.3.5 Sample Packaging and Shipping

Groundwater samples will be packaged and shipped as follows:

1. Wrap glass sample containers in bubble wrap to protect from breakage. Small (less than 500 ml) glass containers will also be placed in plastic bags.
2. Place sample containers in a strong outside container such as a plastic or metal picnic cooler. Fill water-tight plastic bags with ice and place around the sample containers. Use a sufficient amount of ice to keep the samples cooled to 4°C until the samples reach the laboratory.
3. Place a temperature blank in the cooler with other samples, and note on the chain of custody forms the presence of this blank.
4. Place the original chain-of-custody form in a water tight plastic bag. Tape plastic bag securely to the inside lid of the cooler.
5. Seal shipping container securely with tape to prevent leakage of melting ice and preclude tampering.
6. Place two custody seals over the sealed cooler lid. Custody seals should be placed on opposite corners of the lid. Custody seals will be signed and dated.
7. Clearly label shipping container with destination.
8. Ship via air freight or other overnight carrier.

Samples may be transported directly to the laboratory by the sampling personnel. Samples will be wrapped, cooled, and placed in a strong outside container as described above. The chain-of-custody procedures will be followed, as described in Section 5 of the QAPP.

Samples will be shipped to:

- Lancaster Laboratories
  2425 New Holland Pike
  P.O. Box 12425,
  Lancaster, PA 17605-2425
  (717) 656-2300
- Microseeps
  University of Pittsburgh
  Applied Research Center
  220 William Pitt Way
  Pittsburgh, PA 15238
  (412) 826-5245

2.4 Field Documentation

Field documentation must provide a clear, unbiased picture of field activities. Field log books provide the basic means for documenting field activities. Photographs are also used to document site conditions and field activities.

2.4.1 Field Log Book

Bound, serially numbered field notebooks will be used on work assignments requiring field activities. The On-site Coordinator will be responsible for issuing and reviewing field notebooks. Entries into field notebooks will be legibly written in waterproof ink and provide a clear record of field activities.

The following information will be provided in the inside front cover or first page of the field notebook:

- Project Name
- Site Location
- Project Number

Instructions for documenting field activities are provided below.

Format

- Leave the first two pages of the field notebook blank. They will provide space for a table of contents to be added when the field notes are complete.
- Entries will be made in ink. Waterproof ink is recommended.
- Entries will be made in language which is objective, factual, and free of personal feelings or other terminology which might prove unclear or inappropriate.
- Entries will be printed as neatly as possible.
- Entries will be logged using military time.
- Errors in the field notes will be indicated by drawing a single line through the text. The text must remain legible. Errors will be initialed and dated.
- The person taking notes must sign and date each page as it is completed.
- All photos taken must be traceable to field log book entries.
- A new page will be started at the beginning of each day's field activities, and the remaining clear page at day's end will be filled with a single initialed diagonal line.

- If the individual designated for field documentation tasks transfers those tasks to another team member, he or she must clearly document this transfer of responsibility as a logbook entry.
- Isolated logbook entries made by a team member other than the team member designated responsible for field documentation, must be signed and dated by the person making the entry.
- The On-site Coordinator will complete a quality control check to see that the notes are legible and contain an accurate picture of the field activities. This review should occur as soon as possible after the notes were taken.
- Additions, clarifications, or corrections made after completion of field activities must be dated and signed.

Content

- The first written page identifies the date, time, field personnel and their responsibilities, other non-field personnel, observed weather conditions, and verification that work plan and QA requirements were discussed with listed on-site personnel. Additionally, during the course of site activities, deviations from the work plan and changes in weather conditions must be documented.
- Sketches or maps of the site may be included to identify photograph and/or sample locations. Landmarks will be noted, north will be indicated, and if possible, an approximate scale will be included.
- Photograph information will include the date, time, location, orientation, photographer, roll number, frame number, and a description or identification of the subject in the photograph.
- Use of on-site health and safety equipment will be documented. Observed potential hazards to health and safety will be described. The level of personal protective equipment used and decontamination procedures will be recorded.
- Sampling information will include sample identification, date, time, sampling personnel, sample type, designation of sample as a grab or composite, sampling techniques, and any preservatives used. Collection of split or duplicate samples will be noted and recipients of split or duplicate samples will be documented.
- Information for field measurements will include the sample identification number, the date, time, and personnel taking the measurements. If in-field calculations are necessary, they will be checked in the field by a second team member whenever possible.
- If visitors arrive on-site, relevant discussions will be recorded. Include the name of conversation participants, the interest group represented (if applicable), and addresses and phone numbers, if available.

- Record any other relevant information.

2.4.2 Photographs

Photographs taken in the field will be documented in the field notebook. After the film is developed, each slide or print will be labeled with the following information:

- Project number
- Date and time
- Location

Section 3
Field Analytical Techniques

3.1 Flow-Through Cell Measurements

Field measurements and readings to determine stabilization of field parameters will be conducted utilizing a flow-through cell. Final field measurements will be obtained from the pump discharge tubing. Use of the field meters and calibrations for measurements of pH, specific conductance, and temperature will be in accordance with those specified in Attachment 2. The instruments used in the field include equipment capable of measuring turbidity, Eh, pH, temperature, and specific conductance. The following field meters and equipment will be utilized during implementation of this SAP:

- YSI Model 3520 Flow-Through Conductivity Cell
- YSI Model 3550 Flow-Through Cell Sample Chamber
- YSI Model 3560 Water Quality Monitoring System
- YSI Model 3510 Temperature Probe
- YSI Model 3520 Eh/pH Probe
- Orbeco-Hellige Model 966 Portable Turbidimeter

Operation and maintenance instruction and procedures for the field equipment are included in Attachment 2. Documentation of field readings will be conducted in accordance with this FSP utilizing the field forms included in Attachment 3. Field instrument calibration procedures are described in Attachment 2 and will be performed twice daily, or once per 10 samples, whichever is more frequent.

3.2 Measurement of Dissolved Oxygen

A YSI Model 55 Hand-held Dissolved Oxygen System will be used to measure dissolved oxygen. Dissolved oxygen system will be checked before each field trip. Batteries will be checked, check probe protective membrane, install KCl solution and membrane if needed. Procedures for checking calibration and making field measurements are as follows:

- Ensure that the sponge inside the instrument's calibration chamber is wet. Insert the probe into the calibration chamber.
- Turn the instrument on by pressing the ON/OFF button on the front of the instrument. Wait for the dissolved oxygen and temperature readings to stabilize (usually a few minutes is required).

- Use two fingers to press and release the two up and down keys at the same time.
- The LCD will prompt you to enter the local altitude in hundreds of feet. Use the arrow keys to increase or decrease the altitude. EXAMPLE: Entering the number 12 here indicates 1200 feet.
- When the proper altitude appears on the LCD, press the ENTER key once to view the calibration value in the lower right of the LCD; and a second time to move to the salinity compensation procedure.
- The LCB will prompt you to enter the approximate salinity of the water you are about to analyze. You can enter any number from 0 to 40 parts per thousand (PPT) of salinity. Use the arrow keys to increase or decrease the salinity compensation. When the correct salinity appears on the LCD, press the ENTER key.

Note: Each time the YSI Model 55 has been turned off, it may be necessary to recalibrate before taking measurements. All calibrations should be completed at a temperature which is as close as possible to the sample temperature.

- Insert probe into sample to be measured.
- Stir sample at the rate of at least 1 foot per second in an up-and-down motion.
- Wait for dissolved oxygen and temperature readings to stabilize.
- Record readings.
- Rinse probe with deionized water and place probe back into calibration chamber.

Note: Dissolved oxygen readings can be obtained inside well or a designated container large enough to allow stirring of sample at a rate of 1 foot per second in an up-and-down motion.

3.3 Field Test Kit Analyses

Field measurements for total iron, ferric iron, and ammonia, and hydrogen sulfide will be conducted in accordance with the CHEMets® instructions; catalog numbers K-6010 and K-1510 included in Attachment 2.

Section 4
Decontamination Procedures

Proper decontamination of well purging and sampling equipment is essential to prevent cross contamination of wells and samples. All well pumping and sampling equipment will be decontaminated before each sampling event and between each well as follows.

4.1 Decontamination During Mobilization

All sampling equipment not having been thoroughly decontaminated will be decontaminated prior to delivery to the site using the following procedures:

1. Prepare a water bath using a laboratory-grade detergent such as Alconox.
2. Unwind-water level measuring devices, hosing and wires and soak them in the water bath and wipe clean with a cloth.
3. Rinse all equipment and flush the interior of hosing and pumps with tap water.
4. Rinse the equipment and flush the interior with purified water or Type II Reagent Grade water.
5. Wipe dry all hosing, wires and tubing while recoiling on equipment reels.
6. Wrap all equipment in polypropylene sheeting to protect it from contamination

4.2 Decontamination in the Field

Cleaning of well purge and sampling equipment will benefit from the high volume of water being purged and the relatively low concentrations of solubilized chlorinated solvents present. This makes detectable cross contamination unlikely and cleaning with detergent unnecessary. In addition, purging and sampling of wells not having dedicated pumps will progress from the least to most contaminated wells.

Upon completion of purging process at each well, the pump and hosing will be drained into the purge-water transport tank and the pump and discharge line flushed with a minimum of twenty gallons of tap water obtained from a potable public water supply source such as the North Penn Water Authority.

The following procedures will then be used for cleaning sampling equipment in the field between sampling rounds at each well.

1. Rinse all equipment with clean water from a public water supply.

2. Thoroughly rinse all equipment with purified water or deionized water.
3. Collect and transport all rinsate to the on-site purge-water holding tank.

Section 5
"Investigation Derived" Materials Accumulation And Management

5.1 Purge Water and Rinsate

Purge water and rinsate will be tanked and trucked to an on-site central storage tank where it will be handled in one of the two following manners:

1. A temporary discharge permit will be obtained from PADEP to allow for disposal of treated water to the ditch on the north side of Trooper Road in the vicinity of one of the two driveway entrances to the site. The water will be collected in a primary storage tank from which it will drain to or be pumped through a carbon unit for treatment and then collected and stored in a secondary holding tank for testing. At completion of the sampling round, a composite water sample would be taken from the secondary tank and submitted for quick turnaround analysis of VOCs (14 days or less). Assuming the concentration of VOCs meets the permit requirements, the tank would then be emptied into the ditch.
2. In lieu of on-site treatment, the purge water and rinsate would be collected in either an onsite holding tank or a tanker trailer. Within two weeks of the well sampling the water would be transported by a licensed waste hauler to a commercial waste treatment facility.

5.2 Other Materials

Due to the nature of the site, the sampling conditions. and the low exposure risk presented, accumulation of contaminated solid materials is not anticipated as a result of groundwater sampling activities.

Section 6
References

ASTM, Standard Practice for Groundwater Sampling: D4448.

ASTM, Standard Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers: Designation: D5092-90.

Barcelona, M.J., Wehrmann, H.A., and Varljen, M.D. 1994. Reproducible well-purging procedures and VOC stabilization criteria for groundwater sampling: Groundwater, v. 32, No. 1, pp. 12-22.

Barcelona, M.J., and J.P. Gibb. 1988. Development of Effective Ground-Water Sampling Protocols, in A.G. Collins and A.I. Johnson, eds., Ground-Water Contamination: Field Methods, ASTM STP 963, ASTM, Philadelphia, pp. 17-26

Barcelona, M.J., J.P. Gibb, J.A. Helfrich, and E.E. Garske. 1985b. Practical Guide for Ground-Water Sampling, USEPA, Cooperative Agreement #CR-809966-01, EPA/600/2-85/104, 169 pp.

Freeze, R.A., Cherry, J.A. 1979. Groundwater. Prentice-Hall, Englewood Cliffs, New Jersey.

Giddings, T. 1983. Bore-Volume purging to improve monitoring well performance: an often-mandated myth: Proceedings of the NWWA Third National Symposium on Aquifer Restoration and Groundwater Monitoring, Columbus, Ohio. pp. 253-256.

Kearl, P.M., N.E. Korte, and T.A. Cronk. Suggested modifications to groundwater sampling procedures based on observations from the colloidal borescope: Groundwater Monitoring Review, v. 12, No. 2, pp. 155-161.

Puls, R.W. and C.J. Paul. 1995. Low-Flow Purging and Sampling of Ground-Water Monitoring Wells with Dedicated Systems. Ground Water Monitoring and Remediation 15(1):116-123

Puls, Robert W. and Michael J. Barcelona. Low Flow (Minimal Drawdown) Ground-Water Sampling Procedures. EPA/540/S-95/504. April 1996.

Puls, Robert W. A New Approach to Purging Monitoring Wells. Ground Water Age. January 1994.

Plumb, R.H. 1991. The occurrence of Appendix IX organic constituents in disposal site groundwater: GWMR, 11(2):157164.

Powell, R.M. and R.W. Puls, 1993, Passive sampling of groundwater monitoring wells without purging: multilevel well chemistry and tracer disappearance: Journal of Contaminant Hydrology, No. 12, pp. 51-77.

Puls, R.W., D.A. Clark, B. Bledsoe, R.M. Powell, and C.J. Paul. 1992. Metals in groundwater: Sampling Artifacts and Reproducibility, Hazardous Waste and Hazardous Materials, v. 9, No. 2, pp. 149-162.

RCRA Groundwater Monitoring Technical Enforcement Guidance Document (TEGD), NWWA/EPA, September 1986.

Robin, M.L. and R.W. Gillham. 1987. Field Evaluation of Well Purging Procedures: Groundwater Monitoring Review, v. 7, No. 4, pp. 85-93.

Schilling, Keith E. Low-Flow Purging Reduces Management of Contaminated Groundwater. Environmental Protection. December 1995.

Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Interim Final Guidance: EPA/530-SW-89-026, April 1989.

Test Methods for Evaluating Solid Waste: EPA SW-846, 3rd. ed., 1986.

USEPA. 1977. Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities: EPA SW-611, Office of Solid Waste.

USEPA. 1987. Data Quality Objectives for Remedial Response Activities. OSWER Directive 9335.0-7B. March 1987.

USEPA. 1988a. Statistical Methods for Evaluating Ground-Water Monitoring from Hazardous Waste Facilities; Final Rule: Federal Register, 53, 196, 39720-39731.

USEPA. 1988b. A compendium of Superfund Field Operation Methods.

USEPA. 1988c. Office of Solid Waste and Emergency Response, Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final, October 1988.

USEPA. 1989. Interim final guidance document, statistical analysis of ground-water monitoring data at RCRA facilities.

USEPA. 1991. Code of Federal Regulations (CFR) Parts 257 and 258: Solid Waste Disposal Facility Criteria; Final Rule.

USEPA. 1992a. Addendum to Interim Final Guidance Document - Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities.

USEPA. 1992b. RCRA Ground-Water Monitoring: Draft Technical Guidance. Office of Solid Waste, Washington, DC. EPA/530/R-93/001, NTIS PB 93-139350.

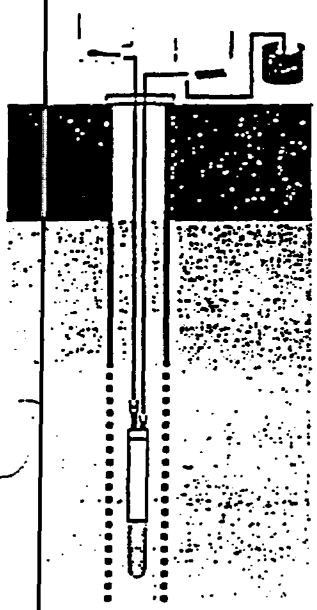
Attachment 1
Dedicated Low-flow Sampling

MICROPURGE

From The Leader in Low-Flow Sampling ▼QED

Low-Flow Sampling Equipment Catalog

LOW-FLOW MICROPURGE EQUIPMENT



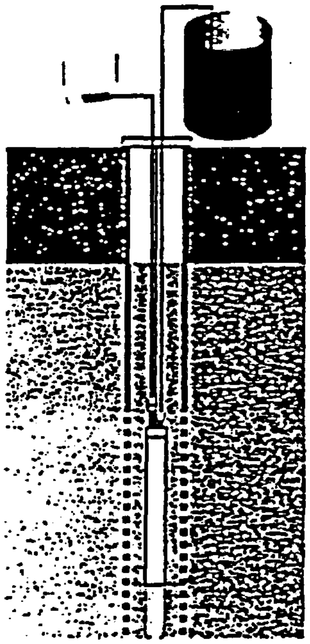
The choice for:
Long-term monitoring (more than 4 events) where low-flow methods are accepted.

Advantages:
- Most precise samples
- Lowest sampling cost
- Lowest purge volume and disposal cost
- No need to filter in most cases

Disadvantages:
- Higher capital equipment cost
- May not be accepted yet

EVERYTHING YOU NEED IS IN THIS CATALOG

CONVENTIONAL DEDICATED SAMPLING



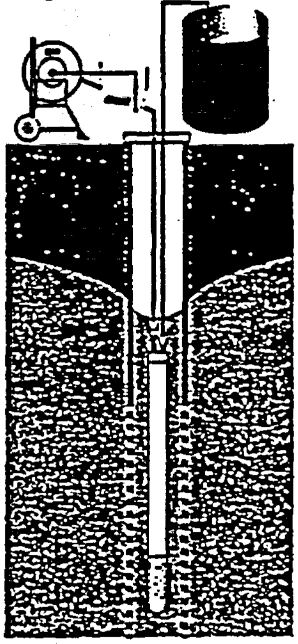
The choice for:
Long-term monitoring (more than 4 events) if purging 3 to 5 well volumes is required.

Advantages:
- Proven, accepted sample quality
- Reduced sampling labor cost
- No decontamination or equipment blanks

Disadvantages:
- Higher purge volume and disposal cost
- Higher labor cost than MicroPurge

See Ground Water Sampling Catalog or www.qedenv.com

SAMPLING WITH PORTABLE EQUIPMENT



The choice for:
Short-term monitoring (less than 4 events) in existing wells if sample quality is acceptable.

Advantages:
- Lower capital equipment cost
- Acceptable quality if performed properly
- Equipment ready off-the-shelf

Disadvantages:
- Higher turbidity
- Expensive decon and equipment blanks
- Contamination danger
- Higher labor cost

See Ground Water Sampling Catalog or www.qedenv.com

WHAT'S INSIDE...

CONTACT ▼QED

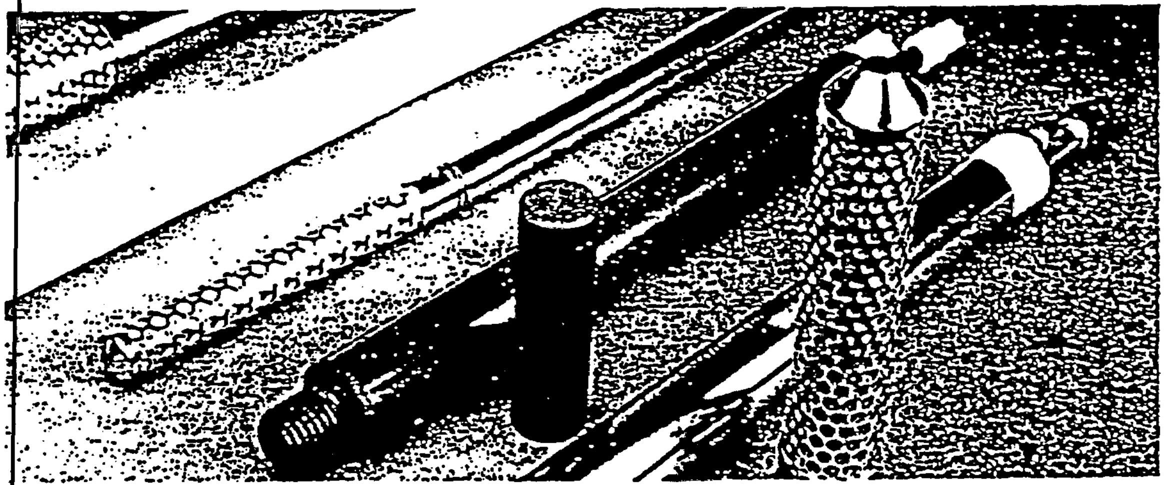
P.O. Box 3726,
Ann Arbor MI 48106
1-800-624-2026
Fax: 313-995-1170
www.micropurge.com
e-mail: info@qedenv.com

1/10

CODE 1295 REV 5-97

MICROPURGE®

Well Wizard® Bladder Pumps: The Low-Flow Sampling Standard



The leaders since 1982 in dedicated pump technology, performance, and support.

The heart of every low-flow ground water monitoring system is the sampling device. For the system to do its job properly, the sampling device must:

- run reliably even at low rates (100 ml/min or less) over a wide range of conditions;
- operate gently without increasing turbidity or altering samples;
- deliver reliable performance for many years without needing frequent repairs or maintenance.

For over 15 years, Well Wizard pumps from QED have been doing all this...at more sites...for more users... then any other system.

The most complete low-flow pump selection

MicroPurge system pumps come in an unsurpassed range of sizes, materials, and capabilities, including models for deep wells, narrow or obstructed casings, and small-volume pumps for -yield wells. Together with MicroPurge controllers, flow cells, and accessories, they create the most reliable, cost-effective low-flow system available.

Field proven pump designs and exclusive, high performance PTFE bladder formulation offer the reliability critical to long-term monitoring. QED was first in the industry with a standard 10-year sampling pump warranty.

Unmatched regulatory and user acceptance

Bladder pumps, EPA-accepted for low-flow sampling, have been shown to deliver superior sample accuracy and precision in dozens of independent studies. Nearly 40,000 Well Wizard bladder pumps are in use — <u>more than all other brands and types of dedicated ground water samplers combined</u>.

Well Wizard Pump Advantages

- EPA-accepted low-flow sampling accuracy.
- Models for every well — low yield, short water column, depths to 1,000 feet, casing I.D. down to 1.25".
- Proven reliability since 1982, with the industry's first standard 10-year warranty.
- Exclusive PTFE bladder formulation rated for years more flex life than other bladder materials.

2

QED Environmental Systems, Inc.

HOW THEY WORK

Well Wizard® Bladder Pumps

Designed for superior low-flow sampling performance

Pneumatic bladder pumps operate with a unique, gentle action ideal for low-flow sampling. Timed on/off cycles of compressed air alternately squeeze the flexible bladder to displace water out of the pump, and release it to allow the pump to refill by submergence, without creating any disturbance that could affect sample chemistry. Bladder pumps run easily at low rates for extended times, without the problems of other devices.

- No overheating of high-speed electric pump motors, which can alter samples and ruin the pumps.
- No churning action, like that of bailers or inertial-lift samplers that increase turbidity.
- No suction to cause degassing of dissolved volatile contaminants.

The bladder prevents contact between the pump drive air and the ample, and the downwell equipment is permanently dedicated to each well, so both samples and the well are protected from disturbance or the danger of cross-well contamination.

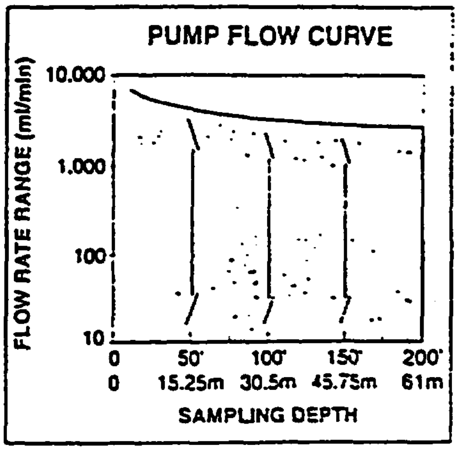
The easiest system to order and use

Well Wizard Bladder Pumps are part of the complete low-flow MicroPurge sampling system engineered for easy installation and use. QED application specialists will help specify the most effective, economical pumps and accessories for your site.

Each pump is cleaned and laboratory-certified to be free of volatile organic compounds, acid extractable and base neutral contaminants. Your system is preassembled, with tubing cut to length, ready to install.

If desired, installation by OSHA-certified field technicians is available. QED customer support — with trained local representatives, 24-hour toll-free hotline, and next-day loaners or service turnaround when needed — backs you with unmatched expertise and service.

More Well Wizard and MicroPurge dedicated sampling systems and pumps have been chosen since 1982 than all other manufacturers' equipment combined. To find out why, call QED today for a Low-Flow Data Sheet and site-specific cost analysis.



This graph shows the extremely wide range of precisely controlled flow rates available from Well Wizard Bladder Pumps and the MicroPurge Model 400 controller. Consult QED for flow rates at greater depths or other special applications.

For up-to-date specifications go to:
www.micropurge.com

MICROPURGE PUMP SPECIFICATIONS

Model No.	Pump Materials	Length	O.D.	Fitting Material	*Tubing Size	Volume (ml)	Max. Lift
T1100M	Teflon	3.3' (1.0 m)	1.66" (4.2 cm)	Teflon	1/4 & 3/8" (6 & 9 mm)	395	250' (75m)
P1101M	PVC	3.4' (1.04 m)	1.66" (4.2 cm)	Polypropylene	1/4 & 3/8" (6 & 9 mm)	395	300' (90m)
P1101HM	PVC	3.3' (1.0 m)	1.66" (4.2 cm)	Stainless Steel	1/4 & 3/8" (6 & 9 mm)	395	600' (180m)
ST1101PM	316 Stainless Steel	3.4' (1.04 m)	1.66" (4.2 cm)	Stainless Steel	1/4 & 3/8" (6 & 9 mm)	395	1.000' (305m)
T1200M	316 S.S. and Teflon	3.4' (1.04 m)	1.50" (3.8 cm)	Stainless Steel	1/4 & 3/8" (6 & 9 mm)	495	300' (90m)
T1250	316 Stainless Steel	1.25' (0.38 m)	1.50" (3.8 cm)	Stainless Steel	1/4 & 1/4" (6 & 6 mm)	100	300' (90m)
P1150	PVC, Teflon	1.63' (0.5 m)	1.66" (4.2 cm)	Polypropylene	1/4 & 1/4" (6 & 6 mm)	130	300' (90m)
T1300	316 S.S. and Teflon	3.8' (1.16 m)	1.00" (2.5 cm)	Stainless Steel	1/4 & 3/8" (6 & 9 mm)	220	300' (90m)

* To choose 1/2" (13 mm) rather than 3/8" (9 mm) discharge tube option, delete suffix M from pump model number.

Intake Screen Specifications

Model No.	Material	Screen Size	Fits Pump Model(s)
35200	Stainless Steel	0.01" (0.25 mm) mesh	T1200, T1250
37789	PVC	.010" (0.25 mm) slot	P1101, P1101H
7727	PVC	.010" (0.25 mm) slot	P1250 (also P1101, P1101H)
733	Teflon	.010" (0.25 mm) slot	T1100

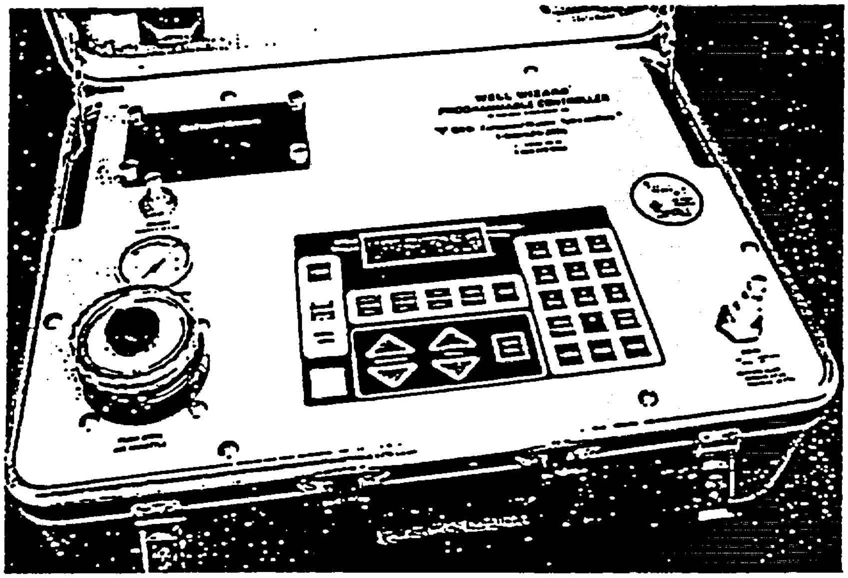
Note: Pump models ST1101P, T1300 include intake screens. Screens are optional on other pump models, but are required for full 10-year warranty coverage.

Materials Specifications

Stainless Steel:	Type 316 electropolished
PVC:	NSF-grade, extruded specifically for QED with no markings or lubricants.
Teflon (pumps):	duPont Teflon® and other premium PTFE resins
Teflon (bladders):	Q-flex exclusive 200.000 cycle rated PTFE.

Teflon is a registered duPont trademark.

MicroPurge® Smart Controller: Programmed Purging and Sampling



Digital controller provides simple, repeatable operation for precision purging and accurate low-flow sampling.

The MicroPurge® Model 400 Controller is the <u>only</u> pneumatic pump controller designed specifically for low-flow sampling.

Precise flow control capable of minimizing rates to 100 ml/min or less is essential. The Model 400 achieves this with instant recall of controller settings and direct, single turn pressure adjustment. The graduated regulator allows exact pressure setting without cycling the controller, preventing sample volume loss in low yield wells.

Saves time in the field

The simple, repeatable operation of the MicroPurge 400 Controller makes low-flow sampling faster and easier, event after event. Exact digital timer display permits rapid optimization.

Consistent purging and accurate, reproducible sampling are assured even with different field personnel, thanks to easy recall of stored settings. The "manual sample" mode simplifies filtration and sampling even more; one button pauses the controller while you ready sample bottles, then starts the pump again for sampling.

Easy to operate and upgrade

Well data entry and controller commands are easy with the alphanumeric keypad and LCD display. Software is on replaceable EEPROM chips to allow for future upgrading.

Take control of your sampling program. Call QED today for a Low-Flow Data Sheet and site-specific cost analysis.

Smart Controller Advantages

- Save field time with simple operation and instant recall of stored control settings for up to 500 wells.
- Depth-graduated pressure regulator allows precise flow rate control for low-flow sampling.
- Easy adjustment and pump optimization with precision cycle times displayed.

4

HOW IT WORKS

MicroPurge® Controller

Proven reliability and performance

The MicroPurge Model 400 Controller regulates the alternating on/off air supply and exhaust cycle (discharge and refill modes) required to operate pneumatic bladder pumps — the EPA-accepted choice for low-flow, minimal draw-down sampling.

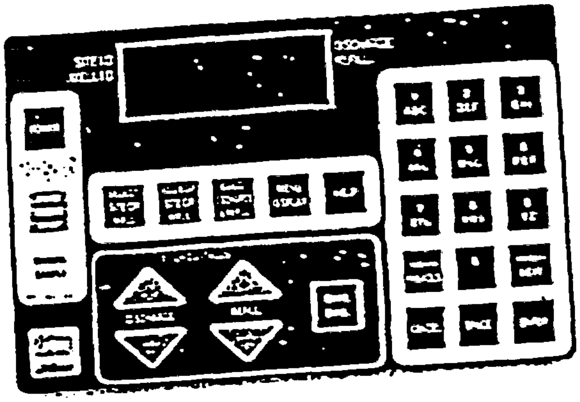
The 400 Controller is the product of QED's 15 years of leadership in the design and manufacture of ground water sampling systems. Its heavy-duty pneumatic valves, proven during years of service in other QED equipment, deliver reliable performance under the toughest field conditions.

The lightweight, self-contained unit comes in a rugged, weather-resistant case. Power is supplied by 8 easy-to-replace AA alkaline batteries; one set of batteries lasts approximately 7 days of 24-hour continuous operation (with 6-second refill and discharge cycles). A digital battery life indicator makes sure you won't run out of power between wells.

As much control as you'll ever need

The Model 400 can be used in basic mode for simple pump operation or with all of its advanced functions.

- Data storage for 500 wells (10 sites x 50 wells each).
- Displays timer settings, refill/discharge mode, well and site I.D.
- Drive air regulator calibrated in PSIG and Feet of Water.
- Single turn control over the entire range (0-120 PSIG, 0-250') — no need to adjust and cycle to observe pressure setting.



The large, user-friendly alphanumeric keypad and LCD display make timer setting and pump control faster and easier.

For up-to-date specifications go to: www.micropurge.com

MICROPURGE CONTROLLER SPECIFICATIONS

Model No.:	400
Overall Dimensions:	18" x 14" x 7.5" (46 x 36 x 19 cm)
Overall Weight:	17 lbs. (7.7 kg)
Case:	Ultra High Molecular Weight Polyethylene (resists shock, oil, fuel, solvent, acid, cold & heat), corrosion resistant hardware.
Keyboard:	29 key membrane
Display:	LCD — 4 lines x 20 characters
Pump Drive Air Throttle:	Single turn analog knob, graduated in PSIG and Feet of Water Pressure
Power:	12 VDC (8 AA alkaline batteries)
Battery Life:	Approx. 7 24-hour days continuous operation (with 6-second refill and discharge cycles)
Software:	Replaceable EEPROM
Memory:	500 well settings (10 sites x 50 wells)
Warranty:	1 year
Max. Pressure:	120 psi
Max. Pump Depth:	250 feet (75 meters)
Operating Environment:	
Temperature:	14 ° to 120 °F (-10 ° to 49 °C)
Storage Temp.:	-4 ° to 158 °F (-20 ° to 70 °C)
Air/Gas Supply:	Compressed air or nitrogen tanks or oilless compressor

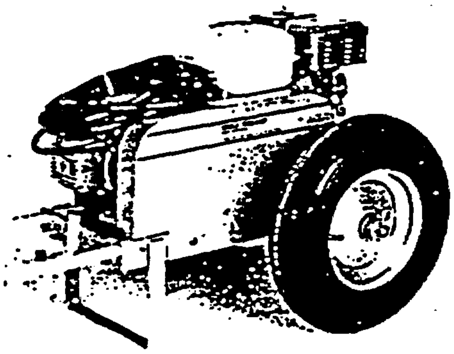
5

QED Compressors and Controllers: Compact, Self-Contained Power

Your choice of gasoline or electric powered compressors and electronic or pneumatic controllers makes sampling easier.

To get a portable, reliable air source that's right for your site, choose one of our proven gasoline-powered or electric compressors along with an electronic or pneumatic controller.

Well Wizard® pneumatic controllers are also compatible with bottled compressed gas, for use in high pressure, deep well sampling applications or at other sites where appropriate.



Gasoline-powered air supply

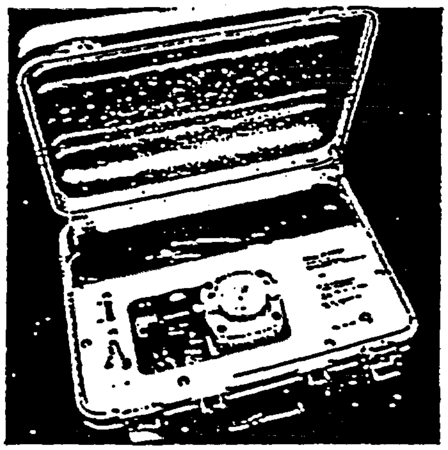
The 41000 Series gasoline engine-driven compressors provide dependable performance on a rugged cart that goes anywhere.

Standard 100 psi and high-pressure 165 psi versions come with clean-running 4-cycle Honda industrial/commercial engines — no sloppy oil/gas mixing.

Operating on regular unleaded gasoline, QED compressor engine choices meet California exhaust emission standards.

The whole assembly is mounted on a strong, lightweight cart engineered for easy portability and long lasting service in the field.

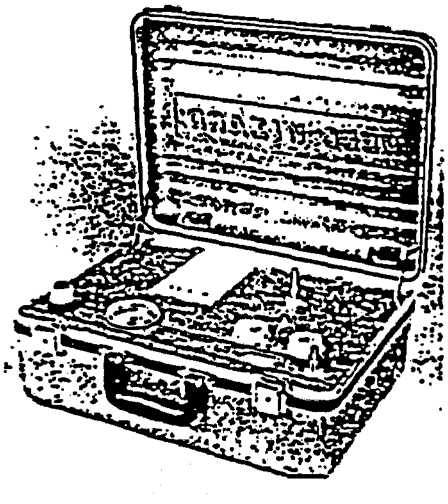
Compact electric air source



Model 3020 electric compressors provide 100 psi output ideal for MicroPurge equipment use in a convenient, portable package now only 15 x 11 x 6.5" and 15 pounds. Just connect the supplied cables to your 12 VDC truck or car battery.

Air flow is sufficient for low-flow sampling to depths as great as 200 feet, or conventional sample pump operation to 75 feet.

Reliable controllers and compressor/controller carts



In addition to MicroPurge Model 400 electronic controllers (pp. 6-7), QED makes Well Wizard 3013 Series pneumatic controllers. Fully adjustable units can operate high rate purge pumps, yet be throttled back to deliver precise EPA-recommended low flow rates for sampling.

All models are compatible with a wide range of gas sources; high pressure models allow maximum lifts to 1,000 feet with bottled high-pressure compressed gas.

3111 Series compressor/controller carts combine a pneumatic 3013 controller with a 41000 series compressor cart. Self-contained, one-person portability, fast setup, and unattended operation reduce sampling labor.

All QED systems come complete — no extra charges for hoses or other necessary equipment.

QED Air Source Advantages

- Engineered for one-person portability — in a pick-up truck or on foot.
- Proven reliability under the toughest field conditions since 1982.
- Oilless compressors with 4-cycle engines — no oily smoke, maximum protection against contamination.
- Precision sampling pump control over an unsurpassed range of depths (to 1,000 feet).

6

Compressors and Controllers

Heavy-duty compressors for workhorse performance

QED has engineered our gasoline-powered compressors for long-lasting, reliable performance. Oversized compressors have heavier-than-standard castings for better heat dissipation in rugged field duty. Opposable pistons minimize noise, vibration, and wear. A heavy-duty belt guard protects personnel.

Engines are 4-cycle Honda industrial/commercial models, for first-pull starting every time. They run on regular unleaded gasoline, with no oil mixing and no "blue smoke" problems.

The tough, compact Model 3020 electric compressor — now 40% smaller and lighter in weight — provides dependable 100 psi output anywhere you can hook it up to a 12 VDC car or truck battery. It comes complete and ready to use with air hose coupling and battery cable in a durable hardshell case.

All QED air sources are supplied with low-maintenance filter modules to remove particulates and contaminants that may be present in the site air, plus moisture knockout vents to keep water out of the pump air supply.

Simple, rugged pneumatic controllers

All-pneumatic Well Wizard controllers have no batteries to recharge or replace — if you've got air pressure, they've got power. QED's third-generation pneumatic logic provides precise, controlled on/off cycles to power sampling pumps at any flow rate, with inherent shock and moisture resistance to withstand harsh field conditions.

Their toughness is legendary — Well Wizard controllers have survived being left out in storms, dropping from trucks, even having their lids ripped off — without missing a single pump cycle.

Carts that keep rolling

The ideal platform for a trouble-free air source is a rugged, field-proven QED cart.

High-flotation tires allow true one-person portability over rough terrain, even in heavy mud or snow. The cart platform is built with underside bracing to provide improved rigidity and increased life. Engine/compressor stabilization minimizes competing vibration to reduce wear and tear on all components.

Specially engineered handle (and wheels, if necessary) disassemble quickly and easily without tools for transport and handling. A new lifting handle makes the whole assembly more convenient to move in and out of vehicles.

Don't be fooled by so-called "equivalent" products. Years of field-testing and engineering improvements make QED carts and air sources the most practical, dependable units you can find.

AIR SOURCE SPECIFICATIONS

Compressor and Compressor/Controller Cart Specifications

Model No.	Maximum Pressure	Max. Lift (Internal)	Max. Lift (External)	Output (at listed pressure)	Dimensions (LxWxH)	Weight
41000LR*	100 psi (690 kPa)	200' (61 m)	—	4.3 SCFM @ 100 psi (7.3 m^3/h @ 690 kPa)	49.5 x 25.5 x 21.5" (126 x 65 x 55 cm)	87 lbs. (40 kg)
3111LR†	100 psi (690 kPa)	200' (61 m)	250' (76 m)	4.3 SCFM @ 100 psi (7.3 m^3/h @ 690 kPa)	49.5 x 25.5 x 21.5" (126 x 65 x 55 cm)	111 lbs. (50 kg)
3111LH††	165 psi (1138 kPa)	320' (97.5 m)	600' (183 m)	2.2 SCFM @ 100 psi (3.74 m^3/h @ 690 kPa) 2.1 SCFM @ 165 psi (3.57 m^3/h @ 1138 kPa)	49.5 x 25.5 x 21.5" (126 x 65 x 55 cm)	115 lbs. (52 kg)
3020	100 psi (690 kPa)	#200' (61 m)	—	0.21 SCFM @ 100 psi (0.357 m^3/h @ 690 kPa)	15 x 11 x 6.5" (38 x 28 x 17 cm)	15 lbs. (7 kg)

* Includes cart

† Includes cart and 3013 Controller

†† Includes cart and 3013H Controller

\# Maximum lift for MicroPurge low-flow equipment applications; for conventional sampling, maximum lift = 75 feet (23 m)

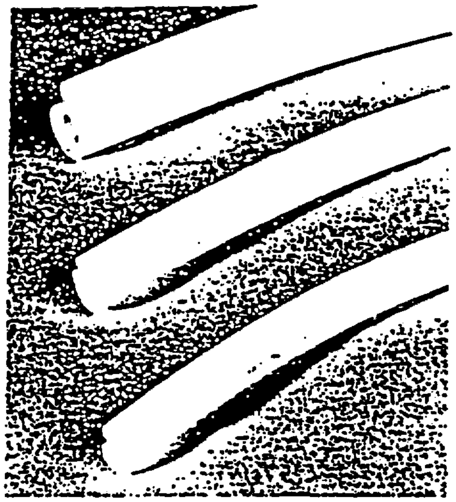
Pneumatic Controller Specifications

Model No.	Maximum Pressure	Maximum Lift	Dimensions (LxWxH)	Weight
3013	125 psi (862 kPa)	250' (76 m)	18 x 14 x 7.5" (46 x 36 x 19 cm)	22 lbs. (10 kg)
3013H	300 psi (2070 kPa)	600' (183 m)	18 x 14 x 7.5" (46 x 36 x 19 cm)	26 lbs. (12 kg)
3013UH	500 psi (3448 kPa)	1000' (305 m)	18 x 14 x 7.5" (46 x 36 x 19 cm)	32 lbs. (15 kg)

Note: For Model 400 Electronic Controller specifications, see page 7.

Sample Pump Tubing

Innovative, problem-solving tubing in the widest range of materials and sizes.



The last thing your sample contacts before collection is the sample tubing; this demands the highest standards in tubing quality. QED tubing innovations protect your sample integrity while making system installation and operation easier and more economical.

Twin-line simplicity

Our standard twin-line air supply/sample discharge tubing has a continuous heat-welded bond. It costs a little more than loose or cable-tied tubing, but users report several major benefits. It saves time and hassle by preventing tangles or hangups during pump installation and maintenance, and avoids entanglement with portable water level meters or other equipment.

Tubing assemblies are cut to exact length and pre-assembled to well cap and pump per customer specifications at no extra cost. QED also stocks the largest variety of discharge adapters, elbows, and couplers — what you'd expect from the leading supplier of ground water sampling equipment.

Quality materials and samples

All tubing is controlled quality, virgin grade material that passes QED's rigorous standards — the toughest in the industry. Economical Teflon-lined polyethylene tubing the most frequently used, with Teflon on the inside of the sample tubing, where it's really needed.

Other material choices include all-Teflon, polyethylene, and polypropylene (for deep-well use).

QED also stocks bulk tubing and many other sizes and materials; inquire for details.

QED Tubing Advantages

- Twin-line bonded tubing without the hassles of cable ties or loose tubing.
- Custom cutting and assembly — systems are pre-assembled, leak-tested, and poly-bagged for easier installation with no leftover tubing.
- Highest quality materials — 100% virgin grade, extruded in USA with US manufactured resins, with no regrind, printing, additives, or mold release agents.
- True continuous lengths — no unexpected joins or couplings.
- Convenient discharge options — MicroPurge discharge adapters or Teflon or polypropylene elbows allow easy sampling without bending, kinking, or sample alteration.

SAMPLE TUBING SPECIFICATIONS

Model No.	Material	Air Supply O.D.	Discharge O.D.	Maximum Pressure	Maximum Depth	Min. Bend Radius
P5000	Polyethylene	1/4" (6 mm)	3/8" (9 mm)	300 psi (2070 kPa)	600' (183 m)	1.25" (3 cm)
PT5000	Teflon-lined PE	1/4" (6 mm)	3/8" (9 mm)	300 psi (2070 kPa)	600' (183 m)	1.25" (3 cm)
T5010	Teflon	1/4" (6 mm)	3/8" (9 mm)	300 psi (2070 kPa)	600' (183 m)	2.5" (6 cm)
PR5010	Polypropylene	1/4" (6 mm)	3/8" (9 mm)	300 psi (2070 kPa)	600' (183 m)	1.25" (3 cm)
P5100	Polyethylene	1/4" (6 mm)	1/2" (13 mm)	200 psi (1380 kPa)	400' (122 m)	2.5" (6 cm)
PT5100	Teflon-lined PE	1/4" (6 mm)	1/2" (13 mm)	200 psi (1380 kPa)	400' (122 m)	2.5" (6 cm)
T5110	Teflon	1/4" (6 mm)	1/2" (13 mm)	240 psi (1650 kPa)	500' (153 m)	3.0" (7.5 cm)
PR5100	Polypropylene	1/4" (6 mm)	1/2" (13 mm)	300 psi (2070 kPa)	600' (183 m)	2.5" (6 cm)
P5200	Polyethylene	1/4" (6 mm)	1/4" (6 mm)	300 psi (2070 kPa)	600' (183 m)	1.0" (2.5 cm)
PT5200	Teflon-lined PE	1/4" (6 mm)	1/4" (6 mm)	300 psi (2070 kPa)	600' (183 m)	1.0" (2.5 cm)
T5200	Teflon	1/4" (6 mm)	1/4" (6 mm)	300 psi (2070 kPa)	600' (183 m)	1.0" (2.5 cm)

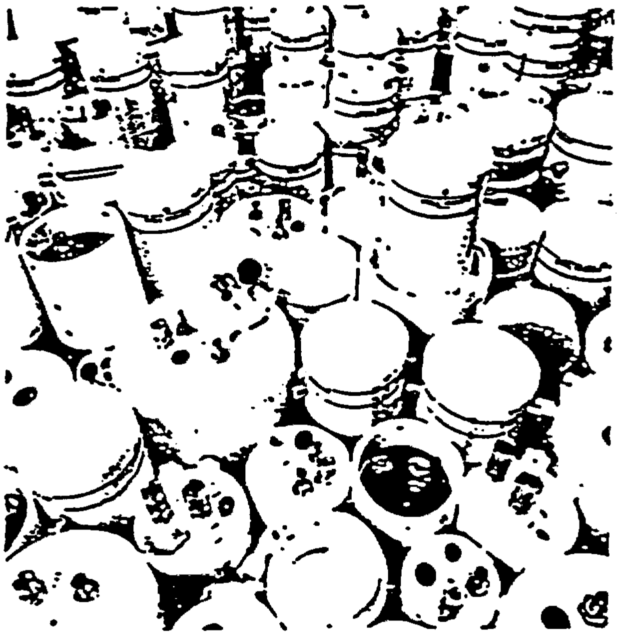
Note: Polypropylene tubing is cable-tied, not heat-bonded.

Tubing I.D. is as follows: 1/4" (6 mm) O.D. = 0.17" (4.3 mm) I.D.; 3/8" (9 mm) O.D. = 0.25" (6 mm) I.D.; 1/2" (13 mm) O.D. = 0.375" (9 mm) I.D.

8

Well Cap Assemblies

Standard and custom caps make every well easier to sample.



A cap that really fits the wellhead, with properly designed fittings for ready access, can make the difference between easy installation and sampling or problems requiring on-site modification.

We'll fit your well, no matter what it takes

Since 1982, QED has developed the industry's broadest range of sampling system well caps, engineered for secure hardware attachment and well protection. Our large stock of standard, locking, and/or sealing caps will fit most wells off the shelf, but we've also supplied thousands of customized designs — with rapid, responsive service to complete even the largest installations on time.

Standard non-locking PVC cap assemblies with brass and polypropylene fittings deliver space-saving performance where wells are installed in an outer protective casing.

Special requirements are no problem

Flooding... contaminants... extra equipment... non-standard casing... security concerns... no room at the wellhead... special fittings for gas monitoring... we handle these situations, and more, before they become problems.

Protected caps have PVC bodies with locking covers, available for wells from 1.25" to 8" diameter. Threaded models and special purpose caps are also available.

Ultra-low clearance, watertight caps are one of our most frequently used specialties, solving problems for well completions below grade in parking lots or other critical areas. Sealing caps and special discharge options are essential to protect well heads subject to flooding.

QED Well Cap Advantages

- Machined for easy installation and removal — even standard caps are lathe-turned to prepare the I.D. for a smooth fit with no jamming.
- Large stock of caps for most MicroPurge and conventional sampling system applications.
- Low clearance caps for tight quarters at the wellhead.
- Watertight caps protect wells with below-grade closures.
- Numerous configurations allow the widest range of auxiliary equipment and discharge options.
- Custom caps with quick turn-around — to match your well casing, closure, and downwell equipment needs on schedule.

WELL CAP SPECIFICATIONS

Cap Configuration	*Sample Pump	†Sample & Purge Pumps
Standard Cap Sizes	2", 4", 5", 6" (5,10, 12.5, 15 cm)	2", 4", 5", 6" (5, 10, 12.5, 15 cm)
Locking/Sealing Cap Sizes	2", 4" (5 cm, 10 cm)	4" (10 cm)
Low Clearance Cap Sizes	2", 4" (5 cm, 10 cm)	4" (10 cm)
Low Clearance Locking Cap Sizes	2", 4" (5 cm, 10 cm)	— —

* Tube fitting sizes available: 1/4" & 1/4" (6 & 6 mm); 1/4" & 3/8" (6 & 9 mm); 1/4" & 1/2" (6 & 13 mm)

† Tube fitting sizes: 1/4" & 1/2" (6 & 13 mm) plus 1/2" & 3/4" (13 & 19 mm)

Cap Options

MicroPurge Flexible Discharge Adapters

High Pressure Cap Adapter (fitting compatible with high pressure controller air supply hose).

High Pressure to Standard Adapter (adapts high pressure controller air supply hose to fit standard cap fittings).

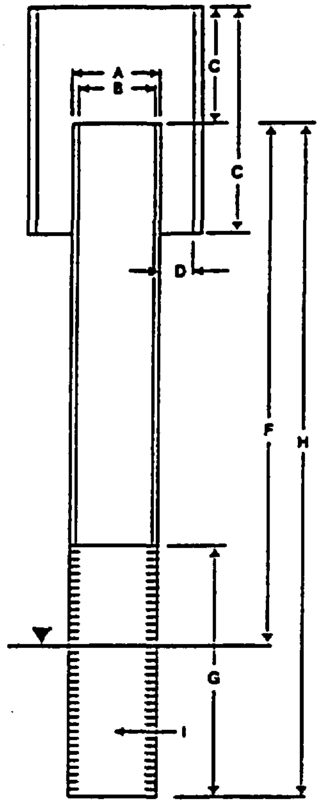
Ultra High Pressure Cap Adapter (fitting compatible with ultra high pressure controller air supply hose).

Marine Quality Padlocks (keyed alike).

All standard caps are ready for use with Purge Mizer packers.

9

Copy this and fax to: QED *Environmental Systems, Inc.* **Fax Number: 313-995-1170**



Sampling System Design Data

Site: ____________________

Location: ____________________

Date: __________ Well Purge Volumes Required: __________

☐ MicroPurge low-flow sampling system required

Sampling Parameters (Metals, Low Level Organics, etc.): __________

Well Bottom to Pump Intake Distance: __________

Casing Material: ____________________

Pump Material Preference: ____________________

Pump Tubing Material Preference: ____________________

Optional Cost Analysis Information

Current Sampling Method: __________

Frequency of Events (Quarterly, Yearly, etc.): __________

No. of Persons in Sampling Crew: __________

Man Hours to Purge, Sample and Clean: __________

Hourly Labor Rate Assumed: __________

No. of Cleaning Banks per Event: __________ Blank Cost: __________

Standard Casing Dimensions:

ominal Pipe izes (inches)	Schedule 40 O.D.	Schedule 40 I.D.	Schedule 80 O.D.	Schedule 80 I.D.
2	2.375	2.049	2.375	1.913
2 1/2	2.875	2.445	2.875	2.289
3	3.500	3.042	3.500	2.846
3 1/2	4.000	3.520	4.000	3.326
4	4.500	3.998	4.500	3.786
5	5.563	5.017	5.563	4.767
6	6.625	6.031	6.625	5.709

WELL I.D. NUMBER

A. Well Casing Diameter — O.D.						
B. Well Casing Diameter — I.D.						
C. Clearance from Top of Well Casing to Top of Outer Casing/Vault						
D. Clearance of Outer Casing/ Vault to Well Casing						
E. Outer Casing/Vault Depth						
F. Depth to Top of Static Water						
G. Screen Length						
H. Depth of Well						
Water Yield (G.P.M.)						

QED **1-800-624-2026** **www.micropurge.com**

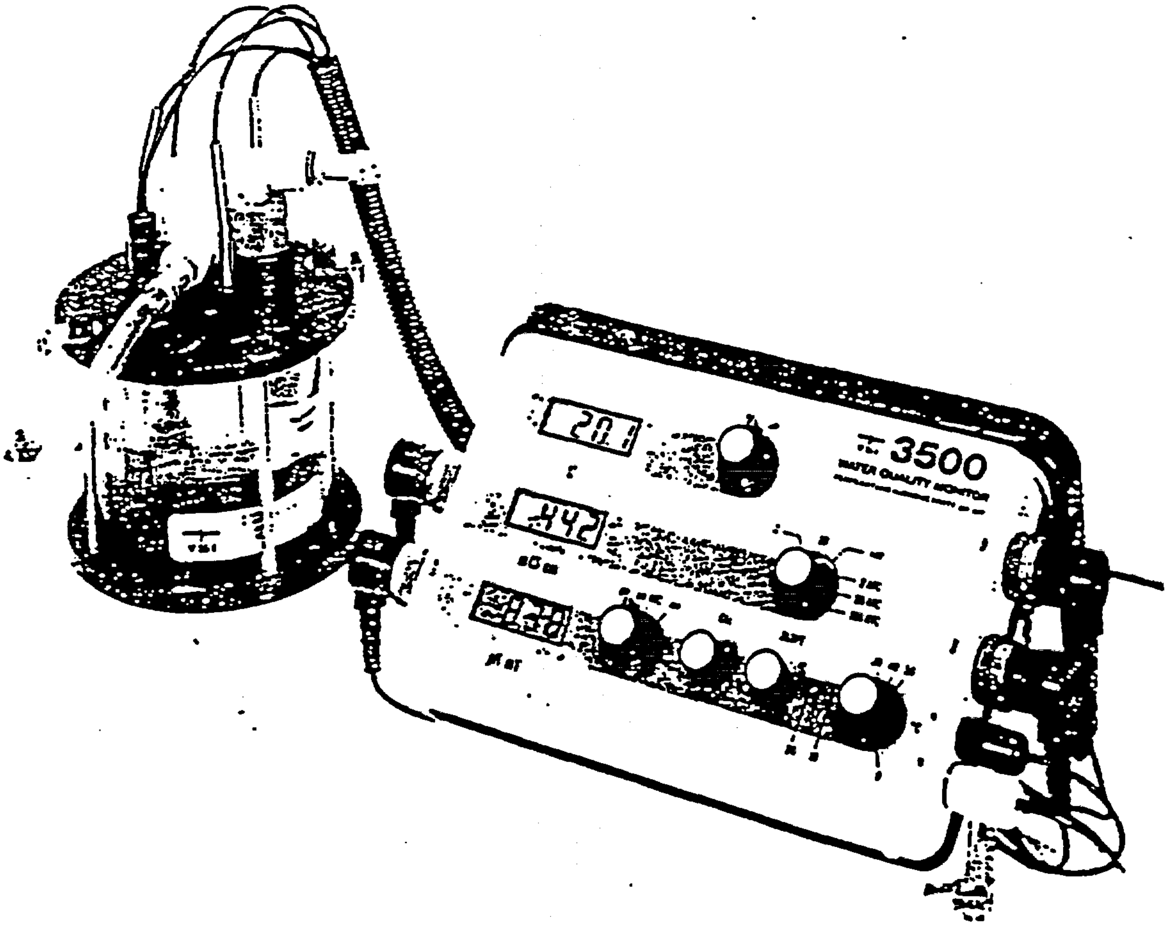
CODE 1295 REV 5-97

10/C

Attachment 2
Field Equipment Operation/Specifications

YSI Model 3560 Water Quality Monitoring System

YSI MODEL 3560
WATER QUALITY MONITORING SYSTEM
INSTRUCTIONS



YSI Incorporated
Yellow Springs Instrument Co., Inc., Yellow Springs, Ohio 45387 USA • Phone 513 767-7241 • 800 343 HELP • Fax 513 767-9353 • Telex 205437

Price $10.00 2

TABLE OF CONTENTS

GENERAL DESCRIPTION

OPERATION

MAINTENANCE

Calibration

3

GENERAL DESCRIPTION

The YSI 3560 Water Quality Monitoring System

The rugged YSI 3560 Water Quality Monitoring System is primarily designed to be used in the field with a well or surface water pump, but use with a bailer, in the laboratory, or the like, is also possible. The 3560 system consists of a YSI 3500 Water Quality Monitor, a YSI 3510 Temperature Probe, a YSI 3520 Flow-Through Conductivity Cell, a YSI 3530 pH Electrode, a YSI 3550 Sample Chamber Assembly, a YSI 3565 Sample Cup Pack and assorted fittings. Other components, described below, are available as optional accessories.

As water is pumped through the system, temperature, conductivity, temperature compensated conductivity, pH, temperature compensated pH, and millivolts can all be measured. It is possible to make stable readings of the fluids running through the sample chamber in as little as two minutes. The constant monitoring of these values will help determine when a representative sample of the aquifer has been obtained. The system is designed for simple assembly and disassembly to facilitate frequent sensor calibration and easy cleaning.

The YSI Model 3500 Water Quality Monitor

The YSI 3500 Water Quality Monitor is an integral part of the 3560 system. This instrument allows the user to visually monitor three parameters simultaneously by means of three 1/2" LCD displays. The recorder output allows simultaneous recording of four parameters. The monitor is housed in a yellow molded ABS plastic case which has been tested to military specifications for shock and vibration. The 3500 uses 6 alkaline D cells which will power it for a minimum of 1400 hours. When BAT is shown on any of the displays, it is time for battery replacement.

An on/off switch controls power to the instrument. A second function switch controls each of the three ranges of conductivity and automatically temperature compensated conductivity as indicated on the middle display. The displayed values are read out in millimho/cm (mΩ/cm). When a temperature probe is attached, temperature is read out constantly in °C on the top display and temperature compensated conductivity can be measured, automatically corrected to 25°C. This correction uses a temperature coefficient recommended in "Official Methods of Analysis of the Association of Official Analytical Chemists", Ed. Sidney Williams, 14th edition, 1984, Arlington, Va. This temperature coefficient of 2%/°C is calculated by the formula:

$$\text{Compensated Conductivity} = \frac{\text{Uncompensated Conductivity}}{[(P/4\%)(0.04T-1)]+1}$$

T = temperature in °C
P = temperature coefficient in %

A third function switch controls the bottom display which shows manually temperature compensated pH, or automatically temperature compensated pH, in either pH units or in millivolts (mV). Both of the temperature compensated pH functions use a temperature coefficient of .335%/°C. The mV function is designed to work with optional electrodes such as the YSI 3540 ORP Electrode. It may be used with most ion specific electrodes that meet the 3500 input specifications.

The YSI Model 3510 Temperature Probe

The YSI 3510 Temperature Probe can be used as either a Temperature/ATC Conductivity Probe or as a pH ATC Probe when attached appropriately to the YSI 3500 Water Quality Monitor. It is usable over a temperature range of -5 to 50°C with an accuracy of ±.2°C. The polyurethane cable is three feet long and is terminated at one end with a watertight MS connector. A YSI Thermilinear® thermistor is mounted in a stainless steel sheath.

The YSI Model 3520 Flow-Through Conductivity Cell

The YSI 3520 Flow-Through Conductivity Cell is an integral conductivity cell of rigid and durable chlorinated polyvinyl chloride (CPVC). A three foot polyurethane jacketed cable is attached to the cell body with a bend relief. A watertight MS type connector terminates the cable.

Two electrodes measure conductivity. The cell response time is 10 seconds for 95% reading of conductivity changes. Accurate measurements can be made with a flow rate up to 1.5 gallons per minute. The conductivity cell constant is K = 5.0/cm.

The YSI Model 3530 pH Electrode Assembly

The YSI 3530 pH Electrode Assembly has been designed for YSI for use with the YSI 3560 Water Quality Monitoring System, but it may be used equally well with other pH measuring systems that have similar specification requirements. The 3530 has a rugged 5.5 inch long polymer body designed to withstand demanding field and laboratory use. The silver/silver chloride reference electrode and silver working electrode are sealed in a 4 molar potassium chloride gel to eliminate the need to add filling solution; a porous Teflon® junction is used to maximize electrode life. The 3530 comes with a 36 inch long cable, a black BNC cover and a black end cap for easy visual distinction. The unit is shipped in a soaker bottle containing pH 4.0 buffer. It is important that the electrode be immersed in the buffer solution to prevent the electrode from drying out in storage or transport.

The YSI Model 3540 ORP Electrode Assembly

The YSI 3540 ORP Electrode Assembly has been designed for YSI for use with the YSI 3560 Water Quality Monitoring System, but it may be used equally as well with other ORP measuring systems that have similar specification requirements. The 3540 has a rugged 5.5 inch long polymer body designed to withstand demanding field and laboratory use. The silver/silver chloride reference electrode and platinum working electrode are sealed in a 4 molar potassium chloride gel to eliminate the need to add filling solution; a porous Teflon Circle R junction is used to maximize electrode life. The 3540 comes with a 36 inch long black cable, a yellow BNC cover and a yellow end cap for easy visual distinction.

The electrode assembly is shipped in a soaker bottle containing pH 4.0 buffer. It is important that the electrode be immersed in the buffer solution to prevent the electrode from drying out in storage or transport.

4

The YSI Model 3682 Zobell Solution

This is a reference solution used to verify the performance characteristics of redox potential cells such as the YSI 3540 ORP Electrode Assembly.

The YSI Model 3550 Sample Chamber Assembly

The YSI 3550 Sample Chamber Assembly is an integral part of the YSI 3560 Water Quality Monitoring System. It is designed to be attached to a pump outlet but can be used equally well as a non-flowing sample chamber. It is designed to hold up to five sensors and to provide inlet and outlet ports for fluid movement through the chamber. It provides good mixing of fluids so residual sample will not be a problem. The clear acrylic sides of the chamber permits observation of fluid flow.

Two gaskets keep fluids from leaking around the sensor mounting plate and base assemblies, while two o-rings in each of the sensor ports provide excellent seals. The sensor mounting plate is permanently marked to indicate the location of each sensor. This sample chamber holds approximately one liter. See Figure 1.

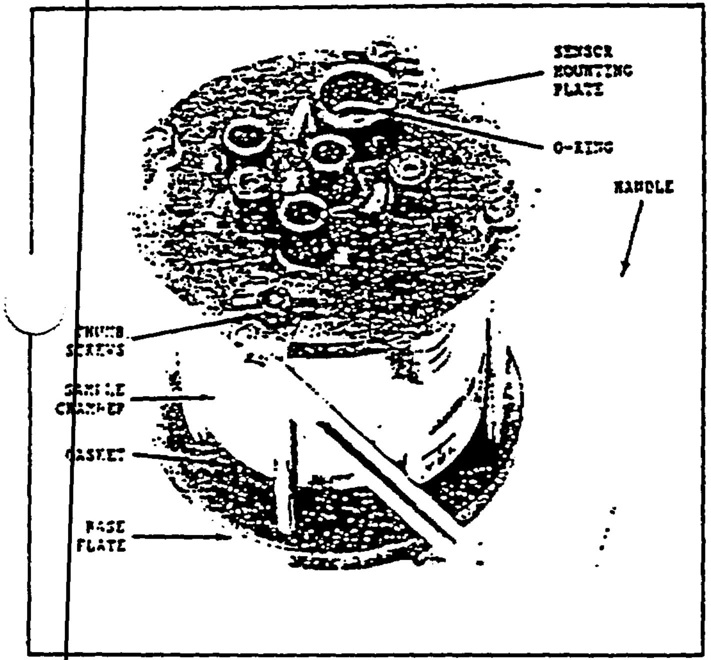


Figure 1. The YSI Model 3550 Sample Chamber Assembly

The YSI Model 3555 Sample Chamber Maintenance Kit

The YSI Model 3555 Sample Chamber Maintenance Kit is designed to provide all the o-rings, gaskets and tools necessary to perform the prescribed annual maintenance on the 3550 Sample Chamber Assembly.

The YSI Model 3565 Sample Cup Pack

The YSI Model 3565 Sample Cup Pack consists of five boxes of 100 each 50 ml polypropylene sample cups. Each box comes with velcro strips for easy installation to most surfaces. The 50 ml size is ideal for use with the 3560 system to minimize the consumption of buffers and standards used in routine calibration procedures.

The YSI Model 3570 Recorder Interface Cable

The YSI 3570 Recorder Interface Cable Assembly has four leads and a common conductor, terminated with a PVC molded connector. The 1/4 inch diameter, 10 foot long polyurethane jacketed cable provides the interface between the YSI Model 3500 Water Quality Monitor and whatever data logging or data recording device is in use. The watertight MS connector is pinned out as follows:

Pin A - Green Conductor - mV
Pin B - White Conductor - pH
Pin C - Gray Conductor - Common
Pin D - Red Conductor - m℧/cm
Pin E - Black Conductor - °C

The YSI Model 3580 Carrying Case

The YSI Model 3580 Carrying Case is constructed of yellow polyethylene outer shells and has a yellow ABS insert which holds the 3560 system in place for carrying and provides a convenient working platform for the system in use. All metal parts are either plated or anodized to resist corrosion in the harshest environments. Two stays and a continuous hinge give the case rugged strength and durability. Two locks assure that it will stay closed in transit; tie-down straps keep the components secure from movement or damage. Up to four bottles of calibrator solutions can be put into the cavity in the lid for easy access and safe storage away from the instrument. A recess in the lid of the case is provided for convenient mounting of a 3565 Sample Cup Pack box.

5

YSTEM SPECIFICATIONS

he time needed for the system to come to equilibrium ith the sample under test will very with sample flow haracteristics. It could be two minutes or longer.

emperature Measurement (using YSI 3500 and 3510)
easurement range: -5.0 to 50.0°C.
ccuracy of temperature measurements: ±0.4°C
esolution: 0.1°C
esponse Time: 95% of reading in 10 seconds

onductivity Measurement (using YSI 3500, 3510 and 3520)
anges: 0.0 to 2.000 m℧/cm conductivity
0.0 to 20.00 m℧/cm conductivity
0.0 to 100.0 m℧/cm conductivity
0.0 to 2.000 m℧/cm conductivity ATC to 25°C
0.0 to 20.00 m℧/cm conductivity ATC to 25°C
0.0 to 100.0 m℧/cm conductivity ATC to 25°C

ccuracy of conductivity and ATC conductivity easurements:
t 25°C: ±3% of full scale from 0 to 20.00 m℧/cm,
and ±6% of full scale from 20.00 to 50.0 m℧/cm,
with cell electrodes not platinized

When the cell is platinized using YSI 3140 Platinizing Solution and YSI 3045 Platinizing Instrument an accuracy of ±6% of full scale from 50.0 to 100.0 m℧/cm, can be achieved.

emperature compensated conductivity is automatically orrected to 25°C with a temperature coefficient of %/°C

esolution: 0.001 m℧/cm for 0.0 to 2.000 m℧/cm range
0.01 m℧/cm for 0.0 to 20.00 m℧/cm range
0.1 m℧/cm for 0.0 to 100.0 m℧/cm range

esponse Time:95% of reading in 10 seconds

H Measurement (using YSI 3500, 3510 and 3530):
Range: 0 - 14.00 pH units
Accuracy: Subject to calibration using available pH buffer solutions in measurement range
Resolution: 0.01 pH
Response Time: 95% of reading in 10 seconds
Temperature Compensation: Automatic: -5 to 50°C
Manual: ±1°C from 0 to 50°C
Sample Temperature: -5 to 50°C

V Measurement (using YSI 3500)
Range: -1500 mV to +1500 mV
Accuracy: ±1% of reading, plus 1 count
Resolution: 1 mV

nstrument (YSI 3500)
Monitor Size: 8.3 x 11.8 x 4.1 inches
(21.1 x 30.0 x 10.4 centimeters)
Weight: 5.5 pounds (2.5 kilograms)
Ambient Operating Temperature Range: -20 to 50°C
Humidity: operates in 10 to 90% RH, non-condensing at 25°C
Shock and Vibration: conforms to MIL-T-28800-C, Class 3, Style A
EMI: conforms to FCC (47CFT, Part 15, Subpart J), Class A & B
Recorder Output: 4 channels simultaneous (°C, m℧/cm, pH, mV)
Sensitivity: 1 mV = 1 count on display
Accuracy: ±10 counts of display
50 K ohm minimum load impedance
Conductivity ATC output = uncompensated conductivity output
Calibrated with 50 K ohm load resistor

Power Supply: Batteries: 6 alkaline D cells
Life: At 1 micromho/cm, 25°C, 8 hr. per day, 700 hours minimum, 1,000 hours typical

Carrying Case (YSI 3580) (not included with system)
Size: 8.5 x 24.0 x 14.9 inches
(21.6 x 61.7 x 37.8 centimeters)
Weight: 11.0 pounds (5.0 kilograms)

ACCESSORIES

3500	Water Quality Monitor
3510	Temperature Probe (also used for Conductivity ATC, and pH ATC)
3520	Flow-Through Conductivity Cell
3530	pH Electrode Assembly
3540	ORP Electrode Assembly (Redox Potential)
3550	Sample Chamber Assembly
3555	Sample Chamber Maintenance Kit
3565	Sample Cup Pack (500 each)
3570	Recorder Interface Cable Assembly
3580	Carrying Case
3682	Zobell Solution (ORP Calibrator Solution)
3167	Conductivity Solution, nom. 1.0 m℧/cm, field use
3168	Conductivity Solution, nom. 10.0 m℧/cm, field use
3169	Conductivity Solution, nom. 50.0 m℧/cm, field use
3045	Platinizing Instrument
3140	Platinizing Solution

Accessories may be purchased through your YSI dealer.

OPERATION

Pump Hook-Up

The YSI 3560 Water Quality Monitoring System is shipped unassembled and must be assembled before use. The system may be connected to the pump outlet at any time during the purging-pumping process as long as the flow rate does not exceed 1.5 gallons per minute. The system is normally connected prior to starting the pump so that constant parameter monitoring may be achieved and the point for logging the representative sample values can be determined. Because of sample chamber construction, it is very important that a 1.5 gallons per minute sample flow not be exceeded; otherwise, leakage may occur.

The outlet from the pump must first be prepared for the sample chamber input. Inlet and outlet lines for the 3550 are cut to the length desired from the ten foot long plastic tubing supplied. Insert a tube-hose stem adapter into each end of the inlet tubing. This section connects the pump outlet to the sample chamber inlet. Insert a third tube-hose stem adapter into one end of the outlet tubing. This goes from the sample chamber to a waste container.

6

Next. the 3550 is connected to a 1/2" or 3/8" OD pump outlet by using the appropriate straight union connector supplied. For a 1/2" OD pump outlet, use the straight-union connector with two 1/2" ID ports. For /8" OD pump outlet, use the straight-union co or which has one 3/8" ID port and one 1/2" ID Hand-tighten the appropriate port of the straight connector at the pump outlet. Insert one end of the previously constructed sample chamber inlet tubing into the opposite port of the straight union connector and hand tighten it (see Figure 2).

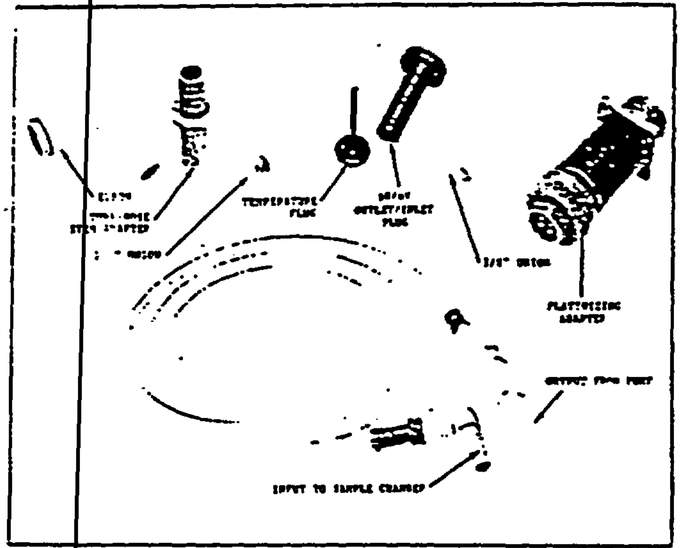


Figure 2. Plumbing Components and Platinizing Adapter

Insert the other end of the constructed inlet tubing into an elbow until it stops. Then insert the elbow into the top of the YSI 3520 Flow-Through Conductivity Cell and push down until it stops. Two internal o-rings in the cell serve as water seals.

The constructed end of the outlet tubing with the inserted tube-hose stem adapter is then pushed into another elbow until it stops. Then the elbow is inserted into the outlet port of the sensor mounting plate and pushed down until it stops. There is a double o-ring seal here too.

Install the sensors that will be used into the sensor mounting plate in their respective ports. The sensor ports not in use must have plugs installed to close off the system. Attach each of the sensors to the 3500. The input jacks are marked for proper placement of each connector. The temperature, conductivity, pH ATC probe inputs, and the recorder output have MS connectors. The pH and ORP electrodes come with BNC connectors which have very low water integrity and so should have their "boots" installed over their connectors. The color coding on the boots also helps identify them when they are in the cable harness. With the sensors attached to the 3500, place all the cables from the sample chamber into the black cable harness provided with the 3560 system. The harness is slotted for easy installation. The system is now ready for operation. (See Figure 3.)

With the system connected to the pump, begin pumping according to the pump manufacturer's instructions. Turn on the 3500. Before recording any values, make sure the sample chamber is full, that all air is voided, and that all of the displayed values are stable.

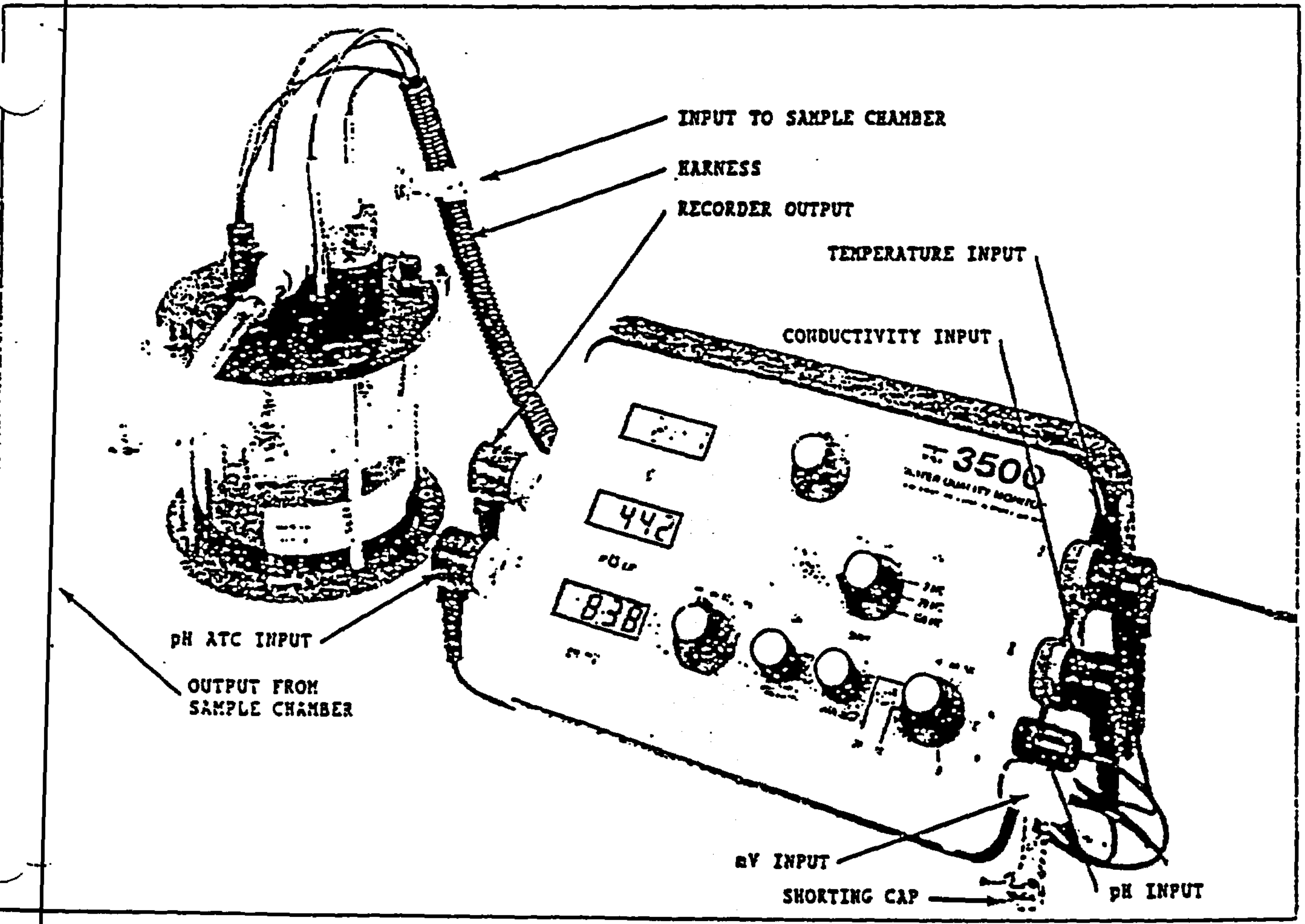


Figure 3. The 3560 System, Assembled

Temperature Measurement

To measure temperature, connect a 3510 Temperature Probe to the 3500. Temperature is measured in °C and is shown continuously on the top display. With no probe attached, the 3500 display will read -34.0 ±.2°C.

Conductivity Measurements

Before any conductivity cell is used, it should be soaked in distilled or deionized water for at least one hour. To make conductivity measurements, connect a YSI 3520 Flow-Through Conductivity Cell to the 3500. Set the conductivity function switch to 2 and observe the displayed value after the reading is stable. The display reads out in millimhos/centimeter (mʊ/cm). If micromhos/centimeter (μʊ/cm) is desired, multiply the displayed value by 1000.

If the overrange signal (1.___) is displayed, the conductivity of the water being assayed is greater than 1.999 mʊ/cm. Reset the function switch to 20. If the overrange signal is still displayed, reset to 100. If the overrange signal is still displayed, either the conductivity is greater than 100.0 mʊ/cm and the YSI 3500 Water Quality Monitor can not be used for conductivity determinations, or else there is a system error.

If no cell or a dry cell is attached to the 3500, the display will read 000 (±002) with the appropriate decimal point.

Automatically Temperature Compensated Conductivity

To measure automatically temperature compensated conductivity, connect a YSI 3510 Temperature Probe and a YSI 3520 Flow-Through Conductivity Cell to the 3500, and set the conductivity function switch to the correct ATC conductivity range. Readings are automatically compensated by 2%/°C to 25°C. The 3510 must be located in the sample under test for the automatic compensation to work correctly. If no temperature probe is connected to the monitor, the display will show the overrange signal (1.___). See Tables I and II for the correction values.

pH Measurements

To measure pH, connect a YSI 3530 pH Electrode or equivalent to the 3500, and set the pH function switch to pH. Typically, a two point calibration is necessary before actual measurements can be made. See pH Calibration procedure. Once the 3530 is calibrated, install the electrode into its port in the 3550. Though the instrument and electrode have been calibrated at one temperature, they can be used at other temperatures as long as the manual temperature knob is reset to the new sample temperature before final values are determined. Be sure to reset the dial to the temperature indicated by the top display. Though pH is temperature dependent, it is not customarily corrected to 25°C, as conductivity often is. pH changes with temperature at the rate of .335%/°C from the calibration point.

When measuring pH with no electrode connected to the mV input, the shorting cap attached to the 3500 should be on the mV input jack.

Automatically Temperature Compensated pH

To measure automatically temperature compensated pH, a YSI 3510 Temperature Probe and a YSI 3530 pH Electrode must be connected to the 3500. As long as the pH ATC mode is being used, the 3510 must remain connected to the pH ATC input jack or else the pH display will show an underrange negative value, or an overrange condition greater than 14.00--which are outside of the pH range of 0.00 to 14.00 and can not be adjusted into the measurable pH range.

Typically, a two point calibration is necessary before actual measurements can be made. See pH Calibration procedure. Once the 3530 is calibrated, install the electrode into the 3550 in its appropriate port, and the 3510 into the pH ATC port. Though the instrument and sensors have been calibrated at one temperature, they can be used at other temperatures, since temperature changes from the calibration point will be automatically corrected to the new value. Though pH is temperature dependent, it is not customarily corrected to 25°C, as conductivity often is. pH changes with temperature at the rate of .335%/°C from the calibration point.

When measuring pH with no electrode connected to the mV input, the shorting cap attached to the 3500 should be on the mV input jack.

mV Measurement

The millivolt (mV) function is intended for use with the YSI 3540 ORP Electrode, though other sensors may also be used. Set the pH function switch to the mV mode and read the bottom display. There are no adjustments in this mode, so any sensor that is attached to this input jack should be tested against some known standard as defined by its manufacturer. See Calibration for ORP Electrode. When no electrode is attached to the mV input, the shorting cap attached to the 3500 should be installed on this jack. If the pH input is not in use when an ORP electrode is on the mV input, the shorting cap should be connected to the pH input jack. With the shorting cap installed, the display will read 000 ±002.

Bailers

To use the 3560 system with a bailer instead of a pump, use the funnel provided to fill the sample chamber with the solution to be tested. The sample chamber and the conductivity cell must be filled to the very top and all air must be removed to ensure accurate readings.

Recorder Output

The Model 3500 recorder output is capable of driving a data logging device or strip chart recorder. Four outputs are located on the connector designated REC OUT and are defined as Temperature (pin E), Conductivity (pin D), pH (pin B), and mV (pin A); the common for each output is pin C. Each output circuit has a minimum load impedance of 50 K ohms. Each produces 1 mV for every count on the respective displays, and is accurate to ±10 counts of the display. The outputs have been calibrated with a 50 K ohm load. It should be noted that the conductivity output in the ATC mode is not temperature compensated. Conductivity output is always uncompensated conductivity. Compensated conductivity can be calculated as described elsewhere.

Shut Down

To shut down the system, simply turn the power switch to OFF. Turn the pump off before disconnecting the plumbing. Remove the straight union connector from the pump outlet, then remove the hose and fittings from the sample chamber ports and drain them. Plug the ports with the plastic plugs provided.

To keep the sensors in a suitable environment, the sample chamber can be moved from one site to another with its contained fluid. When the day's measurements are finished, drain the chamber by removing one of the plugs from its port and pouring out the sample. The pH and ORP electrodes should be stored in their soaker bottles to prevent them from drying out. The conductivity cell should be stored moist to minimize its equilibration period.

8

MAINTENANCE

Instrument

The YSI 3500 Water Quality Monitor requires occasional battery replacement and cleaning. Six alkaline "D" cells in the 3500 provide a minimum of 1400 hours of operation. When BAT appears on any of the three displays, it is time to replace the batteries. It is important to replace all the alkaline batteries at the same time for long life between battery changes. Remove the four rubber feet located on the back of the instrument and take off the back. Replace the batteries in the battery holder tubes, making sure the polarity is correct (red is positive). Reassemble the case, being careful to align the gasket correctly to prevent water infiltration. The rubber feet should be reinstalled finger tight. Do not use a screw driver.

Use a mild soap and water solution to clean the instrument. Wipe the solution on and wipe it off right away; follow this with a clean water wipe. Either a probe or connector cap should be in place over every jack to keep water out. If water gets into the instrument, disassemble it and wipe it dry. Do not dry it with hot air; this could damage the electronic components.

For stubborn stains and other marks, a solution of 50% water and 50% isopropyl alcohol may be used. Do not allow the solution to stand on the instrument case. Rinse by wiping with water, as above.

When storing the 3500 for long periods, remove the batteries to lessen the possibility of leakage.

Sample Chamber

The YSI 3550 Sample Chamber Assembly comes apart easily. The o-ring seals in the ports and the chamber gaskets should be replaced annually. Use the tweezers provided in the YSI 3555 Sample Champer Maintenance Kit to remove old o-rings and install new ones. Be sure the o-rings are properly seated in their grooves; they fit back in the sides of the ports. When you replace the gaskets located in recesses at the top and bottom of the clear acrylic tube, re-apply the thumbscrews finger-tight only; do not use any tool to tighten them. The gaskets could be cut, which would cause them to leak.

You may clean the parts of the disassembled chamber, as well as the plumbing fittings, with a mild soap solution or with isopropyl alcohol for tough stains. Rinse the cleaned components with water to remove any residual soap or alcohol; residues might cause interference with measurements.

Whenever storing the 3550, remove all the sensors to minimize the possibility of damaging, and store each one as recommended below. The sample chamber should be disassembled and dried before storage to prevent microbial growth.

The tubing and fittings used with the Sample Chamber may be cleaned with a general laboratory detergent. The tubing may be autoclaved. To remove the hose-stem adapter from the elbow, push in the collar on the elbow while pulling out the hose-stem adapter.

Temperature Probe

The 3510 requires very little maintenance in normal use. The durable stainless steel sheath and polyurethane cable may be cleaned with a mild soap and water solution. A solution of 50% isopropyl alcohol and 50% water may be used to remove stains and mineral deposits.

The 3510 should be stored dry in its own shipping box, and kept in a dry location.

Flow-Through Conductivity Cell

The stainless steel electrodes of the 3520 do not require platinization when used between 0.0 and 50.0 mO/cm. When conductivity values from 50.0 to 100.0 mO/cm are to be measured, the electrodes do require platinization for system accuracy. A platinization adapter has been provided with the system for use in conjunction with the YSI 3045 Platinizing Instrument and YSI 3140 Platinizing Solution. See the 3045 instructions for further information. The cell must always be kept clean to assure proper operation and reproducible accuracy. A dirty cell will contaminate the sample under test and change the conductivity reading. Any of the foaming acid tile cleaners such as Dow Chemical "Bathroom Cleaner" will clean the cell adequately. When a stronger cleaning preparation is required, use a solution of 10 parts distilled water, 10 parts isopropyl alcohol, and one part 10 normal hydrochloric acid.

Dip the cell into the cleaning solution and agitate for two or three minutes. A small test tube brush may be used to gently clean the electrodes and the flow-through port. Be careful to not scratch the electrodes. Rinse the cell in several changes of distilled or deionized water. The cell constant should be checked after each cleaning (see Calibration).

Store the 3520 in deionized water. For short term storage, the cell can be wrapped in a moist towel and placed in a plastic bag. After the 3520 cell has been stored dry, the cell constant will be in error until it has been soaked in deionized water for at least an hour.

Change the two silicone o-rings annually to maintain their sealing integrity. Use the tweezers provided in the 3555 Sample Chamber Maintenance Kit to remove old o-rings and install new ones. Be sure the o-rings are properly seated in their grooves, and be careful not to damage the o-rings or the cell with the tweezers.

pH Electrode

All sealed pH electrodes, including the YSI 3530, will deteriorate with time. The typical electrode will deteriorate after 3 to 6 months of normal use. Age deterioration is characterized by a shortened slope adjustment and slower speed of response. Aging can best be detected by calibrating the electrode. As a rule, if the span for slope adjustment can not be brought into range (that is, a reading of 4.00 can not be set), the electrode should be cleaned and retested or reconditioned (see below). When storing the electrode, keep it in the soaker bottle provided. The solution in the bottle may be replenished with 5 to 10 mL of pH 4 buffer with 1/2 teaspoon of sodium chloride (NaCl). If performance is not restored the electrode should be replaced. The slope control on the YSI 3500 Water Quality Monitor will allow a pH electrode with an 80% to 100% efficiency to be calibrated to the slope adjustment value. If this cannot be set, the electrode is probably below an 80% efficiency value. To clean or recondition a 3530, proceed as follows:

pH Electrode Cleaning: Coating of the bulb can lead to erroneous readings including shortened slope adjustment. Cleaning technique is determined by the type of coating. Soft coatings can be removed by vigorous stirring or by use of a squirt bottle of water. Organic chemicals or hard coatings should be chemically removed. A half-hour soaking in an industrial strength

9

detergent is recommended. Only in extreme cases should the bulb be mechanically cleaned as abrasion can lead to permanent damage. If cleaning does not restore performance, reconditioning may be attempted.

pH Electrode Reconditioning: When reconditioning is required due to electrode aging or severe fouling, the following chemical treatments can be tried. They are presented in the order of the severity of their attack on the pH electrode glass and may not improve electrode performance, and in some cases they might actually reduce it.

NOTE: USE PROPER PRECAUTIONS WHEN HANDLING THESE HAZARDOUS CHEMICALS.

1. Immerse the electrode tip in 0.1 normal hydrochloric acid for 15 seconds, rinse it in tap water, then immerse the tip in 0.1 normal sodium hydroxide for 15 seconds, and rinse in tap water again. Repeat this sequence three times and then recheck electrode performance. If it has not been restored, try the next step.

2. Immerse the electrode tip in a solution of 20% ammonium bifluoride and 80% water for two to three minutes, rinse in tap water and recheck performance. If performance has not been restored, try the next step.

3. Immerse the electrode tip in a solution of 5% hydrofluoric acid and 95% water for 10 to 15 seconds, rinse well in tap water, quickly rinse in 5 Normal hydrochloric acid, then rinse well in tap water again and recheck performance. If performance has not been restored, replace the electrode.

ORP Electrode

The 3540 should be periodically inspected for coating of the platinum surface, which can cause erroneous readings. The bulb guard of the electrode can be removed to expose the platinum for cleaning. When storing the electrode, keep it in the soaker bottle provided. The solution in the bottle may be replenished with 5 to 10 mL of pH 4 buffer with 1/2 teaspoon of sodium chloride (NaCl) .By testing the 3540 with YSI 3682 Zobell Solution, the need for cleaning can be determined (see Calibration). To clean the 3540, proceed as follows:

1. Soft coatings should be removed by use of a squirt bottle of water or by gently wiping with a soft cloth. Remove the bulb guard if necessary. Be careful not to scratch the platinum.

2. Hard coatings or organic chemicals should be removed by an appropriate chemical solvent, by gently scrubbing with a very fine cleansing powder such as "Softscrub," or by gently polishing with 600 grade wet silicon carbide paper. Wet a piece of the paper with water and gently polish the electrode with a circular twisting motion.

NOTE: After cleaning the platinum surface, soak the electrode for 8 to 24 hours in 4.0 pH buffer, then recheck it with YSI 3682 Zobell Solution before further use.

CALIBRATION

Instrument

The Model 3500 has no user serviceable adjustments. If you suspect that the instrument is out of calibration, it may be tested for accuracy using the YSI 3590 pH Sensor Simulator and the 3595 Test Probe Kit. Install the 3595 Test Probe Assembly by connecting the temperature unit (4 pins) to the TEMP input jack on the 3500, and the conductivity unit (2 pins) to the COND input jack. The readings you should see to ascertain correct operation of the temperature, conductivity and ATC conductivity functions of the 3500 are as follows:

°C = 15.5 ±0.3

2 mO/cm = 1.563 ±0.020
20 mO/cm = 1.56 ±0.10
100 mO/cm = 1.6 ±0.2

2 mO/cm ATC = 1.928 ±0.020
20 mO/cm ATC = 1.93 ±0.10
100 mO/cm ATC = 1.9 ±0.2

Connect the 3590 pH Sensor Simulator to the 3500 as described on the instruction label on the back of the 3590, then follow the steps listed in these instructions. If the displayed values are out of specification, the 3500 should be returned for service. See Warranty and Shipping Information.

Temperature

The 3510 Temperature Probe is assembled with a YSI Thermilinear thermistor and may be tested by customers using an ohmmeter. With the sheath of the probe submerged in a 0.0 ±.1°C ice bath, thermistor resistance can be compared to the following values:

Across Pins A & B = 94.98 K ±482 Ohms
Across Pins B & C = 19.59 K ±103 Ohms
Across Pins A & C = 114.6 K ±585 Ohms
Across Pins B & D = 0 ±1 Ohm

If any measurement is out of tolerance, see Warranty and Shipping Information for repair or replacement information.

Conductivity

The designed cell constant of the YSI 3520 Flow-Through Conductivity Cell is K = 5 /cm. Different accuracies in different ranges is a characteristic of the stainless steel electrodes. Though in normal use, re-determination of the cell constant may not be required, the constant can be affected by electrode fouling or mechanical shock. Therefore, it is wise to re-determine the cell constant routinely. When testing the calibration of the system, be sure check the accuracy of the test against System Specifications.

The total accuracy of the system is the sum of all the inaccuracy of its parts. As an example, at 10.00 mO/cm the 3500 and 3520 have an accuracy of ±3% of full scale (20.00), and the 3168 Conductivity Solution has an accuracy of ±1% of solution value. So when the solution is tested in the ATC mode, the displayed value should be 10.00 ±.70 mO/cm.

To check the cell constant, YSI 3167, 3168 or 3169 Conductivity Calibrator Solutions may be used. These solutions are packaged eight to a box in unbreakable plastic one pint bottles designed for field use. The solutions are manufactured to nominal values of 1, 10, or 50mO/cm at 25°C, with a ±1% accuracy of the stated

10

alue o the label. A chart for uncompensated values t temperatures other than 25°C is included with each ox.

n th[illegible] following example, cell/instrument calibration s [illegible]rmed by use of YSI 3167 solution, but these r[illegible]es may be followed using any of the YSI solu- [illegible]ith only slight procedural changes.

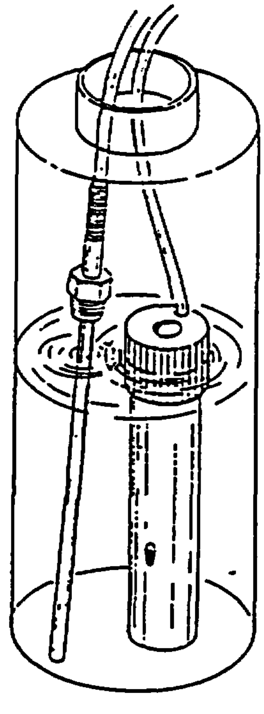
onnect the 3520 cell and a 3510 Temperature Probe to he 3500, and remove them from the sample chamber. Set ne conductivity function switch to 2 ATC. Rinse the nside and outside of the cell and the probe with about /3 of the contents of the 3167 bottle. Place both of ne sensors into the remainder of the solution in the ottle, and allow them to come to temperature equilibrium. Make sure that the 3520 body is immersed so that ne water level is half way up the knurled portion of ne cell. See Figure 4. Read the displayed value and etermine if the cell/instrument is within specified ccuracy. The displayed value is corrected to 25°C utomatically and should be 1.000 ±.070 m℧/cm. If the alue is within specification, the measured error can e used to further improve the accuracy of the system y providing a correction factor for further readings. his is done as follows:

$$\text{orrected Sample Value} = \frac{\text{Calibrator Value}}{\text{Displayed Value}} \text{ X Sample Value}$$

alibrator Value = 1.000 m℧/cm
isplayed Value = .978 m℧/cm
ample Value = .634 m℧/cm

.648 m℧/cm = (1.000 m℧/cm)/(.978 m℧/cm X (.634 m℧/cm)

iscard the calibrator solution once the accuracy of he [illegible]tem has been determined. It has been contamin- [illegible] should not be reused. If system accuracy is [illegible]pecification, see Warranty and Shipping Inform- [illegible] for repair instructions.



gure 4. Sensor Level in Conductivity Calibrator lution

pH

The frequency at which calibration is needed depends on the electrode, the pH monitor and the characteristics of the water to which the electrode is exposed. Since normal life of a pH electrode is only three to six months, it is advisable to calibrate the pH system before sampling at each site. The pH electrode should be tested for background noise and appropriately offset on a weekly basis.

Before connecting the pH electrode, zero the electronics with the shorting cap attached to the 3500. Turn on the 3500 and set the pH function switch to pH. Next, connect the shorting cap to the pH input jack and set the manual temperature compensation knob to 25°C. Then, adjust the CAL control to indicate 7.00 ±0.01 on the pH-mV display. Disconnect the shorting cap from the pH input and connect it to the mV input jack. The monitor is now zeroed.

Test the 3530 pH Electrode for noise and offset as follows. Rinse the 3530 and a YSI 3510 Temperature Probe with pH 7.00 buffer to remove any contaminants. Connect the 3530 to the pH input jack and the 3510 to the TEMP input jack. Pour pH 7.00 buffer into a 50 ml sample cup, such as one from the YSI 3565 Sample Cup Pack, then immerse both of the sensors into the buffer at 25.0 ±0.1°C (use the °C display to confirm the temperature). Allow the sensors to equilibrate. A display value other than 7.00 shows electrode background noise and offset. The 3530 background noise and offset at pH 7.00 should not exceed ±0.2 pH units at 25°C.

Once it has been established that the electrode offset is functioning properly, a two point calibration should be performed. pH buffers of 7.00 and 4.00 or of 7.00 and 10.00, whichever two are closer to the expected sample value, should be used. Proceed as follows to make a two point calibration.

Rinse the 3530 and a YSI 3510 Temperature Probe with pH 7.00 buffer to remove any contaminants. Connect the 3530 to the pH input jack and the 3510 to the TEMP input jack. Pour pH 7.00 buffer into a 50 ml sample cup, such as one from the YSI 3565 Sample Cup Pack, then immerse both of the sensors into the buffer. Allow the sensors to equilibrate in the buffer until a stable reading is obtained. Read the temperature and adjust the pH manual temperature compensation knob to the same value. Adjust the CAL control knob for 7.00 ±0.01 pH units on the display and discard the buffer. Rinse the sensors with deionized or distilled water, followed by a rinse of the next desired buffer (typically pH 4.00 or 10.00). Half fill another disposable 50 ml sample cup with the next buffer for calibration and immerse the sensors. Allow the sensors to equilibrate until a stable reading is obtained. The temperature of the two buffers should not differ by more than ±0.1°C. Adjust the SLOPE control until the display is within 0.01 pH units of the buffer's stated value. Discard the buffers. The pH system is now calibrated and ready for use.

Temperature Compensated pH

Follow the pH instructions above, with the following modifications:

Set the pH function switch to pH ATC. Connect the 3510 to the pH ATC input jack. While the 3510 can be used in either location, the pH ATC function will not work unless the 3510 is connected to the pH ATC input. It is recommended that a second YSI 3510 Temperature Probe be used for this operation. Manual temperature compensation is not necessary since temperature compensation is performed automatically in this mode.

mV

The frequency with which the mV function needs to be evaluated depends on the electrode, the monitor and characteristics of the ground water to which the electrode is exposed. It is wise to test the ORP system against a standard on a weekly basis. The YSI 3540 ORP Electrode comes with a bottle of YSI 3682 Zobell Solution which is used as a reference solution. To test the system with this standard, proceed as follows:

First, turn on the YSI 3500 Water Quality Monitor and set the pH function switch to mV. Next, connect the shorting cap attached to the 3500 to the mV input jack. The display should read 000 ±2 mV. This indicates that the 3500 electronics are zeroed. Detach the shorting cap and connect the 3540 to the mV input jack. If a pH electrode is not attached to the pH input jack, connect the shorting cap to it. Attach the 3510 to the TEMP input jack. Rinse the 3540 and 3510 with distilled or deionized water, followed by a rinse with a small amount of reconstituted YSI 3682 ZoBell Solution. Half fill a disposable 50 ml sample cup, such as one from the YSI 3565 Sample Cup Pack, with ZoBell Solution and fully immerse the bulb of the 3540 and the end of the sheath of the 3510. Allow the sensors to equilibrate, and note the reading. The displayed mV value is not temperature compensated and should be corrected to 25°C at 1.3 mV/°C. The temperature coefficient is in reverse proportion to the temperature. The calculated value for the ZoBell Solution should be 231 ±10 mV at 25°C.

Example: Displayed Temperature = 22.1°C
Displayed Value of ZoBell Solution = 236 mV

231 mV = Display Value + [(Display Temp. - 25°C) x (1.3 mV)]
231 mV = 236 mV + [(22.1°C - 25°C) x (1.3 mV)]
231 mV = 236 mV + [-3.8 mV]
231 mV = 232.2 mV, corrected to 25°C

The calculated value of the Zobell solution in this example is within its specified range of 231 ±10 mV. This confirms that the ORP system is functioning properly. Rinse the sensors with deionized or distilled water and discard the used Zobell solution.

NOTE: If a pH sensor such as the 3530 and another potentiometic sensor such as the 3540 are to be installed at the same time into the 3550 Sample Chamber, and if both have their own reference electrodes, both reference electrodes must be immersed in the calibration solution during calibration.

WARRANTY AND SHIPPING INFORMATION

The YSI 3560 is warranted for one year against defects in workmanship and materials exclusive of batteries when used for its intended purposes and maintained according to manufacturer's instructions. The YSI 3530 and 3540 are warranted for three months. Damage due to accidents, misuse, tampering, or failure to perform prescribed maintenance is not covered. The warranty period for chemicals and reagents is determined by the expiration date printed on their labels. This warranty is limited to repair or replacement at YSI's option.

IF SERVICE IS REQUIRED

Contact the YSI dealer from whom you bought the instrument, or the YSI Product Service Department. Report the date purchased, model, serial number, and the nature of the failure. When shipping any instrument, be sure that it is properly packaged and insured for complete protection. When returning for repair, please note the requirements of the Cleaning Certificate. In communications regarding this instrument or accessories please mention the model and serial number.

Yellow Springs Instrument Co., Inc.
Product Service
1725 Brannum Lane
Yellow Springs, Ohio 45387

YSI Toll Free Number: 1-800-343-HELP

REQUIRED NOTICE

The Federal Communications Commission defines this product as a computing device and requires the following notice:

This equipment generates and uses radio frequency energy and if not installed and used properly, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class A or Class B computing device in accordance with the specification in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

a) reorient the receiving antenna
b) relocate the computer with respect to the receiver
c) move the computer away from the receiver
d) plug the computer into a different outlet so that the computer and receiver are on different branch circuits

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful: "How to Identify and Resolve Radio-TV Interference Problems." This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 0004-000-00345-4.

TROUBLESHOOTING INFORMATION

Five basic assemblies make up the 3500: the conductivity-temperature board assembly, the pH-mV board assembly, the battery assembly, the meter assembly and a front panel assembly. The conductivity-temperature board provides references for the conductivity and temperature circuits as well as signal conditioning, timing, upper display drives and recorder output for all four monitor parameters.

Power is provided by the Battery Assembly and conditioned by the Cond-Temp board. +V is a constant 3.5 V to common and -V varies with the battery level. Power and timing are provided to the pH-mV board via a cable. The pH-mV board in turn provides signal conditioning, lower display drive and circuit isolation for the pH and mV circuits.

The Front Panel Assembly provides interfacing for the sensor inputs, front panel controls and Meter Assemblies.

With no sensors connected, the °C display will indicate -34.0 ±.2°C. The m℧/cm display will indicate 000 ±002 m℧/cm plus the appropriate decimal point in the 2, 20, and 100 ranges and an overrange condition (1___) in the 2 ATC, 20 ATC, and 100 ATC ranges with appropriate decimal point. With a temperature probe connected to the TEMP input, the overrange condition will turn off and the same display will appear as for the 2, 20, and 100 ranges.

With the function switch set to pH, and with the shorting cap on the pH input, the CAL knob can be adjusted so that the display shows from approximately 6.00 to 8.00 pH units, and the SLOPE and manual temperature compensation knobs will not affect the display value. With the shorting cap on the mV input, the display will indicate 000 ±002 mV in the mV function.

The pH electrode can be tested at the mV input. See Table IV for the electrode output in millivolts at different temperatures when the electrode is immersed in 4.00 and 10.00 pH buffers. The table shows the ideal mV outputs when the electrode is 100% efficient. Since the instrument SLOPE knob permits for adjustment from 100% down to 80%, the table value minus 20% is acceptable as an electrode output at any of the listed parameters. Before the electrode is tested for output, it should be evaluated for background noise and offset. At 25°C in pH 7.00 buffer, the electrode should indicate 0 ±11 mV.

TABLES

I. Temperature Correction Values Used for Automatic Temperature Compensation by the Model 3500 at 2%/°C

Temperature °C	Conductivity Ratios in m℧/cm ATC to 25°C
-5	2.500
0	2.000
5	1.667
10	1.429
15	1.250
20	1.111
25	1.000
30	.909
35	.833
40	.769
45	.714
50	.667

II. Temperature Correction Values of Two Typical Solutions (0.007 Normal and 0.089 Normal Potassium Chloride)

Temperature °C	0.007 Normal KCl m℧/cm at T°C	0.089 Normal KCl m℧/cm at T°C
-5	.455	5.54
0	.541	5.54
5	.628	6.39
10	.718	7.26
15	.810	8.15
20	.904	9.07
25	1.000	10.00
30	1.098	10.96
35	1.199	11.93
40	1.302	12.93
45	1.406	13.95
50	1.513	14.99

III. Temperature Values for Zobell Solution used with Silver/Silver Chloride and Calomel Electrodes

Temperature °C	Ag/AgCl (4M KCl) Millivolts	Calomel Millivolts
-5	270.0	234.2
0	263.5	226.0
5	257.0	217.8
10	250.5	209.6
15	244.0	201.4
20	237.5	193.2
25	231.0	185.0
30	224.5	176.8
35	218.0	168.6
40	211.5	160.4
45	205.0	152.2
50	198.5	144.0

IV. Ideal pH Electrode Output in pH 4.00 and 10.00 Buffers

Temperature °C	pH 4.00 Millivolts	pH 10.00 Millivolts
-5	159.6	-159.6
0	162.6	-162.6
5	165.6	-165.6
10	168.6	-168.6
15	171.5	-171.5
20	174.5	-174.5
25	177.5	-177.5
30	180.4	-180.4
35	183.4	-183.4
40	186.4	-186.4
45	189.4	-189.4
50	192.4	-192.4

YSI Model 3510 Temperature Probe

YSI MODEL 3510 TEMPERATURE PROBE INSTRUCTIONS

The YSI Model 3510 Temperature Probe is shipped with a warranty card, a certificate of traceability, and a cleaning certificate.

DESCRIPTION

The YSI 3510 Temperature Probe is designed for use with the YSI 3560 Water Quality Monitoring System. When it is connected to the TEMP receptacle on the 3500, it provides a signal for both temperature measurement and for automatic temperature compensation (ATC) of conductivity measurements. When it is connected to the pH ATC receptacle, it provides automatic temperature compensation for pH measurements. One 3510 probe is provided with the 3560 system; two may be used at the same time to provide these functions simultaneously.

The 3510 can be used over a temperature range of -5 to 50°C with an accuracy of ±.2°C, traceable to the National Bureau of Standards. The black polyurethane cable is three feet long and is terminated at one end with a watertight MS connector. The sensor end of the probe contains a YSI Thermilinear® thermistor assembly mounted in an epoxy sealed sheath 3.25" long by .15" diameter. The time constant of the probe is less than 4 seconds for registering 95% of a change in temperature.

OPERATION

When using the 3510 in any ATC mode, be sure it is located beside the sensor for which it is to provide ATC measurement, whether in the YSI 3550 Sample Chamber Assembly or in any other container.

Insert the 3510 into either of the designated ports on the sensor mounting plate of the 3550. Two o-rings in each port provide a watertight seal.

MAINTENANCE

The 3510 requires very little maintenance when used in routine operations. The durable stainless steel sheath and polyurethane cable may be cleaned with a mild soap and water solution when required. Alcohol may be used to remove stains and mineral deposits.

When storing the 3510, it should be put into the shipping box provided and kept in a dry location.

CALIBRATION

The 3510 is assembled with a YSI Thermilinear thermistor assembly and may be checked with an ohmmeter. With the sheath submerged in a 0.0 ±.1°C ice bath, the thermistor resistances can be compared to the values in this table:

Across Pins A & B = 94.98 K ±482 Ohms
Across Pins B & C = 19.59 K ±103 Ohms
Across Pins A & C = 114.5 K ±585 Ohms
Across Pins B & D = 0 ±1 Ohm

If any measurement is out of tolerance, see warranty and shipping instructions.

WARRANTY AND SHIPPING

The YSI 3510 is warranted for one year against defects in workmanship and materials when used for its intended purposes and maintained according to manufacturer's instructions. Damage due to accidents, misuse, tampering or failure to perform prescribed maintenance is not covered.

IF SERVICE IS REQUIRED:

Contact the YSI Dealer from whom you bought the probe, or the YSI Product Service Department. Report the date purchased, model, serial or lot number and the nature of the failure. If the repair is not covered by warranty, you will be notified of the charge for repair or replacement.

When shipping any instrument or sensor, clean it as required (see Cleaning Certificate) and be sure that it is properly packaged and insured for complete protection. In communications regarding this instrument or accessories please mention the model and serial or lot number.

YSI Incorporated
Yellow Springs Instrument Co., Inc., Yellow Springs, Ohio 45387 USA • Phone 513 767-7241 • 800 343-HELP • Fax 513 767-9353 • Telex 205437
ITEM 061384 PN A35181 B

YSI Model 3550 Sample Chamber

YSI MODEL 3550 SAMPLE CHAMBER ASSEMBLY INSTRUCTIONS

The YSI Model 3550 Sample Chamber Assembly is shipped with 4 pH/ORP/Outlet/Inlet plugs, 2 temperature plugs, 2 elbows, a warranty card and a cleaning certificate.

DESCRIPTION

The YSI 3550 Sample Chamber Assembly is an integral part of the YSI 3560 Water Quality Monitoring System. It is designed to be attached to a pump outlet, but it can also be used as a non-flowing sample chamber. It will hold up to five sensors and provide inlet and outlet ports for fluid movement through the chamber. The sample circulates through the chamber at up to 1 1/2 gallons per minute. The chamber provides good mixing of fluids so residual sample is not a problem. Clear acrylic sides allow the user to see fluids flowing through the chamber.

Two black EPR gaskets keep fluids from leaking around the sensor mounting plate and base plate assemblies, and two orange silicone o-rings in each of the sensor ports provide excellent seals. The sensor mounting plate is permanently marked to indicate the port for each sensor. This sample chamber holds approximately one liter in volume and operates with flowing sample over a temperature range of -20 to 50°C. A convenient handle is provided for carrying the chamber between test sites.

'ERATION

To use the 3550, first install the sensors to be used with the system into their respective ports. Two o-rings in each port provide effective water seals. The sensor ports not in use should be plugged to close the system. Plugs are provided with the 3550 package. Next, connect the chamber to a pump. Push an adaptor onto the tubing provided, then press the adapter into an elbow. Insert the elbow into the top of the YSI 3520 Flow-Through Conductivity Cell and push down on the elbow until it stops (see 3560 Water Quality Monitoring System Instruction Manual). To finish the installation, insert the remaining tubing and adapter into the second elbow provided and install that assembly in the OUT port of the sensor mounting plate. Push the elbow down until it stops and place the other end of the tubing where the fluid under test is to be collected or drained. The pump can now be turned on and regulated so that it does not exceed the chamber maximum flow rate of 1 1/2 gallons per minute.

---WARNING---

Do not block the outlet port or crimp the outlet hose. Pressure within the sample chamber must not exceed 10 psi or else sample will leak or sensors will be pushed out of the sensor mounting plate.

MAINTENANCE

The 3550 is easy to disassemble and clean. The o-ring seals in the ports and the chamber gaskets should be replaced annually. Use the tweezers provided in the o-ring maintenance kit to remove the old o-rings and install new ones, making sure they are properly seated all the way in the backs of the grooves. When reassembling the sample chamber after replacing the gaskets, resecure the thumb screws only finger-tight. Use of any tool could cause the gaskets to be cut and fail to seal.

Clean the disassembled chamber and all of its associated parts with a mild soap solution or isopropyl alcohol for tough stains. Thoroughly rinse the cleaned components with water to remove any residual soap or alcohol which would cause interference with measurements. The plugs and elbows of the 3550 may also be cleaned this way.

WARRANTY AND SHIPPING

The 3550 is warranted for one year against defects in workmanship and materials when used for its intended purposes and maintained according to manufacturer's instructions. Damage due to accidents, misuse, tampering or failure to perform prescribed maintenance is not covered. The warranty period for chemicals and reagents is determined by the expiration date printed on their labels. The warranty is limited to repair or replacement.

IF SERVICE IS REQUIRED:

Contact the YSI Dealer from whom you bought the chamber, or the YSI Product Service Department. Report the date purchased, model, serial number and the nature of the failure. If the repair is not covered by warranty, you will be notified of the charge for repair or replacement.

When shipping any instrument or sensor, clean it as required (see Cleaning Certificate) and be sure that it is properly packaged and insured for complete protection. In communications regarding this instrument or accessories please mention the model and serial number.

YSI Incorporated
Yellow Springs Instrument Co., Inc., Yellow Springs, Ohio 45387 USA • Phone 513 767-7241 • 800 343-HELP • Fax 513 767-9353 • Telex 205437

17

ITEM 061349 PN A35180 B Jan 89 MP

YSI Model 3520 Flow-Through Conductivity Cell

YSI MODEL 3520 FLOW–THROUGH CONDUCTIVITY CELL INSTRUCTIONS

The YSI Model 3520 Flow-Through Conductivity Cell is shipped with a warranty card, a cleaning certificate, and a certificate of traceability.

DESCRIPTION

The YSI 3520 Flow-Through Conductivity Cell is designed for use with the YSI 3560 Water Quality Monitoring System. It is constructed of rigid and durable chlorinated polyvinyl chloride (CPVC).

Conductivity is measured using two stainless steel electrodes. The cell constant is K = 5.0/cm ±2% at 25°C (77°F) at 1.00, 50.0 and 100.0 millimhos/cm, referenced to YSI standards which have been calibrated with standard solutions prepared in accordance with recommendation 56-1981 of the Organisation Internationale De Metrologie Legale (OIML). Measurements above 100.0 millimhos/cm will not be within specification accuracy.

Attached to the cell body with a stainless steel bend relief is a three foot polyurethane jacketed cable terminated with a watertight MS type connector.

The time constant of the cell is 10 seconds for registering 95% of a change in conductivity. Measurement is accurate with flow rates up to 1 1/2 gallons per minute.

OPERATION

The YSI 3520 Flow-Through Conductivity Cell is designed to be used in the YSI 3550 Sample Chamber Assembly. For use of the 3550, see its instructions or the 3560 Water Quality Monitoring System instructions.

1. Insert the 3520 into the designated port on the 3550 Sample Chamber Assembly sensor mounting plate. Two sensor mounting plate o-rings provide a watertight seal.

2. Press the adapter provided (or a length of 1/2" OD hard plastic tubing) into the elbow until you reach the stop. Then, press the elbow into the top of the 3520 until you reach the stop. Another two o-rings inside the top port of the 3520 provide a watertight seal.

3. Attach the MS connector to the receptacle marked COND on the Model 3500 and fit the lead into the cable harness.

4. Begin fluid flow as described in the 3560 system instructions.

5. To use the 3520 as a conductivity cell other than in the 3550 Sample Chamber Assembly, it is necessary to immerse the cell body in the fluid under test up to the midpoint on the knurled portion of the cell. Do not immerse the entire cell body, as this will change the cell constant (K).

MAINTENANCE

Cleaning: The cell must be kept clean at all times to assure proper operation and accuracy. A dirty cell will contaminate the sample and cause the conductivity to change. Any of the foaming acid tile cleaners such as Dow Chemical "Bathroom Cleaner" will clean the cell adequately. When a stronger cleaning preparation is required, use a solution of 10 parts each of distilled water and isopropyl alcohol and one part 10 normal hydrochloric acid.

Dip the cell into the cleaning solution and agitate for two or three minutes. A small test tube brush may be used to gently clean the electrodes and flow-through port. Be careful not to scratch the stainless steel electrodes. Rinse the cell in several changes of distilled or deionized water.

Storage: It is best to store conductivity cells in deionized water. When the 3520 cell is stored dry, it must be soaked in deionized water for a minimum of 1 hour before use.

The o-rings should be changed annually to maintain their sealing integrity. An o-ring replacement kit can be obtained from the YSI Product Service Department. See SERVICE below.

CALIBRATION

The YSI 3520 Flow-Through Conductivity Cell is calibrated at the factory. The cell constant may vary slightly with the conductivity of the solution being measured. Calibration may also be affected by electrode fouling, mechanical shock or scratched electrodes. The 3520 cell can be calibrated as a system with the Model 3500, using YSI 3160-3169 Conductivity Calibrator Solutions.

YSI Incorporated
Yellow Springs Instrument Co., Inc., Yellow Springs, Ohio 45387 USA • Phone 513 767-7241 • 800 343-HELP • Fax 513 767-9353 • Telex 205437

YSI 3160-3165 Conductivity Calibrator Solutions are high precision standards, packaged in amber quart or gallon glass bottles. The solutions are manufactured at 1.000 millimho/cm, 10.00 millimho/cm or 100.0 millimho/cm concentrations.

167-3169 Conductivity Calibrator Solutions are ially packaged in unbreakable plastic one pint bottles, eight to a box, for lab or field use. The solutions are manufactured to nominal 1.000 millimho/cm, 10.00 millimhos/cm or 50.0 millimhos/cm. The accuracy of each solution is printed on the container label.

WARRANTY AND SHIPPING:

The YSI 3520 is warranted for one year against defects in workmanship and materials when used for its intended purposes and maintained according to manufacturer's instructions. Damage due to accidents, misuse, tampering or failure to perform prescribed maintenance is not covered. The warranty period for chemicals and reagents is determined by the expiration date printed on their labels. This warranty is limited to repair or replacement.

IF SERVICE IS REQUIRED:

Contact the YSI Dealer from whom you bought the cell or the YSI Product Service Department. Report the date purchased, model, serial number and the nature of failure. If the repair is not covered by warranty, you will be notified of the charge for repair or replacement.

When shipping any instrument or sensor, clean it as required (see Cleaning Certificate) and be sure that it is properly packaged and insured for complete protection. In communications regarding this instrument or accessories please mention the model and serial number.

YSI Incorporated
Yellow Springs Instrument Co., Inc., Yellow Springs, Ohio 45387 USA • Phone 513 767-7241 • 800 343-HELP • Fax 513 767-9353 • Telex 205437

20

ITEM 061385 PN A35182 B Jan 89 HP

YSI Model 3530 pH Probe

YSI MODEL 3530 pH ELECTRODE ASSEMBLY INSTRUCTIONS

The YSI Model 3530 pH Electrode Assembly is shipped with a warranty card and a cleaning certificate.

DESCRIPTION

The YSI 3530 pH Electrode is designed for use with the YSI 3560 Water Quality Monitoring System, but it may also be used with other pH measuring systems that require pH probes with similar specifications. The rugged 5.5" long by .76" diameter polymer body will withstand demanding field and laboratory use. A spin-off bulb guard is provided for easy cleaning and protection. (The silver/silver chloride reference electrode and the silver working electrode are held within a porous Teflon® matrix, surrounded with a 4 molar potassium chloride gel, and sealed to eliminate the need for adding electrolyte and to prolong their working life.)

The 3530 has a 36 inch long black polyurethane cable and a retractable black BNC cover. A black end cap distinguishes it from the similar-appearing ORP probe, which has a yellow end cap. The unit is shipped in a soaker bottle containing pH 4.0 buffer. To prevent the probe from drying out, the soaker bottle should be used to store it whenever it is not in use.

SPECIFICATIONS

pH Range: 0 to 14.00 pH

Operating Temperature Range: -5 to 50°C

Accuracy: Accuracy is subject to calibration with available pH buffer solutions in the desired measurement range.

Sodium Error: .05 pH in 0.1 Molar Na+ Ion at 12.8 pH

Response Time: 95% of reading in 10 seconds

Zero Potential: 7.00 ±0.2 pH

Impedance: 60 megohms at 25°C

OPERATION

The 3530 is designed to be used in the YSI 3550 Sample Chamber Assembly. Once the 3530 is calibrated, install the electrode into the 3550 in the port marked pH. Set the pH function switch on the 3500 to pH if manual compensation is desired, and set the temperature compensation knob to the correct temperature in °C. Set the pH function switch to pH ATC if a pH ATC probe is in use, and disregard the manual compensation knob setting. See the 3500 instruction manual for further instructions.

MAINTENANCE

pH Electrode Aging: All pH electrodes age with time. The typical electrode begins to deteriorate after 3 to 6 months of use. Age is characterized by a lessened capacity for slope adjustment and slower speed of response. The best way to detect aging effects is when performing a slope adjustment. For example, if you calibrate with a pH 7.0 buffer and then cannot make the slope adjustment for a pH 4.0 or pH 10 buffer, the electrode should be cleaned and retested or reconditioned (see below). If performance is not restored, the electrode should be replaced.

pH Electrode Cleaning: If a coating forms on the bulb, erroneous readings and a shortened slope adjustment may result. The type of coating will determine the cleaning technique. First, remove the bulb guard. Soft coatings can be removed by vigorous stirring or by use of a squirt bottle. Organic chemicals or hard coatings should be chemically removed. A half an hour soaking in an industrial strength detergent is recommended. Only in extreme cases should the bulb be mechanically, cleaned as abrasion can lead to permanent damage. If cleaning does not restore performance, reconditioning may be tried.

pH Electrode Reconditioning: When reconditioning is required due to electrode aging or severe fouling, the following chemical treatments can be tried. They are presented in the order of the severity of their attack on the glass bulb, and may not improve (and may in some cases actually further impair) electrode performance.

NOTE: USE PROPER PRECAUTIONS WHEN HANDLING THESE HAZARDOUS CHEMICALS.

1. Immerse the electrode tip in 0.1 normal hydrochloric acid for 15 seconds, rinse in tap water and then immerse the tip in 0.1 normal sodium hydroxide for 15 seconds and rinse in tap water. Repeat this sequence three times and then recheck the electrode. If performance has not been restored, try the next step.

2. Immerse the electrode tip in a solution of 20% ammonium bifluoride and 80% water for two to three minutes, rinse in tap water and recheck. If performance has not been restored, try the next step.

3. Immerse the electrode tip in a solution of 5% hydroflouric acid and 95% water for 10 to 15 seconds, rinse well in tap water, quickly rinse in 5 normal HCl, rinse well in tap water and recheck. If performance has not been restored, replace the electrode.

YSI Incorporated
Yellow Springs Instrument Co., Inc., Yellow Springs, Ohio 45387 USA • Phone 513 767-7241 • 800 343-HELP

CALIBRATION

A two-point calibration, between 7 and 4, or between 7 and 10 (whichever is closest to the expected pH value), should be done before sample testing.

pH Calibration (Manual Temperature Compensation):

1. Rinse the pH electrode and a YSI 3510 Temperature Probe with distilled or deionized water. Follow with a rinse of pH 7.00 buffer.

2. Pour pH 7.00 buffer into a sample cup. (Suitable cups are provided in the YSI 3565 Sample Cup Pack.) Immerse the pH electrode and temperature probe in the pH 7.00 buffer. Turn the meter on and set the function switch to pH.

3. Allow the sensors to equilibrate in the buffer.

4. Read the temperature and adjust the manual temperature compensation knob to the same value.

5. Adjust the CAL knob for a 7.00 ±.01 display reading. Discard the buffer.

6. Rinse the sensors with deionized or distilled water, followed by a rinse of the next desired buffer.

7. Immerse the sensors in the next buffer.

8. Allow the sensors to equilibrate. Adjust the Slope control until the display is within 0.01 units of the buffer's stated value. This completes calibration.

ATC pH Calibration: ATC calibration is achieved the same way described above, except that the temperature probe is connected for automatic compensation, and manual compensation adjustment is not performed.

WARRANTY AND SHIPPING

The YSI 3530 is warranted for three months against defects in workmanship and materials when used for its intended purpose and maintained according to manufacturer's instructions. Damage due to accidents, misuse, tampering or failure to perform prescribed maintenance is not covered. The warranty period for chemicals and reagents is determined by the expiration date printed on their labels. This warranty is limited to repair or replacement.

IF SERVICE IS REQUIRED:

Contact the YSI Dealer from whom you bought the electrode, or the YSI Product Service Department. Report the date purchased, model, serial number and the nature of the failure. If the repair is not covered by warranty, you will be notified of the charge for repair or replacement.

When shipping any instrument or sensor, clean it as required (see Cleaning Certificate), and be sure that it is properly packaged and insured for complete protection. In communications regarding this instrument or accessories please mention the model and serial number.

YSI Incorporated
Yellow Springs Instrument Co., Inc., Yellow Springs, Ohio 45387 USA • Phone 513 767-7241 • 800 343-HELP
ITEM 061415 PN A35194 B Jan 89 MP

23

Orbeco-Hellige Model 966 Portable Turbidimeter

Operation and Use of the Nephelometric Turbidity Meter

A portable turbidimeter will be used to measure the turbidity of each groundwater sample in Nephelometric Turbidity Units (NTU). The meter will be checked before each field trip and daily while in the field, along with a battery check.

Field Equipment Specifications

The instruments used in the field and their calibration procedures are described in this section. Field measurements will be obtained for temperature, specific conductance, pH, and turbidity. Documentation of field readings will be conducted in accordance with the approved Closure Plan. Equipment calibration frequencies will be conducted in accordance with the approved Closure Plan.

The following field meters and equipment will be utilized during implementation of this GWQAP.

- YSI Model 3520 Flow-Through Conductivity Cell
- YSI Model 3530 Flow-through Cell Sample Chamber
- YSI Model 3560 Water Quality Monitoring System
- YSI Model 3510 Temperature Probe
- Orion Research Model 250A pH Meter

Orbeco-Hellige Portable Turbidimeter (Model 966) - Specifications

This meter tests at the officially mandated 90-degree angle between its photodetector and incident light beam. The direct-reading display gives results in NTUs over the full span of turbidity in three ranges and has a drift-free reading. The turbidimeter is already factory standardized and can be periodically confirmed using two controls on the meter and the permanent calibration standards. Meets official specifications of USEPA and ASTM. This turbidimeter was designed in accordance with USEPA Method 180.1.

Ranges and Sensitivity:

Low:	0.00 to 19.99 NTU, resolution 0.01 NTU;
Medium:	00.0 to 199.9 NTU, resolution 0.1 NTU;
High:	000 to 999 NTU, resolution 1 NTU.
Accuracy:	+/- 2% of reading for low and medium ranges.
Repeatability:	+/- 1%
Sample volume:	15 mL

INSTRUCTION MANUAL

ORBECO-HELLIGE
Model 966
PORTABLE TURBIDIMETER

TABLE OF CONTENTS

ORBECO ANALYTICAL SYSTEMS, Inc.,
185 Marine St., Farmingdale, NY 11735
Phones: 800-922-5242   516-293-4110
FAX: 516-293-8258

26

Section 1

GENERAL DESCRIPTION and FEATURES

The Model 966 Portable Turbidimeter measures the clarity or cloudiness of any type of colorless fluid. It is ideal for regulatory monitoring, process control and field studies. It meets the official specifications of the USEPA, ASTM, Standard Methods of APHA, AWWA, WEF and other world-recognized authorities. It meets the design requirements of USEPA Method 180.1 and is ideal for NPDES and NPDWR compliance reporting.

A true nephelometer, the Model 966 tests at the officially mandated 90° angle between its photo-detector and incident light beam. Its direct-reading LCD display gives results in NTUs (Nephelometric Turbidity Units) over three turbidity ranges: 0-20.00, 0-200.0, and 0-1000. Test resolution is 0.01 NTU in the lowest range..

Its direct-reading digital display is drift-free. It provides automatic error-free decimal shift, over-range indication and a low-battery warning signal.

Model 966 is powered by 4 alkaline AA batteries (supplied), sufficient for over 700 tests. These readily available batteries avoid the problems and inconveniences of rechargeable batteries. Automatic battery shut-off conserves battery life.

Optional regulated AC adapters (battery eliminators) are available for 110 or 220 volt, 50/60 Hz power -- See Section 7.

Optional Flow-through Cell is available for continuous turbidity monitoring with Recorder Models 966-R1 (for 110 volts) and 966-R2 (for 220 volts)..

27

SPECIFICATIONS

RANGES and RESOLUTION in NTU	LOW: 0.00 to 19.99 - resolution 0.01 MEDIUM: 00.0 to 199.9 - resolution 0.1 HIGH: 000 to 999 - resolution 1
ACCURACY..........	±2% of reading for low and medium ranges.
REPEATABILITY.....	±1%
LIGHT SOURCE......	10,000 hour Tungsten Bulb
POWER REQUIREMENT	Four AA Alkaline Batteries (supplied) or optional 110v or 220v 50/60Hz AC Adapters
TEMPERATURE RANGE (Instrument only)	Storage: -10°C to 70°C Operating: 0°C to 45°C (Allow at least 15 minute waiting period after change in ambient temperature).
SAMPLE TUBE.......	Optically matched glass vial with screw cap; 28mmOD x 61mm long.
SAMPLE VOLUME.....	20 mL minimum required.
STANDARDS SUPPLIED	Permanent USEPA-approved Primary, 40.0 NTU, non-hazardous; and Permanent Zero Std.
INSTRUMENT SIZE...	7.5"L x 4"W x 3"H (19 x 10.2 x 7.6 cm.)
SHIPPING WEIGHT...	5 lbs. (2.2 Kg.) including carrying case.
WARRANTY..........	2 years; see Section 8 for details.

* * * * *

Section 2

QUICK OPERATING INSTRUCTIONS

See Table of Contents and Sections 3 and 4
for more detailed instructions and comments

Install batteries or connect AC adapter: Remove battery cover on bottom of instrument, and insert four AA batteries supplied. Observe correct polarity for each. Plug of optional AC adapter connects directly at rear of instrument.

Remove red dust cover plug from TUBE hole before testing. (Retain it to prevent dust penetration during inactive storage).

Range selection: Set RANGE knob for desired range: 0-20.00 NTU, 0-200.0, or 0-1000. If the turbidity of the test sample is higher than the range selected, the readout will show a figure "1" at the left side of the display. If so, turn the RANGE knob to the next higher range.

If sample contains large particles which cause readings to vary widely, switch to a higher range to lessen sensitivity.

Calibration: The Model 966 is pre-calibrated, and does not require standardization before use. (Do not unlock or rotate the ZERO or CAL. knobs; refer to Section 5 for the simple procedure for checking the calibration periodically).

Operation:

1. Pour the test sample into a clean, dry No. 965-50 Sample Tube, filling it to the neck. (For highest accuracy, make certain the tube is not scratched). Cap tube tightly, and thoroughly wipe fingerprints from the outside with lintless cloth or paper towel.
2. Holding the tube by its cap, gently swirl to mix (do not shake vigorously to cause bubbles) and push it down completely into the TUBE hole. Place the Tube Cover over the cap of the tube.
3. Press the TEST button down for 5-10 seconds until the reading is stable, and note the test result. Release TEST button.

* * * * *

29

Section 3

PROPER OPERATING and MEASURING TECHNIQUES

IMPORTANT: For highest accuracy and reproducible results, give careful attention to these instructions and comments.

Do not turn the ZERO or CAL. control knobs except when checking the calibration of the instrument -- see Section 5.

Use care in collecting samples. Make certain sample is representative. Collect a "composite" sample when testing large volumes. Rinse the container and its cap thoroughly with sample. Collect at least 20 mL. Close container, keep it protected from temperature changes, settling, and excessive shaking. Test as quickly as possible.

Vital importance of cleanliness. It is imperative that the containers used to obtain samples, and the tubes for samples and standards used with the instrument are absolutely clean, both inside and out. **This is vital — we cannot stress it enough,** especially when low values below 10 NTU are measured. Always wash and dry tubes promptly after use. If stubborn residues have adhered to the glass surfaces, soak tubes with non-abrasive lab detergent, or use an ultrasonic cleaner. Flush thoroughly with deionized water and air dry.

Even the slightest fingermarks, stains or dirt can lead to inaccurate results. To avoid fingermarks, always hold tubes by their cap threads or caps. If necessary, wipe the sides of sample tubes with an alcohol-treated lintless cloth or paper towel, and make certain they are dry before being inserted in the instrument. Take care to avoid scratching tubes in fixtures used for washing, drying, or storage.

Eliminate scratched tubes and standards. Scratches or etch marks may cause inaccurate results because they distort the instrument's light path and falsely mimic turbidity. To check for scratches, in a dark room place the empty sample tube (with cap removed) in the TUBE well, and keep the TEST button depressed. Slowly rotate the tube while looking down into the tube opening. Any scratches on the tube will be visible when the instrument's light strikes them as the tube is turned.

If tubes develop very small scratches, apply a thin film of No. 966-SO Silicone Oil. Spread with lint free cloth and wipe off excess. This has the same index of refraction as glass, and may temporarily serve to eliminate the effect of such scratches. However, frequent use of this oil may foul the tube well. Tubes with readily visible scratches should be discarded.

Always fill the sample tube to its neck. A lower meniscus may cause inaccurate results. Cap the tube tightly enough to prevent leakage and to avoid its coming loose when the tube is lifted or held by its cap.

Avoid and eliminate bubbles. Pour sample carefully and slowly to avoid bubbles from forming and clinging to the inside tube walls. If bubbles appear, swirl tube, strike bottom gently to dislodge them or let tube stand with cover removed until bubbles can be knocked free by gentle tapping. Other degassing methods include 1) warming sample 2) adding a surfactant 3) applying partial vacuum 4) ultrasonic bath. These methods must be used with caution to prevent changing the turbidity.

Avoid and eliminate condensation. Condensation will cause inaccurate results and may damage the instrument. Generally condensation forms when sample, tube with sample or standard, or the instrument itself is brought from a colder location into a moist and warmer one. All must be allowed to come to ambient temperature. Condensation on tubes must be carefully wiped away until the tube sides remain dry. Simply wiping a condensation-clad tube may be insufficient, as the condensation may quickly appear again to cause reading errors.

Never allow condensation or any liquids to enter the tube well. If this should happen, take immediate action -- see Section 7 Maintenance.

Place the Model 966 on a horizontal flat surface when making tests. Holding it by hand at an angle may disturb the sample or interfere by reflecting the light off the sample's meniscus.

Tube positioning or orientation. Holding the tube by its screwed-on cap, lower it all the way into the tube hole. Just the top edge of the shoulder, and the cap, should be visible. The tubes are specially selected to be uniform for all routine tests irrespective of how they are positioned, rotation-wise, in the tube well.

For extremely critical work, the use of one tube for calibration and subsequent testing provides the best precision and repeatability. A reference mark should be placed on the tube in the following manner: Fill tube with clear water and test in the low range. Rotate tube, step by step, full circle. At the position where the lowest reading is displayed place a felt-tip reference line on the shoulder of the tube aligned with the white index line on the bezel above the word TUBE.on the housing. Perform all subsequent tests with the same tube so positioned. Protect the reference mark with nail polish so it withstands repeated washing.

If using only one tube is unacceptable, test a series of tubes with the same clear or turbid sample, and place a reference mark on the shoulder of each at the position where they all give the same reading.

Always place the Tube Cover over the capped sample tube after the tube has been inserted into the tube well.

Range selection and Over-range. The Model 966 has three turbidity ranges: Low, Medium, and High. These have the nominal readings of 20.00, 200.0, and 1000 NTU (with a maximum digital display in each range of 19.99, 199.9, and 1999 respectively). Unless the sample is known to have a very high turbidity, it is practical to first test on the 0-20.00 range. If the turbidity is higher than this range, the readout will show the figure "1" at the left side of the display. Turn the RANGE knob to the next higher range 0-200.0. Since the lower ends of the ranges overlap, for greatest sensitivity and accuracy use the Low Range to cover 0-20, the Medium Range to cover 20-200, and the High Range to cover 200-1000 NTU.

When testing a sample with various sized particles (such as unfiltered raw water) which may cause readings to drift or vary in the 0-20.00 range, switch to the 0-200.0 or 0-1000 range. After filtration, return to lower range for higher sensitivity.

Samples over 400 NTU are best diluted 1:1 with clear tap water. See Section 4.6 for high range turbidity limitations.

Be aware of turbidity changes if sample is diluted or its temperature changes. This is because the particles causing the turbidity may change in structure or size.

Ambient Temperature Change. Allow at least 15 minutes for Model 966 to come to equilibrium after major changes in temperature.

Cover the Tube Well to keep out dust when the Model 966 is not in use and not in its carrying case. Insert a capped tube and cover with the tube cap, or cover the unit with a plastic wrap.

Low-battery warning is indicated when BAT appears at upper left side of display. Replace all 4 batteries promptly (see Section 7) to avoid inaccurate results.

Remove batteries if instrument is not expected to be used for periods exceeding 3 months to avoid possible damage due to battery leakage. Also, if instrument is always used with AC adapter, remove any batteries that may have been installed.

* * * * *

32

Section 4

UNDERSTANDING TURBIDITY and its MEASUREMENT

4.1 — WHAT TURBIDITY IS

Essentially, turbidity is the optical effect that occurs when light strikes materials that are suspended in a fluid, and it is used to express the "cloudiness" of that fluid. The word Nephelometry, generally accepted as a specific method of measuring turbidity, is derived from the Greek word for "clouds". It thus relates to the "measurement of cloudiness".

The substances that are suspended to form turbidity can vary from very tiny particles, to medium or large-sized ones. They can be "solid" particles like extremely fine silt formed from river or stream water grinding down rocks or stones. They can also be "soft" gelatinous or organic debris or bits of decaying vegetable matter. In addition, some turbidity-causing particles may be suspended droplets of an immiscible fluid, such as oil emulsions. Even gasses coming out of solution as microscopic bubbles, which gradually float to the surface and cling to the walls of the container, produce a turbid effect.

The particles can be any color -- white, grey, tan, green or even jet-black coal dust. They can be opaque or transparent. The particles can be round, or have irregular or even crystalline shapes. Others have no specific shape, such as fibers, irregularly twisted tiny hairs, lint-like structures -- even agglutinated lumps or strung-together globs.

The density of the particles can vary also -- from "stone-heavy" solids which tend to settle to the bottom rapidly after stirring ceases, to "equal-to-water" density chemical substances, fibers, or organic materials that will stay suspended in fluids for long periods after stirring has stopped.

Certain substances dissolved in water, such as sulfates and chloride, can be reacted with reagents to produce turbidities directly proportional to their concentration. The Model 966 is ideal for such turbidimetric analysis.

Turbid cloudiness can be present in many colorless fluids other than water, such as biochemical solutions and pharmaceutical products where suspensions or emulsions are present. With proper technique, these can be measured with the Model 966.

4.2 -- HOW THE MODEL 966 MEASURES TURBIBITY

Simply stated, turbidity is measured by directing a beam of light into the side of a tube containing the test sample,

33

measuring the amount of light that is reflected at a 90° angle by any particles present, and comparing it to the light scattered by a standard reference suspension. The light beam is provided by a special lamp powered by 4 AA batteries or an optional AC adapter. The intensity of the light reflected at 90° is measured by a stable photodetector, amplified, and displayed on a digital readout.

The amount of light is directly proportional to the degree of turbidity. At zero turbidity, no light is reflected or measured. The more particles that are present, the more light is reflected to the photodetector, and the higher the reading. Special design and construction prevents stray light from interfering with the measurement.

The term **FTU (Formazin Turbidity Units)** is used to express the results of a turbidimeter which has been calibrated with Formazin, as explained in Section 5. The 966 qualifies for this, and also for the expression of its results in terms of NTU as explained below.

The term **NTU (Nephelometric Turbidity Units)** is used to describe the test result of a measurement performed with a modern 90° turbidimeter (like the Orbeco-Hellige Model 966), rather than less exacting turbidimeters (like the Jackson Candle, or ineffective "straight-through-the-sample" photoelectric colorimeters). Since the 966 is based on a Formazin standardization, and fully qualifies as a true 90° turbidimeter, you may express results in FTU or NTU, whichever is most common in your work, as you wish. The USEPA considers the terms interchangeable.

UNDERSTANDING TURBIDITY MEASUREMENT

4.3 -- TURBIDITY IS NOT ALWAYS STABLE

It is important to understand that the measurement of turbidity is a changing, dynamic phenomenon. The masses of particles that cause turbidity are not always uniform -- sometimes they are like ever changing fog, heavy mists or rapidly changing clouds in a thunderhead -- turning, spiraling, drifting lower or higher, denser one moment and less dense another. Because of these often changing conditions, completely stable readings should not always be expected.

34

4.4 — COMPLEXITIES OF ACCURATE TURBIDITY TESTING

Even though the Model 966 is a most advanced, state-of-the-art turbidimeter, there can be samples where testing must be done with a good understanding of the phenomenon involved. Sometimes variable size of particles, presence of lint, fibers, "strings" of particles, etc., must be dealt with. Consider the following possibilities.

A. Effect of large particles in the sample

At times particles or foreign matter in a solution are so large or irregular in shape that turbidimeters cannot average them properly. This causes the digital display to drift and change readout values. Switching to the next higher range may dampen the readout changes, so that an average value of the digital readings may be estimated.

To check if erratic results are being caused by large particles, unscrew the cap from the sample tube and, while the uncapped tube is in the instrument (best in a darkened room to avoid extraneous light), press the TEST button and look directly down into the sample with a strong magnifier. Large contaminants may be visible in the illuminated field. Note: Readings without the screw cap may not be valid.

To try to alleviate this problem, pre-filter any sample that appears to be contaminated with large particles and debris. Use a coarse screen or net, no less than 100 microns, and pour the sample through it. This should rid the sample of large particles which can cause measurement errors, without adversely affecting readings of the main, less-than-large particle sample.

B. If particle sizes in the sample vary greatly

If all the particles remain suspended, the reading will represent an average of their optical properties.

If some particles tend to settle out rapidly while others remain suspended, the readings will change at a rate proportional to the settling rate. Therefore, if a plot is made of several readings and their time intervals, an interpolation can be made of the true initial value before settling started. Recorder models of the 966 can be very useful in making such measurements. (Non-recorder 966 models can be converted to recorder use; contact Customer Service).

C. **If particles in the sample are uniform in size, but are grossly different from the particle size of the standard**

In such cases, the optical refractive index may also be different from that of the standardizing solution. Try to use a standard as close to the apparent value of the unknown as possible. Most likely the readings obtained in instruments of different manufacture will be significantly different. Such comparisons should therefore not be made, except to use the results as relative values.

4.5 -- USE SPECIAL CARE WHEN MEASURING BELOW 1.0 NTU

Special cleaning and drying precautions should be taken. Use only scrupulously clean tubes, and dry them using a clean filtered air supply, or dry tank nitrogen. Holding the tube by the threaded end, carefully inspect all surfaces under bright light to assure that no scratches, stains or foreign materials are present. Carefully wipe tube after filling, before inserting in the instrument.

4.6 -- HIGH RANGE TURBIDITY LIMITATIONS

Samples with very high turbidity may exhibit a condition called "going blind" in which the measured turbidity is lower than the actual turbidity because a significant amount of scattered light is blocked by particles and does not reach the detector.

The U.S. Environmental Protection Agency recommends that for drinking water turbidity testing, higher ranges should only be used as indicators of required dilution volumes to reduce readings to less than 40 NTU. The USEPA apparently feels that turbidimeters can most accurately be calibrated at values of 40 NTU or less, and waters which give higher readings should be carefully diluted with water of zero-turbidity, and the results multiplied by the dilution factor. Our No. 966-ZT Zero Turbidity Outfit contains everything necessary to produce zero-turbidity water for diluting purposes, with complete instructions; see Price List.

Even if you are not required to follow USEPA procedures, <u>it is wise not to use direct readings over 400 NTU</u>. Instead, dilute and multiply the result by the dilution factor.

4.7 -- EFFECT OF COLOR. Sample color is due to dissolved substances that absorb light. Colored samples may cause measured turbidity to be low.

36

4.8 -- NON-AQUEOUS SOLUTIONS

The Model 966 can be used for measuring the turbidity of non-aqueous solutions. However, due to the differences of refractive index, the instrument may have to be recalibrated with a suitable standard. Contact Customer Service for details.

4.9 -- SUSPENDED SOLIDS cannot be directly related to turbidity values. Although turbidity readings vary with increased suspended solids measurements, there is no generally accepted conversion factor. This is because of possible differences in refractive index, and differences in size, composition and density of the particles present.

4.10 -- WHY DIFFERENT BRANDS OF TURBIDIMETERS GIVE DIFFERENT RESULTS

Turbidimeters of different manufacture, even when calibrated with the same standard, may give different results on the same test sample, because of several factors. Some pass the light through the bottom of the tube while others pass it through the sides. Some have imperfect ways to try to eliminate stray light. Some use photodetectors that change with temperature changes. Another uses a photomultiplier which ages with time, and thus has varying response. Merely meeting the USEPA specifications is by itself no positive guarantee, as they are not technically specific to details, and subject to interpretation.

* * * * *

37

CALIBRATION

The Model 966 Turbidimeter is supplied already pre-calibrated. The calibration confirmation is very quick and simple. It can be performed whenever desired.

For U.S. Environmental Protection Agency (USEPA) reporting under the National Pollutant Discharge Elimination System (NPDES) or the National Primary Drinking Water Regulation (NPDWR) permits, calibration check of all turbidimeters is required every 4 months. For this purpose a Zero and 40.0 NTU Primary Standard is supplied with the Model 966. Here's how to use them.

5.1 — Checking ZERO and 40.0 NTU calibrations.

Set RANGE switch to 0-200.0 range (the calibration of the other two ranges will be automatically performed by the 966's electronics).

Wipe the outside of the zero standard clean, and holding it by its cap lower it into the TUBE well and cover with Tube Cover. Press TEST button and allow reading to stabilize. If reading is not 00.0, adjust with the ZERO calibrate lock-control. This consists of two parts -- an outer ring that must be pushed down to unlock the control, and a central knob which can then be rotated clockwise (to increase the reading) or counter-clockwise (to decrease it). Releasing pressure on the outer ring locks the setting of the central control knob.

Press the outer ring down with the thumb and forefinger of one hand. Then, with the other hand move the central knob a small amount, release it, press TEST, note reading, and continue to turn in small increments, pressing TEST after each, until 00.0 is reached.

Those using optional AC Adapters 966-AC1 (for 110 volts) or 966-AC2 (for 220 volts) need not press the TEST button down, as readings will be displayed at all times.

After the Zero calibration has been confirmed or adjusted, proceed with the 40.0 NTU Primary Standard. Use a scrupulously clean, unscratched dry sample tube. It is good practice to pour approximately 5 mL of the standard into the tube, swirl it to rinse, and pour it out. Repeat this step twice, however, to prevent contamination, never pour used standard back into the Primary Standard bottle.

Fill the rinsed tube to the neck with 40.0 NTU Primary Standard. Repeat the calibration operation with the 40.0 NTU standard and the CAL. lock-control until a reading of 40.0 NTU is reached.

5.2 -- Calibration Standards.

The 40.0 NTU standard supplied is a primary standard made with styrene divinylbenzene spheres in an aqueous solution, and meets USEPA regulations. It is highly accurate, stable and reproducible. It is more convenient and economical to use than Formazin and is completely non-toxic. It is recognized by the USEPA, ASTM, APHA et. al. as a primary standard -- its value does not have to be checked against Formazin. It is NIST traceable.

The 40.0 NTU standard has a guaranteed shelf life of one year. Order replacement Orbeco standards through your dealer or directly from us.

IMPORTANT: Protect the standards from freezing. If distinct tiny crystals have formed and it does not appear as a uniform haze, replace it.

5.3 -- Sealed Secondary Standard.

The tube which you have just filled with primary standard, and capped tightly, may be used for future calibration checking, as a secondary standard. When you have completed the primary calibration outlined in paragraph 5.1 above, make a permanent felt-tip mark on the shoulder of the tube at the point where it aligns with the line on the bezel of the sample tube hole.

This capped (sealed) tube can now be used as a secondary calibration standard for routine, periodic use. Whenever desired, insert tube, align mark, and check calibration. Note that the USEPA requires that all turbidimeters used for its regulations be calibrated at least every 4 months with a primary calibration standard.

5.4 -- Formazin Calibration.

Those who wish to calibrate the Model 966 with Formazin may do so, but are cautioned that although 4000 NTU Formazin is reported to be stable for 1 year, dilutions of Formazin are far less stable and cannot be stored (even under refrigeration) for long periods. This requires repeated, costly, and inconvenient preparations of standards. Further, Formazin standards change value at different temperatures.

For those interested in calibrating with Formazin standards, we offer a convenient kit (No. 966-FO) which contains five stable concentrates and equipment to make zero turbidity water. Each concentrate can be diluted with zero-turbidity water to make 200 mL of 200 NTU Formazin standard for direct use, or for dilution to any desired lower values. Complete directions are included. Note: Diluted Formazin standards are not stable, and should be prepared fresh daily.

39

5.5 - CALIBRATIONS FOR TURBIDIMETRIC CHEMICAL TESTS and PRODUCT GRADING

Chemical procedures are available which develop a turbidity in proportion to the amount of substance under test. Such tests are available for sulfate and chloride in water, and for several biochemical tests. To determine sulfate concentrations, order No. 966-SO Sulfate Outfit, which contains everything needed.

The 966 can also be calibrated for a variety of product grading applications, such as for suspensions, colloidal solutions, turbid fluids, etc. Call our technical staff for help. Give range desired, sensitivity needed, specific procedure preferred, type of sample to be tested, temperature, etc.

* * * * *

40

RECORDER OPERATION

Models 966-R1 and 966-R2 with recorder outputs must be used with the regulated AC adapters supplied with them. (If you purchased a non-recorder model, it can be factory fitted with a recorder output. Contact Customer Service for details). Recorder output has been factory set to be used with an external meter accessory of 1.0 ma at approximately 1 volt. If a recorder requiring a lower voltage input is used call for technical assistance.

USE OF CONTINUOUS FLOW-THROUGH CELL

The optional 965-56 Flow-through Cell, used with Recorder Models 966-R1 and 966-R2 permits continuous monitoring and recording of the turbidity of a constantly flowing stream or sample.

It is ideal for many applications, especially in research or testing the effect of turbidity-treatment methods or chemicals such as flocculents, precipitants, etc., or the effects of buffering, temperature adjustment, or physical settling and filtering systems. In addition, it can be used for continuous liquid product quality testing, or grading surveillance of the clarity of edible oils, emulsions, oil-in-water mixtures, hydraulic fluids, and in many other special applications.

The flow-through cell has the advantage that calibration and subsequesnt calibration checking is extremely simple. The flow-through cell, with its inlet and outlet tubes still connected and functioning, need merely be momentarily removed from the tube well (without interruption or need to shut down the system), while a calibration standard is substituted in the tube well. The calibration can quickly be confirmed or adjusted, and the flow-through cell then be replaced in the test well after the calibration standard is removed.

Its design helps to keep the cell "self-cleaned". The incoming fluid tube in the cap is specially positioned to forcefully direct the sample in a powerful jet directly against the inside wall of the cell. The inside wall of the cell directs the flow in a strong circular whirlpool fashion, swirling the sample to forcefully cleanse the inside of the cell, until the fluid exits via the hose connection at the center of the cap.

WARNING: The flow through cell has not been designed for use with strong acids and various organics which can attack its plastic parts. Check with our Technical Service or run compatibility tests before proceeding.

Installation and use. Check the calibration of the instrument as described in Section 5. Remove the standard and simply substitute the flow-through cell, with its input and output tubing attached. Cover the cell with the No. 965-57 Cap supplied with the cell, which has pass-through slots for the tubing. Be careful to connect tubing securely, and twist cap on tightly to avoid leakage into tube well.

Connect the input tubing to the source of fluid, and output tubing to drain or receiving tank, etc., and allow flow to start. Flow can be by pump or gravity, but should be controlled by valving, pinch clamp or other means. WARNING: Do not exceed 5 psi (pounds per square inch). Regulate pressure if necessary. Use eye protection and handle with care. We recommend a protective barrier around the glass tube.

Check that air has been purged from flow-through cell by lifting it from the test well for inspection. Tilt or rotate it until all air has been swept through, then lower it back all the way down into the tube well.

Be careful that temperature changes do not cause bubbles or condensation to appear on cell walls. Cold sample streams should be pre-warmed to eliminate condensation before sample enters instrument. Bubble-traps or degassing should be employed to prevent bubbles from entering or forming on the cell. For samples with heavy debris or grossly mixed particle sizes, pre-treat by skimming, settling, centrifuging, floatation, coarse filtering, etc., to obtain desired results.

If water or condensation enters tube well, immediately remove cell. Unplug AC adapter, remove 4 corner screws at bottom of unit, and remove bottom to be able to thoroughly dry out the insides. Use forced warm (not hot) air stream to aid drying, if necessary.

* * * * *

42

MAINTENANCE -- TROUBLESHOOTING
ACCESSORIES and REPLACEMENT PARTS

The Model 966 has been designed and constructed to give years of trouble-free service. Do not allow dust, debris or fluids to enter the tube well. Cover the well or the entire instrument when not in use.

7.1 LAMP REPLACEMENT

The No. 966-54 Lamp Bulb furnished in the Model 966 has an average life of more than 10,000 continuous hours. Should it fail or have a reduced output as evidenced when the CAL. control can no longer bring the reading to the correct value, a replacement should be ordered from your dealer or Orbeco Customer Service. Replace as follows:

Unscrew the 4 corner screws from the bottom of the housing, and remove the bottom. On the circuit board, loosen the 2 connector screws holding the 2 wires from the lamp. Loosen the screw at the bulb, and withdraw the lamp and its wires. Insert new bulb so that 1/8" of its housing protrudes from the back end of the lamp cylinder. Tighten the screw, and attach the 2 wires to the circuit board connector. Check the calibration (Section 5) to ensure accurate results.

7.2 INSTRUMENT NOT WORKING?

If the 966 is not operating at all, or not operating correctly, first review the following points. (If it functions correctly, but the results appear wrong, see Section 7.3 below).

1. Check that each battery has a 1.3v output. If using optional No. 966-AC1 or 966-AC2 Regulated AC Adapter, check that its output is 5-7 volts. These are special <u>regulated</u> AC adapters; do not use ordinary ones.

2. Has sample tube been filled all the way to the neck? It must have 20 mL of fluid in it. Is it free of obstruction such as a label? Outside surface of tube must be unobstructed.

3. If lamp does not light (as seen looking down test well) when TEST button is pressed, or display is blank, see 7.1 above. If lamp lights but display is blank, return instrument (see Note A below).

4. If display digits remain at or near zero, make sure you are on the right range. Look down test well to see if bulb is out or very dim. Open instrument and check if lamp wires are tightly connected. With caution (best by technically trained person) confirm that lamp voltage is 2.5v. If less adjust trimpot next to lamp wires. If voltage is correct and lamp does not go on, replace. If lamp is OK but display does not change, check for obstruction in well. If still unsatisfactory, return instrument (see Note A below).

5. Readings change erratically. Check that batteries or AC adapter connectors have not corroded. Clean with fine emery cloth or replace batteries or connector plug.

6. Standard reads low. Standard may have deteriorated. Replace or if Formazin standardization is preferred, prepare fresh Formazin standard and avoid settling errors by gently swirling tube to mix before inserting and reading.

7. Display fluctuates between 2 adjacent values. Nothing is wrong. Note values and report average.

8. Cannot adjust CAL. control to display desired value. Check batteries or AC adapter as in 7.2.4. If OK, lamp may be failing; replace even though it still lights.

9. Figure "1" appears at left of display. Rotate RANGE selector to next higher range. If Zero standard results in "1" reading, turn ZERO control counterclockwise until zero is displayed. If this cannot be done, return the instrument.

NOTE A -- If it is difficult to return instrument for repair, and if you have access to a competent electronic repair person, contact factory with details of your difficulty.

7.3 WHEN TEST RESULTS ARE IN QUESTION

If the instrument itself seems to be functioning correctly, but the test results seem to be wrong, first thoroughly review Manual Sections 3, 4 and 5, and then the following:

a. Has the sample been taken correctly? Has it changed in value due to settling over time, exposure to heat or cold, or to being kept in a container that contaminated it?

b. Were sample cells clean and dry before use? Free of finger marks and scratches? Are sample tubes scratched or stained? Bubbles clinging to insides of tube? Condensation outside?

c. Have tubes been filled to the neck, positioned all the way down into tube well? Is tube cover being correctly used over the capped sample tube to keep out ambient light? Is instrument being used in horizontal position, and shielded from strong light?

d. Have ZERO or CAL. knobs been accidentally misadjusted? Has calibration been correctly performed? Are supplied calibration standard or Formazin standards still valid? (Dilute Formazin standards are usable only for a day or less!).

e. What are results being compared to, that appears to signify questionable results? Are those readings necessarily valid?

When communicating with us regarding results, please give very complete details of all aspects of your observations, standards used, their age, types and description of samples being measured, and successful results as well as problems encountered.

7.4 -- OPTIONAL ACCESSORIES and REPLACEMENT PARTS.

966-AC1	Regulated AC Adapter for 110v 50/60 Hz
966-AC2	Regulated AC Adapter for 220v 50/60 Hz
965-50	Optically Selected Glass Sample Tubes, pkg of 6
965-55	Tube Cover
966-SO	Silicone Oil
966-51	Package of Zero and 40.0 NTU Standards
966-16	Instruction Manual
966-54	Lamp Bulb
966-CC	Carrying Case
965-56	Flow-through Cell, for Models 966-R1 or 966-2
966-FO	Formazin Calibration Outfit Complete (R-3401P + 966-ZT)
R-3401P	Formazin PermaPak
966-ZT	Zero Turbidity Outfit
966-SO	Sulfate Calibration Outfit

* * * * *

LIMITED WARRANTY

Orbeco Analytical Systems, Inc. warrants the 966 Turbidimeter to be free from defects in material and workmanship for a period of two years from date of shipment. Warranty for expendable parts (such as glass sample tubes, calibration standards, lamp bulbs) is limited to 30 days from date of shipment.

To put the warranty into effect, fill out and mail the enclosed Product Registration Form to us within 2 weeks of your receipt of the instrument. This will enable us to record you as owner and send you news on new accessories and other information.

This limited warranty shall not apply to any instrument subjected to misuse, negligence, accident, shipping damage, or storage under adverse conditions...any instrument modified or used other than in accordance with the instructions furnished... any instrument repaired or altered by persons not authorized by us, in a manner to effect (in our judgement) its performance, safety, or reliability.

Contact us for instructions before returning any instrument. We may upon inspection of the returned instrument, at our discretion repair or replace it, or make an appropriate credit adjustment or prorated refund, for any instrument or accessory that fails to meet our specifications.

This warranty is in lieu of any other, expressed or implied, including those of merchantability or fitness of purpose. We reserve the right to make changes in design or manufacture of our products at any time, without notice, without incurring any obligation to make changes in other units.

We shall in no way be liable for damage, consequential or incidental, due to defects in any of our products, for the failure of delivery, for injuries to persons or property, or for any other cause.

* * * * *

ORBECO ANALYTICAL SYSTEMS, Inc.
185 Marine St., Farmingdale, NY 11735
Phones: 1-800-922-5242 516-293-4110
FAX: 516-293-8258

44/46

CHEMets® K-6010 Iron Test, Soluble & Total

CHEMetrics

CHEMets®

self -filling ampoules for
colorimetric analysis

Cat. No. K-6010

IRON TEST INSTRUCTIONS TOTAL & SOLUBLE

0-1 & 1-10 PPM

SAFETY INFORMATION

Read MSDS before performing this test procedure.

If this product is used as directed, the user will not come in contact with the reagent contained in these CHEMets®. If contact does occur, flush skin or eyes with water. Call a physician, if swallowed.

U.S. Patent No. 3,634,038

THE TEST METHOD

The K-6010 CHEMets® determine either Total Iron or Soluble Iron. The reagent is an acidic, buffered solution of 1,10-phenanthroline which produces an orange-red color with samples containing iron.

The A-6000 Activator Solution contains a mixture of thioglycolic acid and ammonia. This mixture dissolves most forms of particulate iron, allowing total iron to be determined without the use of heat or digestion. However, certain forms of iron (magnetite, ferrite, or hydroxide) do require a digestion (see Digestion Procedure) in place of the Total Iron Procedure.

Results are expressed in ppm (mg/Liter) iron as Fe.

REFERENCES

APHA Standard Methods, 15th ed., p.201, method 315B (1980).
ASTM Part 31 on Water, p.445, method D-1068, part A (1981).

TEST PROCEDURE

Soluble Iron

1. Fill the sample cup to the 25 mL mark with your sample..
2. Place the ampoule's tapered tip into one of the four depressions in the bottom of the sample cup. Snap the tip by squeezing the CHEMet™ ampoule toward the side of the cup (fig. 1). The sample will fill the ampoule and begin to mix with the reagent.
   NOTE: A small bubble of inert gas will remain in the ampoule to facilitate mixing.
3. Remove the fluid filled ampoule from the cup. Mix the contents of the CHEMet™ ampoule by inverting it several times, allowing the bubble to travel from end to end each time.
4. Wipe all liquid from the exterior of the CHEMet™ ampoule and then wait 1 minute.
5. After 1 minute, use the appropriate comparator to determine the level of iron in the sample.

Total Iron

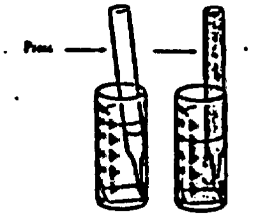
1. Fill the sample cup to the **25 mL** mark with your sample.
2. Add **5 drops** of the A-6000 Activator Solution. Stir briefly.

CAUTION
The A-6000 Activator Solution is a corrosive solution of thioglycolic acid. Avoid contact. Remove only from the glass bottle when in use. In case of contact, flush skin or eyes with water. If swallowed, seek prompt medical attention. READ MSDS BEFORE USING.

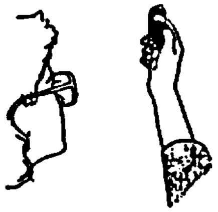
3. Wait 4 minutes.

NOTE: Certain forms of suspended and precipitated iron may require that the reaction time be increased from 4 minutes to 30 minutes or until the sample clears up.

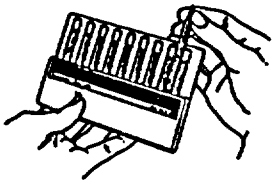
4. Stir briefly one more time, then proceed with the Soluble Iron procedure, beginning with Step #2.



Snapping the Tip
fig. 1



Using the Low-Range Comparator
fig. 2



Using the High-Range Comparator
fig. 3

USING THE COMPARATOR

When using the low range comparator (cylindrical), the CHEMet™ ampoule is placed in the center tube, flat end downward. The top of the cylinder is then directed toward a source of bright, white light while viewing from the bottom (fig. 2). Hold the comparator in a nearly horizontal position and rotate it until the color standard below the CHEMet™ ampoule shows the closest match.

The high range comparator (flat) should be illuminated by a strong white light directly above the comparator. The filled CHEMet™ ampoule should be placed between the color standards for viewing (fig. 3). It is very important that the CHEMet™ ampoule be compared by placing it on both sides of the standard tube before concluding that it is darker, lighter or equal to the standard.

DIGESTION PROCEDURE

Certain forms of suspended and precipitated iron can be measured only if the following procedure is performed in place of the Total Iron Procedure.

1. Fill a heat resistant, glass container to the **25 mL** mark with sample.
2. Add **5 drops** of a A-6000 Activator Solution.
3. Gently boil the sample until the volume is reduced to 10-15 mL.
4. Cool the sample and dilute to **25 mL** with iron-free water.
5. Proceed, beginning with Step #2 of the Soluble Iron procedure.

SOURCES OF ERROR

Strongly alkaline or buffered samples must be acidified to a pH of 4-5 prior to testing. Various metals form colored compounds with the reagent and may contribute to the apparent iron content of the sample.

CHEMets® K-1510 Ammonia - Nitrogen Test

CHEMets®

self-filling ampoules for
colorimetric analysis

Cat. No. K-1510

AMMONIA-NITROGEN
TEST INSTRUCTIONS

0.1-1 & 1-10 PPM

SAFETY INFORMATION

Read MSDS before performing this test procedure.

If this product is used as directed, the user will not come in contact with the reagent contained in these CHEMets ®. If contact does occur, flush skin or eyes with water. Call a physician, if swallowed.

CHEMets® is a registered trademark of CHEMetrics, Inc.

U.S. Patent No. 3,634,038 1358-5

THE TEST METHOD

The K-1510 CHEMets®: employ the Nessler's reagent which is a highly alkaline solution of mercuric iodide. The Nessler's reagent develops a yellow color in the presence of ammonia.

This test kit is intended for application to samples where direct Nesslerization is feasible, that is, where there is no need to separate the ammonia from interfering substances by distillation. Steam condensate and samples from most rivers, lakes and streams are suitable for analysis by this technique.

Results are expressed in ppm (mg/Liter) as ammonia-nitrogen, NH_3-N.

: CHEMets® is a registered trademark of CHEMetrics, Inc.

REFERENCES

ASTM Part 31 on Water, p.275, method D-1426, part B(1981).

APHA Standard Methods, 15th ed., p.351, method 417B(1980).

USING THE COMPARATORS

Two comparators are included in the kit to cover the ranges 0.1 to 1 ppm (cylindrical) and 1 to 10 ppm (flat).

When using the lower range comparator, the CHEMet™ ampoule is placed in the center tube, flat end downward. The top of the cylinder is then directed toward a source of bright, white light while viewing from the bottom (fig. 2). Hold the comparator in a nearly horizontal position and rotate it until the color standard below the CHEMet™ ampoule shows the closest match.

The high range comparator should be illuminated by a strong white light directly above the comparator. The filled CHEMet™ ampoule should be placed between the color standards for viewing (fig. 3). It is very important that the CHEMet™ ampoule be compared by placing it on both sides of the standard tube before concluding that it is darker, lighter or equal to the standard.

TEST PROCEDURE

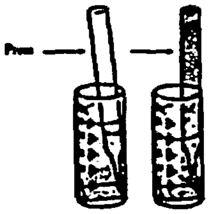
1. Fill the sample cup to the 25 mL mark with your sample.
2. Add 1 to 2 drops of A-1500 Stabilizer Solution.
3. Place the CHEMet™ ampoule's tapered tip into one of the four depressions in the bottom of the sample cup. Snap the tip by squeezing the ampoule toward the side of the cup (fig. 1). The sample will fill the ampoule and begin to mix with the reagent.

   NOTE: A small bubble of inert gas will remain in the ampoule to facilitate mixing.

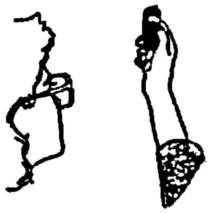
4. Remove the fluid filled CHEMet™ ampoule from the cup. Mix the contents of the ampoule by inverting it several times, allowing the bubble to travel from end to end each time.
5. Wipe all liquid from the exterior of the ampoule and wait 1 minute.
6. After 1 minute, use the appropriate comparator to determine the level of ammonia-nitrogen in the sample.

   NOTE: To convert to ppm (mg/Liter) ammonia as NH3, multiply test results by 1

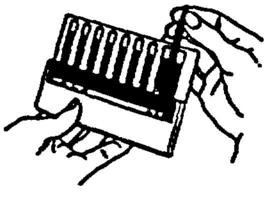
Snapping the Tip
fig. 1



Using the Low-Range Comparator
fig. 2



Using the High-Range Comparator
fig. 3



Attachment 3
Field Data Forms

Page ___ of ___

RMT INC

PROJECT NAME: ______________________

PROJECT NUMBER: ______________________

LOCATION: ______________________

DATES OF FIELD WORK: ______________________

PURPOSE OF FIELD WORK: ______________________

WORK PERFORMED BY: ______________________

Signed ______ Date ______ QC'd By ______ Date ______

1/7

RMT INC.

Page ___ of ___

GENERAL NOTES - EQUIPMENT SUMMARY

WATER LEVEL MEASUREMENTS WERE COLLECTED WITH:

Name and Model Number of Instrument ______ Serial Number (if applicable) ______

DEPTH TO BOTTOM OF WELL MEASUREMENTS WERE COLLECTED WITH:

Name and Model Number ______ Serial Number (if applicable) ______

PURGING METHOD:

Name and Model Number of Pump or Type of Bailer ______ Serial Number (if applicable) ______

PURGE WATER DISPOSAL METHOD:

______

SAMPLING METHOD:

Name and Model Number of Pump or Type of Bailer ______ Serial Number (if applicable) ______

pH/CONDUCTIVITY: *See meter calibration logs

FILTRATION METHOD:

Name and Model Number of Device ______ Serial Number (if applicable) ______

Filter Type ______ Tubing Type ______

DECONTAMINATION AND FIELD BLANK WATER SOURCE:

Potable Water Source (if applicable) ______ DI Water Source ______

Signed ______ Date ______ QC'd By ______ Date ______

2

REV 01/14/94

F-182

RMT

pH AND CONDUCTIVITY METER CALIBRATION LOG

PROJECT NAME: ____________________ DATE: ______

PROJECT NUMBER: ____________ SAMPLER: ______________________

pH METER

MODEL: ______________ SERIAL NO.: ______________

Meter Check	Buffer Check	Slope Reading	Time

Buffer Lot Numbers: pH 4: __________ pH 7: ____________

CONDUCTIVITY METER

MODEL: ______________ SERIAL NO.: ______________

Instrument Zero	Red Line	Reading of Calibration Soln	Temp. of Calibration Soln	Corrected* Cond. @ 25°C	Time

Conductivity Calibration Solution Lot Number: ____________________

Problems/Corrective Actions: ____

____

____

* FORMULA FOR TEMPERATURE NORMALIZING CONDUCTIVITY: SC + {1 + [0.0191 x (T - 25)]} = Cond @ 25°C

NOTE: METER CHECKS AND CALIBRATIONS MUST BE PERFORMED A MINIMUM OF 4X/DAY.

Signed ____________ Date ______ QC'd By ____________ Date ______

3

RMT INC.

Page ___ of ___

WATER LEVEL DATA

PROJECT NAME: ______________________ DATE: ______________________

PROJECT NUMBER: ______________________ SAMPLER: ______________________

Well Location	Time	Depth to Water (feet)*	Depth to Bottom (feet)	Water Elev. (MSL)

* All Water Levels Must Include Reference Point and Tape Correction factor, i.e. 1.11 + 0.00 T/PVC.

Signed ______________________ Date __________ QC'd By ______________________ Date __________

4

RMT

LOW-FLOW GROUNDWATER SAMPLING STABILIZATION LOG

PROJECT NAME: ____________________ WELL NUMBER: ________________

PROJECT NUMBER: __________________ WELL DIAMETER: ______________

DATE: ____________________________ SAMPLER: ____________________

Type Of Pump Used: ____

Pumping Rate (gallon/minute): ____________________________________

Water level before purging (nearest 0.01 ft. below reference point) ____ + ____ T/ ____

Depth to bottom of well (obtained from well logs) ____ + ________ T/ ____________

Calculated volume of water in casing ______________________________

Weather conditions ____

Time	Purge Rate (gal/min)	pH (Units)	Turbidity (NTU)	Conductivity Units: ________		Temperature (°C)	Water Level (0.01 ft.)	Cumulative Purge Volume (gal)
				Uncorrected	Corrected			

NOTE: STABILIZATION TEST IS COMPLETE WHEN 3 SUCCESSIVE READINGS ARE WITHIN THE FOLLOWING LIMITS: pH - ±0.1 pH; COND. - ±5%, TEMP (CORRECTED); TEMP. - ±0.5°c; TURBIDITY ±10%

Signed ____________________ Date ________ QC'd By ____________________ Date ________

document in microsoft internet explorer 04/07/98 3:59 AM

5

RMT

WATER SAMPLE LOG

Sheet ______ of ______

44 Heartland Trail *Madison, WI 53717-8923* *P. O. Box 8923 (Zip: 53708-8923)* *(608) 831-4444* *FAX: (608) 831-3334*

PROJECT NAME	PREPARED		CHECKED		PROJECT NO.
	By:	Date:	By:	Date:	

SAMPLE NO.: ______________ WELL DIAMETER: ☐ 2" ☐ 4" ☐ Other ______________

WELL MATERIAL: ☐ PVC ☐ SS ☐ Iron ☐ Other ______________

SAMPLE TYPE: ☐ GW ☐ WW ☐ SW ☐ DW ☐ Leachate ☐ Other ______________

PURGING

TIME: ______________ DEPTH TO WATER: ________ + ________ T/ ________

WELL VOLUME: ________ gallons DEPTH TO BOTTOM: ________ + ________ T/ ________

TOTAL VOLUME REMOVED: ________ gallons METHOD: ☐ Bailer, ________ ☐ Pump, ________

ODOR: ☐ None COLOR: ________ TURBIDITY: ☐ None ☐ Moderate

☐ Other ________ ☐ Slight ☐ Very

DISPOSAL METHOD: ☐ Ground ☐ POTW ☐ Drum ☐ Other ______________

SAMPLE

TIME: ______________ DATE: ______________

ODOR: ☐ None COLOR: ________ TURBIDITY: ☐ None ☐ Moderate

☐ Other ________ ☐ Slight ☐ Very

pH: ________ CONDUCTIVITY: ______________ µmhos/cm TEMPERATURE: ________ °C

COMMENTS: ______________ CORRECTED CONDUCTIVITY: SC ÷ [1 + [0.0191 x (T - 25)]]: ________

FILTRATE (0.45 µm)

☐ NOT APPLICABLE

ODOR: ☐ None COLOR: ________ COMMENTS: ______________

☐ Other ________

BOTTLES FILLED

*PRESERVATIVE CODES:

A - None B - HNO3 C - H_2SO_4 D - NaOH E - HCL F- ______________

Number	Size	Type	Preservative*	Filtered	Number	Size	Type	Preservative*	Filtered
				Y N					Y N
				Y N					Y N
				Y N					Y N
				Y N					Y N

HAIN-OF-CUSTODY NUMBER: ______________ DATE SHIPPED: ______________ METHOD: ______________

RBILL NUMBER: ______________ SIGNED: ______________ DATE: ______________

b

Page ___ of ___

WELL INSPE ON REPORT

PROJECT NAME: ____________________ DATE: ____________________

PROJECT NUMBER: ____________________ SAMPLER: ____________________

Well No.	Protective Casing (Y/N)	Well Cap (Y/N)	Look (Y/N)	Permanent Legible Labels (Y/N)	Surface Seal (Y/N)	Ease of Inserting/Removing Bailer	Depth of Sediment in Bottom of Well	Degree of Immobility of Protective Casing	Comments

[1] Performed during the second quarter only.

Signed ____________________ Date __________ QC'd By ____________________ Date ____________________

7/7 REV 01/05/94

F-184

Analysis Request/Environmental Services Chain of Custody

Lancaster Laboratories
A division of Thermo Analytical Inc.

For Lancaster Laboratories use only
Acct. # __________ Sample # __________

Please print. Instructions on reverse side correspond with circled numbers.

① Client: __________ Acct. #: __________
Project Name/#: __________ PWSID #: __________
Project Manager: __________ P.O.# __________
Sampler: __________ Quote #: __________
Name of state where samples were collected: __________

For lab use only
FSC: __________
SCR #: __________

② Sample Identification	Date Collected	Time Collected	③ Grab	Composite	Matrix ④ Soil	Water (Potable, NPDES)	Other	Total # of containers	⑤ Analyses Requested								Remarks	⑥ Temp. of samples upon receipt (if requested)

Turnaround Time Requested (TAT) (please circle): Normal Rush
(Rush TAT is subject to Lancaster Laboratories approval and surcharge.)
Date results are needed: __________
Rush results requested by (please circle): Phone Fax
Phone #: __________ Fax #: __________

Data Package Options (please circle if requested)
QC Summary Type VI (Raw Data)
Type I (Tier I) GLP
Type II (Tier II) Other
Type III (NJ Red. Del.)
Type IV (CLP)

SDG Complete?
Yes No

Site-specific QC required? Yes No
(If yes, indicate QC sample and submit triplicate volume.)
Internal Chain of Custody required? Yes No

					⑨
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

Client Name	
Sample Identification	
Date Time By	
Testing Required	Preservative
Lancaster Laboratories	

CLIENT

If you do not have an account with us, results will not be released until payment is received.

SAMPLE IDENTIFICATION / LOCATION **CL. RES:**

COLLECTION INFORMATION:

☐ **COMPOSITE**
☐ **GRAB**

DATE **TIME** **BY:**

TESTING REQUIRED **PRESERVATIVE(S) ADDED**

Lancaster Laboratories
2425 New Holland Pike, Lancaster, PA 17601-5994

LL #

MICROSEEPS, Inc.

220 William Pitt Way, Pittsburgh, PA 15238
Phone: (412) 826-5245 Fax: (412) 826-3433

CHAIN-OF-CUSTODY RECORD

Note: Enter proper letters in Requested Analyses columns below.

Company Name: ______

Address: ______

Proj. Manager: ______

Proj. Location: ______

Proj. Number: ______

Phone # : ______ Fax # : ______

Sampler's signature : ______

Analysis Options

Note: If analysis D,E,or K is selected, [illegible] (option) NOT wanted.

* A	C1 -C4	G	Chlorinated HC
* B	Hydrogen & Helium	H	BTEX
* C	Permanent Gases (CH4, CO, CO2, N2, O2)	J	BTEX & C5 - C10
D	Mercury (Soil) or (Air **)	K	TPH (C5 - C10) or (C4 -C12)
E	TO-14 by GC/MS (Ambient) or (Source **)	L	C11 - C18
F	601 & 602 Compounds	Other	Specify below.

* An additional 22 ml vial of sample is required when requested in combination with another analysis.

** Available upon request.

Collection Date	Collection Time	Number of Containers	"Summa" # If Can. used	Sample Type	Sample Identification	Requested Analyses					(Other)	Remarks

Results to :	Invoice to :

Relinquished by :	Company :	Date :	Time :	Received by :	Company :	Date :	Time :
Relinquished by :	Company :	Date :	Time :	Received by :	Company :	Date :	Time :
Relinquished by :	Company :	Date :	Time :	Received by :	Company :	Date :	Time :

WHITE COPY : Laboratory to return. YELLOW COPY : Laboratory PINK COPY : Submitter

Due to Requirements
of Microseeps'
Sample Autoloaders

PLEASE
USE
ENCLOSED LABELS
ONLY

Due to Requirements
of Microseeps'
Sample Autoloaders

PLEASE
USE
ENCLOSED LABELS
ONLY

Due to Requirements
of Microseeps'
Sample Autoloaders

PLEASE
USE
ENCLOSED LABELS
ONLY

NOTICE
Due to Requirements
of Microseeps'
Sample Autoloader

PLEASE
USE
ENCLOSED LABELS
ONLY

NOTICE
Due to Requirements
of Microseeps'
Sample Autoloader

PLEASE
USE
ENCLOSED LABELS
ONLY

NOTICE
Due to Requirements
of Microseeps'
Sample Autoloader

PLEASE
USE
ENCLOSED LABELS
ONLY

NOTICE
Due to Requirements
of Microseeps'
Sample Autoloader

PLEASE
USE
ENCLOSED LABELS
ONLY

NOTICE
Due to Requirements
of Microseeps'
Sample Autoloader

PLEASE
USE
ENCLOSED LABELS
ONLY

NOTICE
Due to Requirements
of Microseeps'
Sample Autoloader

PLEASE
USE
ENCLOSED LABELS
ONLY

NOTICE
Due to Requirements
of Microseeps'
Sample Autoloader

PLEASE
USE
ENCLOSED LABELS
ONLY

NOTICE
Due to Requirements
of Microseeps'
Sample Autoloader

PLEASE
USE
ENCLOSED LABELS
ONLY

NOTICE
Due to Requirements
of Microseeps'
Sample Autoloader

PLEASE
USE
ENCLOSED LABELS
ONLY

Appendix B
Quality Assurance Project Plan

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN

NORTH PENN AREA 12 SUPERFUND SITE
WORCESTER TOWNSHIP,
MONTGOMERY COUNTY, PENNSYLVANIA

January 1999

Table of Contents

List of Tables

Acronyms

AA	Atomic Absorption Spectrophotometer
AOC	Administrative Order of Consent
ASTM	American Standards for Testing Materials
BNA	Base-neutral/acid extractables (semivolatile organic compounds)
CCB	Continuing calibration blank
CCV	Continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund), as amended by the Superfund Amendments and Reauthorization Act (SARA)
CLP	Contract Laboratory Program
COPC	Constituent of potential concern
CRA	Contract Required Atomic Absorption Spectrophotometer Standard
CRDL	Contract Required Detection Limit
CRI	Contract Required Inductively Coupled Plasma Spectrophotometer Standard
CRQL	Contract Required Quantitation Limit
CRL	Central Regional Laboratory
CVAA	Cold vapor atomic absorption spectrophotometer
DQO	Data Quality Objective
FSP	Field Sampling Plan
GC	Gas chromatograph
GFAA	Graphite furnace atomic absorption spectrophotometer
HRGC/HRMS	High resolution gas chromatograph/high resolution mass spectrometer
ICB	Initial calibration blank
ICP	Inductively coupled plasma emission spectrophotometer
ICS	Interference check sample
ICV	Initial calibration verification
LRA	Linear range analysis

MDL	Method detection limit
MS/MSD	Matrix spike/matrix spike duplicate
NIST	National Institute for Standards and Technology
OSC	On-site Coordinator
PCB	Polychlorinated biphenyl
QA	Quality Assurance
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAS	Routine analytical services
RI/FS	Remedial Investigation/Feasibility Study
RMT	RMT, Inc.
RPD	Relative percent difference
RPM	Remedial Project Manager
SAS	Special analytical services
SOP	Standard Operating Procedure
SOW	Statement of Work
TAL	Target Analyte List
TCL	Target Compound List
TIC	Tentatively Identified Compound
USEPA	United States Environmental Protection Agency
VOA	Volatile organic analysis
VOC	Volatile organic compound

Section 1
Project Description

1.1 Introduction

The Quality Assurance Project Plan (QAPP) presented in this Appendix has been prepared to address the Remedial Design (RD) phase for the North Penn Area 12 Superfund site located in Worcester Township, Pennsylvania. This QAPP is provided as supporting documentation for the RD Work Plan for the former Transicoil site. Applicable project schedules and detailed procedures for sample collection, sample numbers, and locations are given in the Work Plan and Field Sampling Plan (FSP). This QAPP is being submitted to the United States Environmental Protection Agency (USEPA) Region III in compliance with the Administrative Order by Consent (AOC), EPA Docket Number III-98-078-DC.

The USEPA requires that all environmental monitoring and measurement efforts mandated or supported by the USEPA be centrally managed by a QA program to ensure that the precision, accuracy, completeness, and representativeness of the RI/FS data are known and documented. The QAPP also describes the protocols that will be followed for collecting and handling samples, sample storage, chain-of-custody procedures, and laboratory and field analyses.

This QAPP was prepared in general accordance with the following guidance documents:

- EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, EPA /QA/R-5. (Draft), October 1997.
- Data Quality Objectives Process for Superfund, Interim Final Guidance, OSWER Directive 9355.9-01, September 1993.
- EPA NEIC Policies and Procedures Manual,, EPA 330/978-001-R, May 1986.
- National Functional Guidelines for Organic Data Review, EPA 540/R-94-012, and Modifications to the National Functional Guidelines for Organic Data Review, EPA Region III, September 1994.
- Region III Innovative Approaches to Data Validation, EPA Region III, September 1994.
- National Functional Guidelines for Inorganic Data Review, EPA 540/R-94/013 and Modifications to the National Functional Guidelines for Inorganic Data Review, EPA Region III, April 1993.

1.2 Site Description and Background

A description and background of the site is presented in Section 2 of the Work Plan .

1.3 Investigative Objectives

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide results that address the data quality objectives and produce data that are legally defensible. Specific procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal quality control, audits, preventive maintenance of field equipment, and corrective action are described in this QAPP. The purpose of this QAPP is to describe the project objectives and organization, functional activities and quality assurance and quality control protocols that will be used to achieve the desired data quality objectives (DQOs) at the former Transicoil site. The investigative objectives of the Pre-design Phase of the remedial design have previously been described in the Work Plan and Field Sampling Plan for the site.

1.3.1 Analyses

To meet the data needs, the testing program consists of the following analyses to be performed on groundwater samples as outlined in the above documents:

- Volatile Organic Compounds (VOCs)
- Freon 113
- Nitrate, chloride, sulfate, sulfide, alkalinity and hardness
- Hydrogen, methane, nitrogen, and carbon dioxide, ethane and ethene.
- Groundwater field testing for pH, Eh, specific conductance, temperature, turbidity, total and ferric iron, dissolved oxygen and ammonia
- Field physical testing for groundwater level
- Field and Laboratory analytes are listed in Table 1

1.3.2 Field Parameters and Uses

The Sampling Procedures are described in detail in Section 2 of the FSP. This QAPP references the appropriate sections of the FSP without repeating the information. The Field Instrument Calibration and Analytical Procedures (Sections 2 and 8 of the QAPP) and the Field Instrument Preventive Maintenance Procedures (Section 12 of the QAPP) also reference the applicable sections of the FSP.

Temperature, specific conductance, dissolved oxygen (DO), pH, Eh, and turbidity will be measured from all groundwater samples and be used as indicators of well purging stability as well as in later data interpretations.

Samples from selected wells will also be analyzed in the field for ammonia, and total and ferric iron using colorometric kits.

1.3.3 Laboratory Parameters and Uses

All laboratory analyses will be performed by Lancaster Laboratories with the exception of gaseous extraction's which will be performed by Microseeps, Inc.

VOCs will be analyzed using low level quantitation limits with a focus on identifying the levels of TCE, 1,1,1-TCA and daughter compounds including CIS-1,2-DCE, 1,1-DCE and Vinyl Chloride. BTEX analysis will be in support of natural attenuation characteristics. Freon 113 will be analyzed as a potential COC. Additional parameters, nitrogen, sulfate, sulfide, chloride, carbon dioxide, hydrogen, methane, ethane, and ethene will be analyzed to support natural attenuation evaluations hardness and alkalinity will be analyzed to support remedial design evaluations. Tables 3 and 4 in Section 8 of the QAPP contain the quantitation limits for the respective analytes.

1.3.4 Intended Data Uses

The RD Work Plan details the intended data uses, which are only summarized briefly here. This Pre-Design sampling phase has been planned to provide the following information to the extent required to:

1. Confirm the level of VOCs in the groundwater beneath the former Transicoil site and establish a baseline for future monitoring as well as performance monitoring during the remedial action.
2. To evaluate the potential for formation or screen plugging from planned re-injection of treated groundwater, or impacts from groundwater chemistry on the design of the treatment system.
3. To provide an initial assessment of the potential for biodegradation and other natural attenuation mechanisms acting on contaminants in the groundwater at the site.

1.4 Sample Network Design and Rationale

The sample locations and rationale for selected sample locations are described in Section 3 of the Work Plan and Section 2 of the FSP. Figures 1, and 2 of the RD Work Plan and Figure FS-1 of the FSP present site maps and sampling locations. The sample analytical parameters are indicated in Table 1 of this document. Data collection activities conducted during the Pre-Design Phase are described in the FSP.

Table 1
Field Laboratory Analyte List

Field Methodologies		**Analytes**
Purge Stability using a micro purge cell and probe		DO, Eh, pH, Specific Conductance, Temperature Turbidity
Natural Attenuation criteria using a colorometric field kit.		Ammonia, Total and Ferric Iron
Laboratory Methodologies		**Analytes**
Contaminants of Concern	Low Level VOCs	BTEX, VC, chlorotethane, 1,1-DCE, 1,2-DCE (total), cis-1,2-DCE, trans-1,2-DCE, 1,1,1-TCA, TCE, PCE
	Freon 113	1,1,2-Trichloro-1,2,2-trifluoroethane
Natural Attenuation and Remedial Design Criteria:	Anions	Chloride, sulfate, sulfide, nitrate
	Other	alkalinity, hardness
	Gases	Hydrogen, methane, carbon dioxide, ethane and ethene

1.5 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements which specify the quality of the data required to support decisions made during RD/RA activities and are based on the end uses of the data to be collected. As such, different data uses may require different levels of data quality. There are two analytical levels which address various data uses and the QA/QC effort and methods required to achieve the desired level of quality. These levels are:

Screening Data

These data are generated by less precise analytical methods than with less rigorous sample preparation. Sample preparation steps may be restricted to simple procedures, such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data provide analyte identification and quantification, although the quantification may be relatively imprecise. A portion of screening data may be confirmed using analytical methods and QA/QC procedures and criteria associated with definitive data. Screening data without associated confirmation data are not considered to be data of known quality.

Screening quality data will be used for field-measured parameters such as pH, temperature, specific conductance, dissolved oxygen, ferrous iron, redox potential (ORP;Eh), turbidity, depth to groundwater, ammonia and health and safety monitoring. These data would be used for determining the progress of the monitoring well purge process, general groundwater quality, potential for natural attenuation, and possible as input to computer fate and transport models.

Definitive Data

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

The following data will be collected to meet definitive data quality objectives:

- Groundwater to be analyzed for specific volatile organic compounds (VOCs), Freon 113 and BTEX in accordance with USEPA CLP low level analytical protocols and USEPA data validation procedures.
- Alkalinity, chloride, hardness, sulfate, sulfide, and nitrate, will be analyzed in accordance with USEPA-approved analytical methods and laboratory Standard Operating Procedures (SOPs). These data will be used to evaluate remedial design options and evaluate the potential for natural attenuation.
- Hydrogen will be analyzed by gas extraction analysis. Methane, carbon dioxide and nitrogen will be analyzed by Permanent Gas extraction methods and Ethane. Ethene will be analyzed by Light Hydrocarbon extraction methods. Each of these analyses comes under Method AM 19 GA as executed by Microseeps, Inc. There is currently no EPA approved method for these analyses. These data will be used to evaluate the potential for natural attenuation.

Section 2
Project Organization and Responsibilities

2.1 Identification of Key Project Personnel

The Pre-Design and Remedial Design sampling will be conducted by RMT, Inc., on behalf of the Schlumberger Industries. The key management and technical staff responsible for the execution of the Remedial Design are shown on the organizational chart on Figure 6 of the Work Plan.

Personnel involved in the investigation, and in the generation of data as a result of investigation activities, become a part of the overall Project Quality Assurance program. Within that program, the following individuals have specific responsibilities: the Project Coordinator, the Technical Coordinator, the Laboratory Coordinator, and Field Personnel. Specific laboratory personnel with Quality Assurance/Quality Control responsibilities include the Laboratory Quality Assurance Officer and the Laboratory Scientists and Technicians.

2.2 USEPA Region III Project Manager (RPM)

USEPA Region III Project Manager - Patrick McManus is the primary USEPA Region III contact for the project. He will direct project activities for the USEPA Region III, coordinate regulatory status and issues with the USEPA Region III, and ensure that the RD/RA activities comply with the ROD.

2.3 RMT Project Coordinator

Clifford Kirchof will be the primary point of contact and provide Senior Management oversight, technical direction, and review of RMT's performance on this project. He will also provide input concerning Superfund procedures and conformance with the NCP. He will also coordinate activities with the USEPA and the PADEP as appropriate.

2.4 RMT Technical Coordinator

Dan Oman will be responsible for implementation of the RD Work Plan. He will coordinate technical staff assignments, and establish and communicate schedules and budgets. As necessary, he will contact the USEPA RPM regarding status, technical or regulatory issues.

2.5 RMT Field Coordinator

The Field Coordinator will be the principal field team member primarily responsible for project field coordination and in-field Quality Assurance activities. The Field Coordinator will guide the field personnel in achieving a thorough understanding of the project Quality Assurance Plan and their respective roles relative to one another within the established project framework. The Field Coordinator will also act as the site Health and Safety Representative (HSR).

The Field Coordinator is also responsible for the day-to-day activities of contractor field personnel. In this capacity, the Field Coordinator is responsible for the Quality Assurance of daily project activities and the maintenance of the Quality Assurance Project Plan. Further responsibilities include the review of field notebooks, driller's logs, and other field-related documentation.

2.6 RMT Field Personnel

These environmental staff will be responsible for measuring and recording field parameters; installing monitoring points, collecting, labeling, and transporting samples; and conducting in-field measurements, in accordance with the QAPP and FSP. They will report to the Field Coordinator.

2.7 RMT Laboratory Coordinator

The Laboratory QA/QC Coordinator will be responsible for ensuring that applicable QA/QC procedures are followed. This will include reviewing QA/QC procedures and documentation, and directing the data validation and assessment activities, also be responsible for internal performance and system audits.

Section 3
Quality Assurance Objectives for Measurement Data

Data quality requirements are based on the intended use of the data, the measurement process, and the availability of resources. Data quality requirements include detection limits, accuracy, and precision Quality Assurance protocols for the analytical methods to be used and the analyses to be conducted. Specific guidelines for accuracy, precision, completeness, and representativeness are discussed in the following subsections. Field blank, trip blank, decontamination evaluation (*i.e.*, "rinsate" or "equipment") blanks, and field duplicates described in Section 11 of this QAPP will be subjected to the same Quality Assurance objectives as samples.

3.1 Accuracy

Accuracy is defined as the degree of agreement of a measurement or average of measurements with an accepted reference or true value. The project-specific QA objectives established for accuracy are expressed in the following parameters.

3.1.1 Reference Materials

Reference materials used as calibration standards or surrogate compounds will be certified, commercially available materials.

3.1.2 Instrument Performance

Instruments used in this project will be checked each day that samples are analyzed to demonstrate instrument performance. The QA objectives for instrument sensitivity, calibration, and performance are established in the USEPA Contract Laboratory Program (CLP) Statement of Work (SOW) and other USEPA analytical methods. These methods are listed in Section 8 of this QAPP.

3.1.3 Recovery of Surrogates

Surrogate compound recovery is utilized to evaluate proper performance of the analytical method and/or possible matrix interference to the analytical method for organic compounds.

The recovery of a surrogate compound (S) added to a sample will be defined as follows:

$$\text{Recovery \%} = \frac{\text{ug S found in sample}}{\text{ug S added to sample}} \times 100\%$$

This equation assumes that the surrogate is not present in the sample. The objectives for recovery of surrogates from aqueous matrices are given in the USEPA CLP Statement of Work for Organics Analyses (OLM03.0; December 1994).

3.1.4 Recovery of TCL Analytes

The recovery of analytes from samples will be evaluated using matrix spikes. Representative analytes will be added ("spiked") into samples. Matrix spikes and matrix spike duplicates will be performed at the frequency specified in the CLP protocol. The spike recovery of an analyte (X) will be defined as follows:

$$\text{Spike Recovery (\%)} = \left(\frac{\text{ug X found in spiked sample- ug X in native sample}}{\text{ug X added to sample}}\right) \times 100\%$$

Spike recovery data is used to check for possible sample matrix interferences and analytical bias. The objectives for the spike recovery from aqueous matrices are given in the USEPA CLP protocols.

3.2 Precision

Precision is defined as a measure of mutual agreement among individual measurements of a sample property. The project QA objectives established for precision are expressed in the following parameters.

3.2.1 Analysis of Standards

One of the QA objectives for this project is that each initial calibration curve and subsequent (*i.e.*, "continuing") calibration standards meet or exceed the minimum QA criteria established in the CLP protocols.

3.2.2 Analysis of Spiked Samples

A second QA objective for this project is that the results of spiked samples (*i.e.*, matrix spikes) and spiked sample duplicates (*i.e.*, matrix spike duplicates) be within the advisable recovery and Relative Percent Difference (RPD) limits specified in the CLP analytical protocols.

3.2.3 Analysis of Duplicate Samples

A third QA objective for this project is that analyte concentrations be comparable between duplicate samples. This includes 1) duplicate samples collected in the field, 2) duplicate analyses resulting from matrix spike and matrix spike duplicate samples, and 3) results generated from multiple analyses of a sample performed at the laboratory.

A measure of precision is Relative Percent Difference (RPD) of two analyses of the same sample. This measure is applied as a quality control criterion to the recovery of organic matrix spike compounds. The RPD will be calculated using the equation:

$$\% RPD = \frac{S - D}{(S + D)/2} \; x\ 100\%$$

RPD criteria for organic matrix spike compounds are given in the CLP Protocol.

3.3 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. It is expected that 95 percent or more of all samples tested via USEPA CLP or SW-846 methods will provide data meeting QC acceptance criteria. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$\%\ Completeness = \frac{Number\ of\ valid\ results}{Number\ of\ possible\ results} \; x\ 100\%$$

3.4 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter that is dependent on the proper design of the sampling program and the proper laboratory protocol. The sampling program described in the FSP was designed to provide data that is representative of site conditions. Sampling sites, sampling frequency, sampling procedures, and sampling equipment are addressed in the FSP to obtain representative samples. Other procedures such as sample preservation, appropriate sample containers, sample hold times, and analytical procedures are addressed in this QAPP.

3.5 Comparability

Comparability expresses the confidence with which one data set can be compared with another. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in the QAPP, are expected to provide comparable data. These new analytical data, however, may not be directly comparable to existing data because of differences in procedures and QA objectives.

Data acquired for different purposes using different analytical methods, or different DQOs, may not be directly comparable. Samples analyzed using CLP protocols are expected to be comparable.

Section 4
Sampling Procedures

Specific field procedures for purging wells and actual sample collection procedures are addressed in the FSAP. Details on sample designation and location are given in the FSP and RD Work Plans. The collection of QC blanks, duplicate samples, and spike samples will be discussed in Section 11 of this QAPP.

Sample container, preservation procedures and holding time requirements are presented in Table 2. Precleaned sample containers will be obtained from analytical laboratories or sample bottle suppliers such as I-Chem Research, Inc., New Castle, Delaware, and Daniel Scientific, Simpsonville, South Carolina. The preparation of sample bottles (e.g., preservative added) will be documented.

Table 2
Recommended Holding Times for Preservation Procedures and Container Types for Analyses

SAMPLE ANALYSIS	HOLDING TIME (1)	PRESERVATION PROCEDURES	CONTAINER TYPE
	WATER	WATER	WATER
Volatile Organic Compounds	14 days	4°C, 4 drops 1:1 HCl	Three 40 mL glass, Teflon lined septum (2, 3)
Alkalinity, Chloride, Nitrate, Sulfate	Alkalinity - 14 days, Chloride, Sulfate - 28 days, Nitrate - 48 hours	4°C	Collect together in one 1000 mL plastic(3)
Nitrate	48 hours	4°C, H_2SO_4 to pH<2	One 125 mL plastic(3)
Sulfide	7 days	4°C, Zinc Acetate, and NaOH to pH>9	One 1000 mL plastic(3)
Methane, Ethane, Ethene, Carbon Dioxide, Hydrogen	14 days	4°C	One 250 mL Teflon lined septum (obtained directly from Microseeps) (3)
Hardness	6 months	4°C, HNO_3 to pH<2	One 250 mL plastic
Temperature, Eh, pH, Specific Conductivity, Dissolved Oxygen, Ferrous Iron, Turbidity	Immediately after sample collected	—	—

(1) Starting from time of sample collection.
(2) Collect four extra containers for MS/MSD samples.
(3) Collect one extra container as a duplicate sample.

Section 5
Sample Custody

Chain-of-custody documentation enables possession of a sample to be traced from sample collection through analysis and disposal. A sample is considered under custody if:

- the item is in a person's possession;
- the item is in that person's view after being in his or her possession;
- the item was in that person's possession and then placed in a secured location; or
- the item is in a designated and identified secure area.

The field technician performing sample collection activities will be responsible for sample custody in the field. The laboratory sample custodian and analysts will be responsible for custody of the sample at the laboratory.

5.1 Field Chain-of-Custody

Prior to collecting samples in the field, the Field Personnel will obtain the sample bottles necessary for the field operation. Field Personnel will label each sample collected, filling in the appropriate information in waterproof ink. The field sampler will be responsible for collecting the samples and for logging the samples into assigned field notebooks. The field samplers will complete and verify the Chain-of-Custody forms. A sample form can be found in Attachment 3 of the FSP. A copy of the Chain-of-Custody will be placed in the project files and the original will accompany the samples to the laboratory. The identity of field duplicate samples will not be disclosed to the analytical laboratory. Sample analysis request forms will be prepared by the RMT Laboratory Coordinator, or prepared by Field Personnel and reviewed by the RMT Laboratory Coordinator. The analytical request forms will accompany samples, or precede delivery of samples, to the laboratory.

5.2 Transfer of Custody

Shipping containers will be sealed and accompanied by the Chain-of-Custody record, with appropriate signatures. The transfer of custody is the responsibility of the Field Personnel and the laboratory staff.

5.3 Laboratory Custody Procedures

In the laboratory, a sample custodian will be assigned to receive the samples. Upon receipt of a sample, the custodian will inspect the condition of the samples, reconcile the sample(s) received against the Chain-of-Custody record, log in the sample(s) in the laboratory log book, and store the sample(s) in a secured sample storage room or cabinet maintained at an appropriate temperature until assigned to an analyst for analysis. Custody will be maintained until the sample is discarded.

The sample custodian will inspect the sample for any leakage from the container. A leaky multi-phase sample will not be accepted for analysis as this sample would no longer be a representative sample.

The custodian will examine whether the sample bottle seal is intact or broken, since a broken seal may mean sample tampering and may make analytical results inadmissible in court as evidence. The RMT Laboratory QA/QC Coordinator will be promptly notified of broken seals so that appropriate action may be taken (*e.g.*, collect another sample).

When samples requiring preservation by either acid (except samples for volatile organic compound analysis) or base are received at the laboratory, the pH will be measured and documented. The pH will be adjusted by the Laboratory sample custodian, if necessary, and the RMT Laboratory QA/QC Coordinator will be promptly notified of the pH adjustment so that sample collection procedures can be reviewed to determine if a modification is necessary.

Discrepancies observed between the samples received, the information that is on the Chain-of-Custody record, and the sample analysis request sheet will be resolved before the sample is assigned for analysis. The RMT Laboratory QA/QC Coordinator will be informed of any such discrepancy as well as its resolution. Results of the inspection will be documented in the laboratory sample log book. Discrepancies will be documented in the analytical case narrative, as appropriate.

5.4 Sample Labels and Seals

Sample labels as shown in Attachment 3 of the FSP will be affixed to each sample bottle before sample collection. At a minimum, the sample label will contain the following:

- Client - Job Name/Project Number,
- Sample Identification,
- Date and Time Collected (except for duplicate samples),
- Sampler's Signature (or initials), and
- Preservatives Added.

5.5 Shipping of Samples

Protocols for shipment of samples are outlined in the FSP.

Section 6
Sampling Site Location and Sampling Activity Identification

Details on field documentation procedures are outlined in detail in the FSP and generally in the text below.

6.1 Field Log Book

Information pertinent to the soil and ground water investigation will be recorded in field log books. Field log books will be bound, with consecutively numbered pages. The pages will be dated and signed by the person who is recording the information. Unused space at the bottom of a page will be crossed through. Work sketches or phrases that are recorded but deemed incorrect will be marked through in such a way as to still be legible, yet obviously struck from the text. Mark-throughs will be initialed and dated by the person striking the item.

Persons leading a sampling team or performing a distinct task will be issued a field log book by the RMT Field Coordinator. That person will maintain the log book during the RD/RA. At the conclusion of the various phases of the RD/RA, the field books will be collected and reviewed by the Field Coordinator.

6.2 Photographs

Sampling site locations will be identified on a site map. The location will be cross-referenced in the field notebook as to the identification of samples collected from the site location. Photographs of the sampling site location and the activities occurring at a specific location will be made. Photographs will be cross-referenced with an identification/explanation narrative in the field notebook.

Section 7
Calibration Procedures

7.1 Laboratory Calibration

The calibration procedures to be used for this project are summarized below, and will follow the analytical methods specified in Section 8 of this QAPP.

7.1.1 Instrument Performance and Tune

Prior to analysis of each set of samples and on a daily basis during the analysis, it will be demonstrated that the instruments meet the operating performance standards established in the applicable analytical methods. If an instrument does not meet the performance standards it will be tuned, repaired, or replaced until the performance criteria are achieved.

7.1.2 Calibration Curve

For analyses of analytes listed in Section 8 of this QAPP, instruments will be calibrated or standardized, as appropriate for the analytical method being used, prior to the analysis of each batch of samples. Instrument calibration will be verified on the frequency as prescribed in the applicable protocols (e.g., every 12 hours for volatile organic compounds). A new calibration curve will be established if the response observed in the analysis of the continuing calibration check standard varies outside of prescribed protocol limits.

7.2 Field Calibration

In addition to the laboratory analyses conducted during the course of this investigation, field measurements of pH, specific conductance, temperature, dissolved oxygen, Eh, and turbidity will be taken for ground water samples. The calibration of field instruments is discussed in the FSP and its attachments.

Section 8
Analytical Procedures

8.1 Laboratory Analysis

The laboratory will follow analytical procedures detailed in USEPA Contract Laboratory Program Statement of Work for Organics Analysis (version OLM03.0/December 1994 or later). Samples will be analyzed for the site specific volatile organic compounds of interest listed in Table 8-1.

The Contract Required Quantitation Limits for volatile organic compounds (VOCs) in the 1994 EPA CLP SOW are too high. Data quality needs require lower detection limits. Therefore the Superfund Analytical Methods for Low Concentration Water Organic Analysis (June 1991 or later version) will be used for analyzing VOCs in applicable samples. The quantitation limits for this low concentration method are presented in Table 3.

All compounds listed in Table 8-1 are on the Target Compound List (TCL) and in the CLP SOW except for 1,1,2-trichloro-1,2,2-trifluoroethane (Freon-113). This compound will be analyzed by either USEPA SW-846 Method 8260 or by adapting the CLP SOW to include this compound by using applicable information from Method 8260 (e.g., quantitation ion, using an appropriate internal standard compound during quantitation calculations).

Analytical parameters used to assess natural attenuation and to engineer the remedial design include alkalinity, chloride, hardness, nitrate, sulfate, sulfide, methane, ethane, ethene, carbon dioxide, and hydrogen. Analytical methods to be used for these analytes are listed below:

- Alkalinity - USEPA Method 310.1;
- Chloride - USEPA Method 325.3 or 300.0;
- Hardness - USEPA Method 130.2;
- Nitrate - USEPA Method 353.2;
- Sulfate - USEPA Method 375.4 or 300.0;
- Sulfide - USEPA Method 376.1 or 376.2;
- Methane, ethane, ethene - carbon dioxide, and hydrogen - Method M 19 GA (Microseeps in-house method);

The reporting limits for the analyses are listed in Table 4.

Lancaster Laboratories of Lancaster, Pennsylvania will analyze samples for VOCs, alkalinity, chloride, hardness, nitrate, sulfate, and sulfide. Microseeps of Pittsburgh, Pennsylvania, will analyze for methane, ethane, ethene, carbon dioxide and hydrogen.

8.2 Field Analyses

To ensure that the analytical data gathered in the field are both valid and unbiased, the following steps will be taken:

- Field samplers will be trained in the use of each piece of equipment.
- Operating manuals will accompany each piece of equipment in the field.
- Preventive maintenance programs will be carried out on a scheduled basis.
- Spare components will be taken into the field in case of equipment failure or damage.
- Instruments will be calibrated on a daily basis and rechecked as specified in the FSAP.
- Readings and calibrations will be documented.

The accuracy, sensitivity, and precision of the field analytical techniques for measuring water levels, temperature, specific conductivity, turbidity, DO, ferrous iron, redox potential (Eh), and pH are dependent upon the specifications for the instruments used, as well as on the QC techniques employed during their use. Field analytical procedures to be used for this project are described in the FSP.

Table 3
TCL Volatile Organic Compounds

ANALYTE	QUANTITATION LIMIT (Low Level) (µg/L)
Benzene	1
Toluene	1
Ethylbenzene	1
Xylenes (total)	1
Vinyl chloride	1
Chloroethane	1
1,1-Dichloroethene	1
1,2-Dichloroethene (total)	1
cis-1,2-Dichloroethene	1
trans-1,2-Dichloroethene	1
1,1,1-Trichloroethane	1
Trichloroethene	1
Tetracholoethene	1
1,1,2-Trichloro-1,2,2-trifluoroethane	2(1)

(1) Not part of USEPA CLP SOW. Quantitation limits estimated from USEPA SW-846 Method 8260.

Table 4
Natural Attenuation and Remedial Design Analytes

Analyte	Reporting Limit
Ammonia	10 mg/L
Chloride	10 mg/L
Sulfate	10 mg/L
Sulfide	1 mg/L
Iron (II)	1 mg/L
Nitrate Nitrogen	1 mg/L
Alkalinity	10 mg/L
Hardness	-
Hydrogen	0.01 n m/L
Methane	0.1 ppm
Carbon Dioxide	10 ppm
Ethane	0.03 mg/L
Ethene	0.03 mg/L

Section 9
Data Reporting, Validation, and Reduction

9.1 Field Data

Data validation practices will be followed to assure that raw data are not altered and that an audit trail is developed for data which require reduction. Field data, such as those generated during field measurements, will be entered directly into a bound field notebook. Only direct-reading instrumentation will be employed in the field. With the exception of the temperature correction for specific conductance, no calculation will be involved in field data reduction. The Field Coordinator will review field measurements recorded in the field books. Project team members will be responsible for proofing data transfers.

9.2 Laboratory Data

The RMT Laboratory QA/QC Coordinator will oversee validation of the laboratory analytical data from the laboratories. This effort will include an inspection to determine if the data meet the QA/QC criteria specified in each analytical protocol, and which are generically discussed in Section 3 of this QAPP. Aspects of the data which do not meet applicable QA/QC guidelines, and deviations from established analytical procedures, will be documented in a narrative accompanying the data.

The analytical laboratories will prepare and retain full analytical and QC documentation as required by the Contract Laboratory Program. The laboratories will also retain full documentation for the non-CLP parameter data. Such retained documentation need not be hard (paper) copy, but may be in other storage media (*e.g.*, computer diskette or magnetic tape). As needed, the Laboratories will supply a hard copy of the retained information.

For analytical results generated using CLP protocols, the laboratory will provide full CLP data packages as specified in the CLP Statement of Work. Deliverable report packages for 1,1,2-trichloro-1,2,2-trifluoroethane is the same as required for volatile organic compound results performed via the CLP method (data for this compound may be included in the CLP data deliverable). The electronic data deliverable will not be in the format specified in the CLP SOW, but in a form specified by RMT so that the data can be readily incorporated into a relational database.

For the indicator parameters (*i.e.*, nitrate, sulfate, sulfide, chloride, alkalinity, methane, ethane, ethene, carbon dioxide, and hydrogen) used for natural attenuation assessments, the laboratories will provide the following information in each analytical data package submitted:

1. Cover sheet listing the samples included in the report and narrative comments describing problems encountered in analysis
2. Tabulated analytical results
3. Summaries of applicable QC sample analysis (spikes, duplicates, laboratory control samples and blanks)

Analytical Data Reports will be available from the laboratory within four weeks following the receipt of the samples. Upon receipt of the laboratory data reports, the data will be validated by the RMT Laboratory QA/QC Coordinator as described in Section 14 of this QAPP.

RMT anticipates that data reduction for this phase of the investigation will consist of tabulating analytical results from Analytical Data Reports into summary tables through the use of computerized relational database and spreadsheet software. Reduced data will be placed in the central file maintained by the RMT Technical Coordinator.

9.3 Data Archival

The data validation program will track investigation documentation so that it is available when the remedial design has been completed. Accountable documentation include items such as log books, field data records, correspondence, Chain-of-Custody records, analytical reports, photographs, computer disks, and final reports. The RMT Technical Coordinator is responsible for maintaining a file in which all accountable documents will be inventoried. Raw data generated during field operations will be filed to eliminate or correct errors arising from the transfer of data. In order to avoid errors in the transfer of data, copies of raw data from the field notebooks and the data as received from the laboratory will be entered into a data file. The data file will serve as the ultimate archive for information and data generated during this RD/RA.

Section 10
Internal Quality Control Checks

Quality Control procedures for field analyses such as pH, specific conductivity, ferrous iron, dissolved oxygen, redox potential (Eh), turbidity, and temperature measurements consist of proper instrument calibration.

Internal Quality Control Checks used to assess field sampling precision and bias include the collection of the following blanks and samples:

- **Field Blanks** - These blanks consist of organic free, deionized water contained in each sample container with any preservatives required for that analysis. These will serve as a QC check on the field sampling methods for CLP analytes, container cleanliness, and external contamination. A field blank will be submitted for each sampling event.
- **Trip Blanks** - These blanks consists of organic free, deionized water contained in volatile organic compound (VOC) sample containers and preserved similar to VOC samples. These samples serve as a QC check on potential external contamination and/or cross-contamination between VOC samples during shipping and storage. A trip blank will accompany each cooler of VOC samples sent to the laboratory.
- **Rinsate Blanks** - These are samples of organic free, deionized water which have been in contact with decontaminated sampling and/or drilling equipment. These samples serve as a QC check on the decontamination procedure. One Rinsate Blank will be collected for every twenty field samples collected. The rinsate blank should be collected after pouring analyte-free water over/through appropriate sampling equipment (*e.g.*, bailers, tubing, pumps).
- **Field Duplicate Samples** - Duplicate samples will be collected to allow determination of analytical repeatability and sample homogeneity. At a minimum, one duplicate sample for every twenty ground and/or surface water samples, and one duplicate for every twenty soil and/or sediment samples, will be collected and submitted for analysis.
- **Matrix Spike/Matrix Spike Duplicate Samples** - A matrix spike/matrix spike duplicate (MS/MSD) sample pair for volatile organic compounds will be submitted as a further QC check. MS/MSD sample pairs are actually laboratory analytical QC items which are discussed here because sufficient sample must be collected in the field in order to perform these analyses. Sufficient volume for one MS/MSD sample pair will be collected for every twenty ground and/or surface water samples. These samples will allow the amount of recovery of spike compounds (the spike compounds are defined in the CLP protocols) to be determined for matrix effects specific to the study site, through the addition of known concentrations of compounds into the sample at the laboratory and then performing the analysis. The level of added constituent incorporated into QC samples will be consistent with the CLP protocol.

Duplicate samples will be labeled in a manner such that their sampling point location is not disclosed to the laboratory. The duplicate sample number (*e.g,* DU-1) and its corresponding sample location will be recorded in the field notebook. Sampling date and time will *not* be filled out on the label of the duplicate sample nor on the Chain-of-Custody form in order to not to disclose the duplicate's sample point location.

Section 11
Performance and System Audits

11.1 Field Performance Audits

11.1.1 Internal Field Audits

On-site audits may be performed to review field-related Quality Assurance activities. Internal audits may be conducted by the Field Coordinator, the Technical Coordinator, or a senior technical scientist.

Specific elements of the on-site audit may include, but are not limited to, verification of the following items:

- Completeness and accuracy of sample Chain-of-Custody forms, including documentation of times, dates, transaction descriptions and signatures;
- Completeness and accuracy of sample identification labels, including notation of time, date, location, type of sample, person(s) collecting sample, preservation method used, and type of testing required;
- Completeness and accuracy of field notebooks, including documentation of times, dates, drillers' names, sampling method used, sampling locations, number of samples taken, name of person(s) collecting samples, types of samples, results of field measurements, soil logs and problems encountered during sampling;
- Adherence to health and safety guidelines including wearing of proper protective clothing. Level D protective clothing will be worn at a minimum and will be upgraded, if necessary, as specified in the Health and Safety Plan;
- Adherence to decontamination procedures as outlined in the site Health and Safety Plan, including proper washing or steam cleaning of pumps and pump tubing, bailers, and soil sampling equipment;
- Proper calibration and maintenance of field instruments;
- Adherence to sample collection, preparation, preservation, and storage procedures as outlined in this Work Plan.

11.1.2 External Field Audits

External field audits may be conducted by the USEPA Region III.

11.2 Laboratory Performance and System Audits

11.2.1 Internal Laboratory Audits

Laboratory audits consist of random data reviews, continuous trend analysis of laboratory QA data, and periodic analysis of performance evaluation samples. Systems audits are performed to verify the continuity of personnel, instrumentation, and quality control requirements contained in the SOW. Each analytical laboratory is responsible for its own audits.

11.2.2 External Laboratory Audits

External system audits for CLP laboratories may be conducted by USEPA Region III.

Section 12
Preventative Maintenance

The maintenance procedures discussed in the following subsections will be performed to maximize efficiency and minimize downtime in the laboratory and while working on the North Penn Area 12 site.

12.1 Laboratory Maintenance

As part of their QA/QC program, a routine preventive maintenance program is conducted by the analytical laboratories to minimize the occurrence of instrument failure and other system malfunctions. Each team in the laboratory performs routine scheduled maintenance and repair or coordinate with the vendor for the repair of all instruments. All laboratory instruments are maintained in accordance with manufacturer's specifications or as appropriate for the instrument. Instruments used for CLP tests will follow the preventive maintenance procedures outlined in the CLP SOW. The non-CLP test instruments will follow the preventive maintenance procedures established by the laboratory's SOPs. All maintenance activities are required to be documented in the record books to provide a history of maintenance records.

12.2 Field Maintenance

Routine daily maintenance procedures conducted in the field will include the following:

- Removal of surface dirt and debris from exposed surfaces of the sampling equipment measurement systems.
- Storage of equipment away from the elements.
- Daily inspections of sampling equipment and measurement systems for possible problems (*e.g.*, cracked or clogged lines or tubing; weak batteries).

Spare and replacement parts stored in the field to minimize downtime include the following:

- Appropriately sized batteries
- Extra precleaned sample bottles
- Locks
- Calibration solutions for each meter

Backup instruments and equipment should be available on-site or within 1 day via shipment to avoid delays in the field schedule.

Section 13
Specific Routine Procedures Used to Assess Data Precision Accuracy and Completeness

13.1 Laboratory Data Quality Assessment

Data validation will be overseen by the RMT Laboratory QA/QC Coordinator.

The quality of volatile organic compound data will be assessed by the Laboratory Coordinator using CLP protocol-specific criteria, validation methods described in Region III Modifications to National Functional Guidelines for Organic Data Review Multi-Media, Multi-Concentration (September 1994), and USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (February 1994; EPA-540/R-94/012). Data qualifiers described in the latter document, if applied to the data, may be added as lower case letters to distinguish them from upper case qualifiers added by the laboratory. The Laboratory Coordinator will check that data packages include a narrative to document variations from the analytical protocol and actions taken by the laboratory to address those variations. The Laboratory QA/QC Coordinator will advise the Project Team of data having questionable or unacceptable quality and procedural deviations noted in the laboratory report narrative.

Laboratory results that are performed by non-CLP methods will also be reviewed by the Laboratory Coordinator. This review will include checking reporting units, hold times, associated blanks, laboratory data qualifiers, and case narratives. Any data summary tables provided in the final report will only include qualifiers applied during data validation. The project team will be advised of data having questionable or unacceptable quality and procedural deviations noted in the laboratory report narrative.

13.2 Field Data Quality Assessment

To assist in collecting field data accurately and correctly, specific instructions will be issued by the Field Coordinator to personnel involved in field data acquisition. At the end of each field event the Field Coordinator will review the field books used by project personnel to check that tasks were performed as specified in the instructions. Field books will be reviewed periodically throughout the entire project.

Raw data and reduced data will be submitted by project personnel to the RMT Technical Coordinator for review. Equations, calculations, data transfers, consistent units, and significant figures will be subject to this Quality Assurance review.

Section 14
Corrective Action

Corrective actions may be required for two classes of problems: 1) analytical and equipment problems and 2) nonconformance problems. Analytical and equipment problems may occur during sampling and sample handling, sample preparation, laboratory instrumental analysis, and data review.

If a nonconformance with the established quality control procedures in the QAPP or FSAP is identified, it will be noted in the logbooks, and corrected in accordance with the QAPP. For noncompliance problems, a corrective action program will be determined and implemented at the time the problem is identified and reported. The person who identifies the problem is responsible for notifying the appropriate field or laboratory personnel. The laboratories will communicate analytical problems to the RMT Technical Coordinator or the RMT Laboratory QA/QC Coordinator. Implementation of corrective action will be confirmed in writing through the same personnel. Field corrective actions will be reported to the RMT Technical Coordinator, implemented, and documented in the field logbook. Any corrective action that directly impacts project data quality objectives will be reported to the USEPA Region III Project Manager by the RMT Technical Coordinator.

14.1 Field Measurement Corrective Action

Technical staff and project personnel will be responsible for reporting technical or QA nonconformances or suspected deficiencies of an activity or issued document by reporting the situation to the RMT Field Coordinator or designee. If it is determined that the situation has impacted the quality of the data, a nonconformance report will be completed by the RMT Field Coordinator and distributed to the appropriate personnel. The field staff, in conjunction with the RMT Field Coordinator, will recommend a corrective action. The RMT Field Coordinator will be responsible for ensuring that corrective action for nonconformances has been implemented. The RMT Field Coordinator will be responsible for the following:

- Evaluating all reported nonconformances
- Controlling additional work on nonconforming items
- Determining future action to be taken
- Noting nonconformances in the field logbook
- Reviewing nonconformance reports and corrective actions taken
- Ensuring that nonconformance reports are included in the final project files

If appropriate, the RMT Field Coordinator will ensure that no additional work that is dependent on the nonconforming activity is performed until the corrective actions are completed.

14.2 Laboratory Corrective Action

Corrective actions are required whenever an out-of-control event or potential out-of-control event is noted. The investigative action taken is somewhat dependent on the analysis and the event. Corrective action in the laboratory may occur prior to, during, and after the initial analysis.

A number of conditions, such as broken sample containers, multiple sample phases, low/high pH readings, or potentially high-concentration samples may be identified during sample log-in or just prior to analysis. The corrective action program is under the supervision of the RMT Laboratory QA/QC Coordinator. Following a consultation with laboratory scientists and technicians and team leaders, it may be necessary for the RMT Laboratory QA/QC Coordinator to approve the implementation of corrective action. Some conditions during or after analysis may automatically trigger corrective action or optional procedures. These conditions may include dilution of samples, additional sample extract cleanup, automatic reinjection/reanalysis when certain quality control criteria are not met, etc. Corrective actions may be necessary if any of the following occur:

- QC data are outside the warning or acceptable windows for precision and accuracy.
- Blanks contain target analytes above acceptable levels.
- Undesirable trends are detected in spike recoveries or the RPD between duplicates.
- There are unusual changes in detection limits.
- Deficiencies are detected by the Laboratory during internal or external audits or from the results of performance evaluation samples.
- Inquiries concerning data quality are received.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure that was used for possible errors, and checks the instrument calibration, spike, and calibration mixes, and the instrument sensitivity. If the problem persists or cannot be identified, the matter may be referred to the laboratory team leader, and/or the Laboratory QA Officer for further investigation. Documentation of the corrective action procedure, whether resolved or not, is placed in the Laboratories project file. The laboratory will provide documentation as to what, if any, corrective actions were initiated concerning this study and report them to the RMT Laboratory QA/QC Coordinator and/or include descriptions of the corrective action(s) in the analytical report narrative.

14.3 Corrective Action During Data Validation and Data Assessment

Data validation corrective actions typically consist of requesting corrections to laboratory reports. The RMT Laboratory QA/QC Coordinator will notify the respective laboratory of incomplete or erroneous reports and will request the issuance of corrected versions. Final summary data tables will not be issued until all data have been validated and all corrections have been made.

The Laboratory QA/QC Coordinator will review the data from the analysis of field, trip, rinsate, and analytical method blanks. If excessive contamination (*i.e.*, levels above allowable limits set within the applicable analytical protocols) is found in the blanks, corrective action will be taken, including requesting that the analytical laboratory:

- Check raw data and calculations, and
- If the contaminating analyte is also present at high levels in field samples, repeat the analysis of the laboratory stored sample or sample extract.

If the contamination does not appear to originate at the laboratory, the Laboratory QA/QC Coordinator, in conjunction with the RMT Technical Coordinator, will review field sampling procedures to determine if a change in field sampling protocol is necessary.

The objective for completeness is 95 percent. If samples or data are lost during sampling and analysis activities, corrective actions will be taken, including:

- Requesting that the analytical laboratory reanalyze stored samples or extracts, if available, and
- Repeating collection and analysis of ground water samples.

Section 15
Quality Assurance Documentation to USEPA

The RMT Technical Coordinator, in conjunction with the Field Coordinator and Laboratory QA/QC Coordinator, will submit a project status report each month. This report may include the following types of information relating to Quality Assurance Activities:

- Significant irregularities noted in the field notebook during the sampling procedure.
- Results of performance and system audits, if conducted.

QA/QC data generated by the laboratory and a case narrative will be included in the CLP data packages.

Pertinent quality assurance documentation will be submitted to the following person at USEPA:

Addressee:
Mr. Patrick M. McManus
Remedial Project Manager
United States Environmental Protection Agency, Region III
841 Chestnut Building
Philadelphia, PA 19107

Section 16
References

American Public Health Association. 1995. Standard methods for the examination of water and wastes.

USEPA. 1979. Methods for chemical analysis of water and wastes. USEPA Office of Research and Development. EPA-600/4-79-020, including 1982 and 1984 versions.

USPEA. 1986. NEIC Policies and Procedures Manual. EPA 330/978-001-R

USEPA. 1987. A compendium of Superfund field operations methods. USEPA, Office of Emergency and Remedial Response, EPA/540/P-87/001.

USEPA. 1993. Data Quality Objectives Process for Superfund, Interim Final Guidance, OSWER Directive 9355.9-01. EPA 540/R-93/071. September 1993.

USEPA. 1994b. National Functional Guidelines for Organic Data Review. Multi-media, multi-communication (ILM01.0) and low concentration water (OLCO1.0). February 1994.

USEPA. 1994c. USEPA contract laboratory program statement of work for organics analysis. Document Number OLM03.0 (incl. Rev. 3.1), December 1994. EPA 540/R-94/073.

USEPA. 1994d. USEPA contract laboratory program statement of work for inorganics analysis. Multi-media, multi-concentration. Document Number ILM02.0 (incl. Rev 2). December 1994. EPA 540/R-94/095.

USEPA, Region 4. 1996. Environmental investigations standard operating procedures and quality assurance manual. USEPA Region 4 Science and Ecosystem Division, May 1996.

USEPA. 1997a. EPA requirements for quality assurance project plans for environmental data operations. Document No. EPA QA/R-5, October 1997.

USEPA Region III. 1993 Modifications to the National Functional Guidelines for Inorganic Data Review. April 1993.

USEPA Region III. 1994 Modifications to the National Functional Guidelines for Organic Data Review. September 1994.

USEPA Region III. 1994 Innovative Approaches to Data Validation. September 1994.

Appendix C
Health and Safety Plan

APPENDIX C

REMEDIAL DESIGN WORK PLAN
HEALTH AND SAFETY PLAN

NORTH PENN AREA 12 SUPERFUND SITE
WORCESTER TOWNSHIP,
MONTGOMERY COUNTY, PENNSYLVANIA

January 1999

Table of Contents

List of Tables

List of Figures

Scope and Applicability

This Health and Safety Plan (HSP) has been developed for the investigation activities at the North Penn Area 12 Superfund Site (Site), located in Worcester Township, Montgomery County, Pennsylvania. The intent of this plan is to establish appropriate health and safety procedures to be followed by RMT site personnel during the project field operations. This plan will be furnished to contractors who must work on-site as information to assist them in developing their own health and safety plan for site work. RMT, Inc. assumes no liability for the implementation of this plan by subcontractors or other contractors. This plan has been developed specifically for RMT personnel and their work activities at the Site.

Section 1
Coordination and Responsibility

The following Health and Safety Plan (HSP) has been prepared for the investigations at the North Penn Area 12 Site. This plan is intended to provide a framework for the safe conduct by RMT personnel of the field activities at the Site. As such, the plan provides procedures aimed at reducing the potential for accidents from physical hazards, and the potential for exposure to chemical contaminants which may be present in the water, soil, and air.

The Technical Coordinator will not allow work to begin at the Site until this HSP has been provided to all RMT field personnel who will be working at the site. Before visiting the work site, personnel must attend a briefing session, to be conducted by the Health and Safety Coordinator (HSC) or a designee, on the potential site hazards and specific requirements of this HSP, including training in the proper function and operations of air monitoring and personal protective equipment. The designated Site Health and Safety Representative (HSR) will be the senior field representative continually on site during any site activity and will be responsible for implementing the site-specific HSP during field operations. If there is any question whether an unplanned occurrence on site may compromise health and safety, the HSR has the authority to interrupt operations and to remove all personnel from the area. If possible, the HSC should be consulted before any operation is interrupted. If work is stopped due to any health and safety concern, immediate attention should be given by health and safety personnel, working in cooperation with the Project Manager, to identify and correct the cause of concern as quickly as possible. Any such incident will be fully documented by the HSR in a report to the HSC and Project Manager. In the event of a work stoppage, the client must be notified as soon as possible, and kept apprised of progress in resolving the incident until normal operations are resumed.

For this investigation, the following organization and responsibilities have been established.

Technical Coordinator: Will be responsible for matters relating to the completion of this investigation.

Field Sampling Technician: Will coordinate the proper handling and shipping of samples and the related documentation.

Health and Safety Coordinator: Will be responsible for

- Having a sound working knowledge of state and federal occupational health and safety regulations;

- Overseeing the implementation of the Health and Safety Program; and
- Informing RMT personnel of the guidelines set forth in the HSP, including the inherent risks of chemical exposure associated with a study of this nature, and in the use of advanced safety equipment and protective clothing designed to protect against chemical exposure.

Site Health and Safety Representative(HSR): The on-site person appointed by the Health and Safety Coordinator and having:

- Responsibility for the field implementation, evaluation, and any necessary field modifications of this HSP; and
- Authority to suspend work at the Site due to non-conformance to, or problems with, the HSP.

The HSR will be responsible for responding to any emergencies following notification or identification of emergency situations. The HSR will:

- Notify appropriate individuals and/or health care facilities of an emergency. Table 13-1 is a list of emergency telephone numbers that will be posted in the support trailer, in RMT field vehicles, and at the specific site locations as determined by the HSR.
- Maintain appropriate safety equipment at the site: eyewash station, first aid supplies, potable water supply and fire extinguishers.
- Have a working knowledge of safety and fire fighting equipment which is available at the site.
- Keep a map prominently posted at the field office facilities which details the most direct route to the nearest hospital.

The HSR may also serve as the Field Coordinator.

Section 2
Site Description

2.1 Site Location

The North Penn Area 12 Site includes the former Transicoil facility, which occupies approximately 25 acres on Trooper Road in Worcester Township, Montgomery County, Pennsylvania (Figure 1). The former Transicoil facility had been used for industrial and manufacturing activities from approximately 1952 to 1991. Activities included the manufacturing of electric motors for use by the aerospace industry. As part of the manufacturing operations, trichloroethene (TCE), 1,1,1-trechloroethane (1,1,1-TCA) and possibly other solvents were used to degrease parts and equipment.

Adjacent to the former Transicoil facility is the former Control facility for a Nike Missile Battery installation (PH-191) that had been operated by the U.S. Army (Figure 2). The former Nike control facility property was used by the Army from 1954 to 1968 and was located on approximately 12 acres of land. Both TCE and 1,1,1-TCA were used and disposed of at the former Nike Control facility between 1954 and 1968. In 1975, about 9 acres of the property were donated to Worcester Township and is now maintained as a park known as Nike Park. The remaining portion of the property was assigned to the Commonwealth of Pennsylvania, and is currently operated by Montgomery County as a rehabilitation center for the handicapped known as the Center Point Training Center.

2.2 Site History

Sampling of soil and groundwater at the Transicoil facility in 1979, carried out by the Pennsylvania Department of Environmental Protection (PADEP) (then the Pennsylvania Department of Environmental Resources), indicated the presence of TCE and 1,1,1-TCA in groundwater below both the Transicoil property and several surrounding properties' wells. Investigation of contamination at the Transicoil facility and in the surrounding area has been conducted on several occasions since that time. An investigation in 1980 included: sampling near a buried waste solvent tank; sampling of the contents of the waste solvent tank; sampling from underground septic system distribution boxes; and soil sampling in the septic system drain field area. Groundwater in two monitoring wells was also monitored for one year.

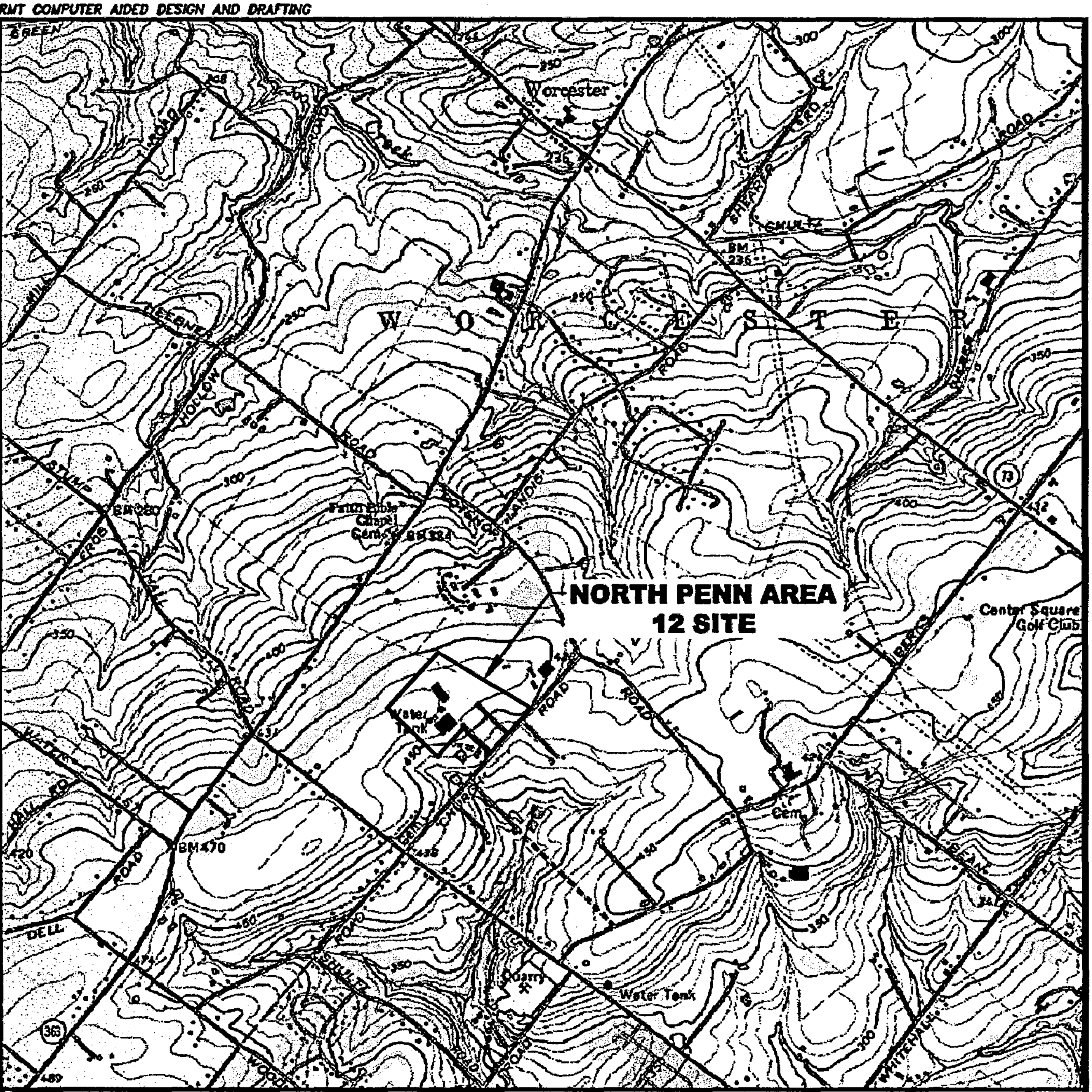
In January 1987, the Transicoil property was proposed for inclusion on the National Priorities List. A soil-gas survey was completed on the Transicoil facility in 1988. A consent agreement between USEPA and two potentially responsible parties (PRPs), Transicoil, Inc. and Eagle-

Picher Industries, Inc. ("Transicoil/Eagle-Picher") was executed in 1989 and led to the initiation of a Remedial Investigation/Feasibility Study (RI/FS) at the Site. The RI/FS work plan was submitted to USEPA Region III on May 18, 1990. USEPA subsequently approved the work plan and the field work was started.

A soil-gas survey conducted by Transicoil/Eagle-Picher in 1990 as part of the RI/FS indicated elevated levels of volatile organic compounds (VOCs) near Building No.2 and the drum storage areas. Levels of TCE and 1,1,1-TCA were very low, although significant concentrations of vinyl chloride, a TCE and 1,1,1 - TCA degradation product, was detected. A hydrogeologic study was conducted in July and August 1988, and indicated the presence of a TCE plume that seemed to be moving from east to west. Twelve monitoring wells were installed on and near the Transicoil property between 1988 and 1990. Residential wells near the former Transicoil facility were sampled in 1990 and again in 1991. During the residential well sampling, 13 home wells were found to contain TCE above the safe drinking water Maximum Contaminant Level (MCL) of 5 parts per billion (ppb). Transicoil/Eagle-Picher agreed, under an amendment to the approved RI/FS work plan, to install and maintain carbon filtration systems on those home wells, that exceeded the 5 ppb MCL for TCE.

All ongoing RI/FS activities were halted on January 7, 1991, when Transicoil/Eagle-Picher filed for relief under Chapter 11 of the bankruptcy code. At the time of the bankruptcy filing, the RI/FS field investigation activities were in progress and no draft or final documents or reports had been prepared. In accordance with the consent agreement, USEPA Region III assumed responsibility for funding, management, and completion of all remaining RI/FS activities. The tasks to be completed included air monitoring, soil sampling, surface water and sediment sampling, residential well sampling, monitoring well installation, groundwater sampling, geophysical logging, packer testing, pump testing, water level monitoring, wetlands assessment, and preparation of all associated reports and documents.

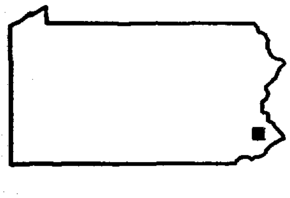
As a result of residential well sampling conducted in 1995 by USEPA, additional residential wells were found to be contaminated with TCE above the 5 ppb MCL for TCE. USEPA subsequently issued an order to four PRPs that required the installation and maintenance of carbon filtration systems on residential wells found to have concentrations of TCE above the MCL. Periodic sampling of over 100 residential wells near the Site was also required to ensure that TCE levels in residential water supplies would be maintained at safe levels. Fourteen additional home wells have been provided carbon filters in accordance with the 1995 order.



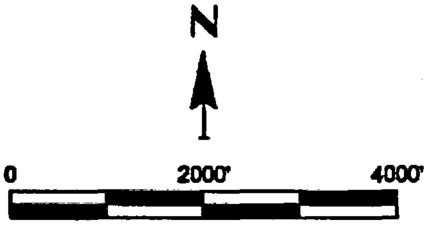
SOURCE:

BASE MAP DEVELOPED FROM THE LANDSDALE, PENNSYLVANIA 7.5 MINUTE U.S.G.S. TOPOGRAPHIC QUADRANGLE MAP, DATED 1966, PHOTOREVISED 1983.

PENNSYLVANIA



QUADRANGLE LOCATION



SCALE IN FEET

RMT INC. MICHIGAN

NORTH PENN AREA 12
REMEDIAL DESIGN WORK PLAN
WORCESTER TOWNSHIP, PENNSYLVANIA

SITE LOCATION MAP

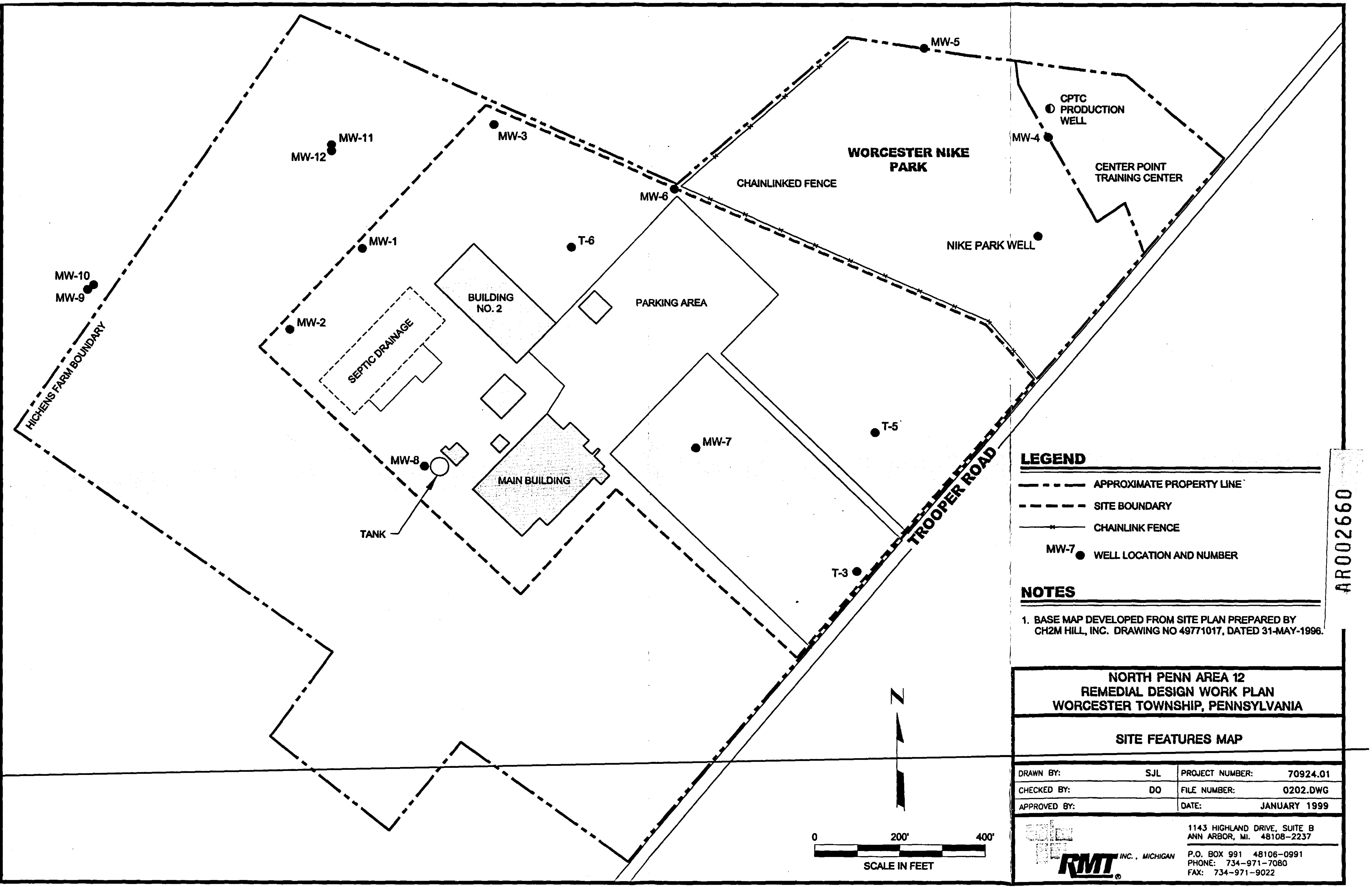
DRAWN BY:	SJL
APPROVED BY:	DO
PROJECT NUMBER:	70924.01
FILE NUMBER:	0101.DWG
DATE:	JANUARY 1999

FIGURE HSP-1

PLOT DATA
Drawing Name: J:\70924\01\0101.dwg
Operator Name: LUCIDOS
Scale: 1"=1'
Dwg Size: 106624 Bytes
Plot Date: Friday, January 15, 1999
Plot Time: 11:15.2194 AM
Attached Xref's: No xref's Attached.

PLOT DATA
Drawing Name: J:\70924\01\0202.dwg
Operator Name: LUCIDOS
Scale: 1"=200'

Dwg Size: 358836 Bytes
Plot Date: Friday, January 15, 1999
Plot Time: 11:18.3221 AM
Attached Xref's: No xref's Attached.



LEGEND

- — · · — APPROXIMATE PROPERTY LINE
- — — — SITE BOUNDARY
- —×— CHAINLINK FENCE
- MW-7 ● WELL LOCATION AND NUMBER

NOTES

1. BASE MAP DEVELOPED FROM SITE PLAN PREPARED BY CH2M HILL, INC. DRAWING NO 49771017, DATED 31-MAY-1996.

NORTH PENN AREA 12
REMEDIAL DESIGN WORK PLAN
WORCESTER TOWNSHIP, PENNSYLVANIA

SITE FEATURES MAP

DRAWN BY:	SJL	PROJECT NUMBER:	70924.01
CHECKED BY:	DO	FILE NUMBER:	0202.DWG
APPROVED BY:		DATE:	JANUARY 1999

RMT INC., MICHIGAN

1143 HIGHLAND DRIVE, SUITE B
ANN ARBOR, MI. 48108-2237

P.O. BOX 991 48106-0991
PHONE: 734-971-7080
FAX: 734-971-9022

FIGURE HSP-2

Section 3
Project Description

The Remedial Design Work Plan requires that one round of samples will be collected from existing monitoring wells MW-1, 2, 3, 4, 5, 7, 8, 9,10, 11 and 12, and the three on-site production wells T-3, T-5, and T-6.

In the Field Sampling Plan (Appendix A), the methods of operation for each applicable activity are discussed in detail. During implementation of these tasks, it is required that all RMT field personnel adhere to the health and safety protocols as specified in the HSP. Additionally, they will maintain an awareness of health and safety issues and to perform work in as safe a manner as possible. This involves constant vigilance for unsafe or potentially hazardous conditions or practices and initiating immediate corrective actions to solve or avoid potentially dangerous conditions or practices.

Section 4
Hazard Assessment

4.1 Chemical Hazards

The site risks are summarized in Section 2.5 of the Remedial Design Work Plan. A review of the site history and backup data indicates that no conditions immediately dangerous to life or health (IDLH) have been identified or exist on the site. The majority of the contamination on and off the site was detected in groundwater. The main groundwater contaminants that were detected are TCE, 1,1,1-TCA, 1,1-DCE, Freon-113, and arsenic. The highest TCE concentration detected in groundwater on the site is 380 µg/L. NIOSH assigns an IDLH concentration of 1000 ppm to TCE. The OSHA PEL is 100 ppm. Concentrations are anticipated to be well below 100 ppm in the breathing zone Chemical properties and other information concerning TCE are provided in Table 1.

The primary potential routes of exposure are:

- Inhalation of volatile compounds.
- Skin absorption through contact with contaminants or contaminated articles.
- Ingestion from contact by accidentally transmitting contaminants to the mouth after skin contact with contaminated solids and liquids.

Inhalation of airborne vapors is not considered to be a likely path of exposure due to the low concentrations of TCE in the groundwater and the open, non-enclosed space under which sampling will occur.

TCE can be absorbed through the skin, therefore dermal exposure to contaminated soils and water will be minimized by the donning of rubber gloves during well purging and sampling. The level of protection will be determined by the Site Health and Safety Representative based on the requirements of this Plan. The protective equipment to be worn will be at a minimum, chemical resistant gloves.

TABLE 1
Chemical Properties And Information Concerning Trichloroethylene

Hazard class: Trichloroethylene (TCE) is a colorless liquid with a chloroform-like odor $(\mathrm{ClCH{=}CCl2})$.

CAS number: 79-01-6

RTECS number: KX4550000

A. TCE has the following chemical and physical properties.

Physical description: colorless liquid with a chloroform-like odor.
Flash point: none.
Vapor pressure: 58 mmHg
Incompatibilities & Reactivities: Strong caustics & alkalis; chemically-active metals (such as barium, lithium, sodium, magnesium, titanium & beryllium)
The ACGIH Time Weighed Average (TWA) is 50 ppm.
The ACGIH Short Term Exposure Limit (STEL) is 100 ppm.
The OSHA Permissible Exposure Limit (PEL) is 100 ppm.

B. NIOSH recommends the following personal protection and sanitation:

Clothing:	Any possibility of liquid contact and repeated or prolonged vapor contact with skin should be avoided.
Eye Protection:	Goggles worn when a reasonable probability of eye contact exists.
Wash:	Immediately wash when skin is contaminated with liquid; promptly wash when skin is contaminated with solid.
Change:	Not required.
Remove:	Remove clothing that is wet or contaminated.

Provide a quick drench eyewash.

TABLE 1

Chemical Properties And Information Concerning Trichloroethylene

C. OSHA mandates the following level of respiratory protection up to the indicated air concentration.

1000 ppm - Any half-face chemical cartridge respirator with organic vapor cartridge(s) in combination with a high efficiency particulate filter (MSA GMA-H)

5000 ppm - Any chemical cartridge respirator with a full-face piece and organic vapor cartridge(s) in combination with a high-efficiency particulate filter. (MSA GMA-H)

100,000 ppm - Any supplied air respirator with a half- or full-face piece and operated in a pressure demand or other positive pressure mode.

D. Exposure Routes

The primary routes of exposure are as follows:

Inhalation
Skin absorption
Ingestion
Skin and/or eye contact

E. Symptoms of Exposure

NIOSH indicates the following general symptoms of exposure: irritation of eyes and skin; headache, vertigo (an illusion of movement); visual disturbance, fatigue, giddiness, tremor, somnolence (sleepiness, unnatural drowsiness), nausea, vomiting; dermatitis; cardiac arrhythmia, paresthesia; liver injury; [Potential occupational carcinogen].

F. First Aid Procedures

NIOSH indicates the following general first aid procedures:

eyes - irrigate immediately
skin - wash promptly with soap and water
breathing difficulties - begin artificial respiration
ingestion - obtain immediate medical attention

4.2 Physical Hazards

Physical and biological hazards may pose the greatest risk to site personnel. Heat stress, cold stress, insects, and snake bites, are hazards with more potential for immediate acute effects to personnel. Equipment and utilities are not considered to be physical hazards on the Site at this time, as the scope of work for this HSP covers collecting groundwater samples. Appropriate work practices and protective measures are addressed in this plan.

4.2.1 Heat Stress

The USEPA Standard Operating Safety Guides (USEPA, 1992) recommend that a heat stress monitoring program be implemented when employees are wearing impervious clothing and ambient temperatures are 70°F or above. The frequency of monitoring should increase as temperatures increase, and employees should be monitored after each work period when ambient temperatures exceed 85°F. The following monitoring program recommended by the USEPA guide shall be used by personnel when ambient temperatures exceed 70°F:

Heart Rate (HR) shall be measured by the radial pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats per minute. If the HR is higher, the next work period shall be shortened by 10 minutes, while the length of the rest period stays the same. If the pulse rate is 100 beats per minute at the beginning of the next rest period, the following work cycle shall be shortened by another 33 percent.

All personnel shall remain alert to the symptoms of heat stress. The general symptoms include the following:

- <u>Heat Rash</u> - Decreased ability to tolerate heat, chafing clothes.
- <u>Heat Cramps</u> - Muscle spasms and pain in the extremities and abdomen.
- <u>Heat Exhaustion</u> - Shallow breathing; pale, cool, moist skin; profuse sweating; dizziness and lassitude.
- <u>Heat Stroke</u> - Red, hot, dry skin; no perspiration; nausea; dizziness and confusion; strong rapid pulse; coma. <u>Immediate medical assistance must be obtained</u>.

Preventive measures for heat-stress shall include shaded rest areas and ample quantities of cool liquids for worker consumption.

4.2.2 Cold Stress

Persons working outdoors in low temperatures, especially at or below freezing, are subject to cold stress. Areas of the body that have a high surface area-to-volume ratio, such as fingers, toes, and ears, are the most susceptible to damage.

Protective clothing generally does not afford protection against cold stress. In many instances, it increases susceptibility due to a reduction in wind chill awareness and exposure to lower than perceived ambient temperatures.

Two factors influence the development of cold injury: ambient temperature and the velocity of the wind. Wind chill is used to describe the chilling effect of moving air in combination with low temperature. A copy of the wind-chill chart is included as Table 2.

Frostbite

Local injury resulting from cold is included in the generic term frostbite.

Symptoms:

The following symptoms are indicative of frostbite:

- Frost nip is characterized by sudden blanching or whitening of skin.
- Superficial frostbite is characterized by skin that has a waxy or white appearance and that is firm to the touch, but the tissue beneath is resilient.
- Deep frostbite is characterized by tissue that is cold, pale, and solid.

Treatment:

Bring the victim indoors, and warm the areas quickly in warm water. Never place frostbitten tissue in hot water because the area will have a reduced heat awareness and such treatment may result in burns. Give the victim a warm drink. The victim must not smoke. Keep the frozen parts in warm water or covered with warm clothes for 30 minutes. The tissue will be very painful as it thaws. Then, elevate the injured area and protect it from physical injury. Do not allow blisters to be broken. Use sterile, soft, dry material to cover the injured areas.

Keep the victim warm and get immediate medical care.

DO NOT:

- Rub the frostbitten part (this may cause gangrene).
- Use ice, snow, gasoline, or anything cold on the frostbitten area.

- Use heat lamps or hot water bottles to warm the frostbitten area.
- Place frostbitten tissue near a hot stove.

Table 2
Wind-Chill Chart
Cooling Power of Wind on Exposed Flesh Expressed as Equivalent Temperature (under calm conditions)*

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
Wind speeds greater than 40 mph have little additional effect	LITTLE DANGER For less than 1 hour with dry skin. Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh within 1 minute.			GREAT DANGER Flesh may freeze within 30 seconds.				
	Trenchfoot and immersion foot may occur at any point on this chart.											

* Developed by US Army Research Institute of Environmental Medicine, Natick, MA.

Hypothermia

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperatures.

Symptoms:

Symptoms are usually exhibited in five stages:

1. Shivering
2. Apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95°F
3. Unconsciousness, glassy stare, slow pulse, and slow respiratory rate
4. Freezing of the extremities

5. Death

Treatment:

Keep the victim warm and get immediate medical care.

Generally, field activities should be curtailed if equivalent chill temperature (°F) as defined in Table 3 is below zero (°F) unless the activity is of an emergency nature.

4.2.3 Construction Job Site Safety Practices

The following job site safety practices have been condensed from the OSHA Safety and Health Standards Digest - Construction Industry and are to be followed as a minimum by personnel working at the site.

General Requirements

a) Each employer must initiate and maintain programs to provide for frequent and regular inspections of the job site, materials, and equipment.

b) Each employer must instruct their employees in the recognition and avoidance of unsafe conditions and in the regulations applicable to their work environment to control or eliminate hazards or other exposure to illness or injury.

c) The use of any machinery, tool, material, or equipment that is not in compliance with the applicable requirements is prohibited.

Hand Tools

a) Employers shall not issue or permit the use of unsafe hand tools.

b) Wrenches shall not be used when jaws are sprung to the point that slippage occurs. Impact tools shall be kept free of mushroomed heads. The wooden handles of tools shall be kept free of splinters or cracks and shall be kept tight in the tool.

c) Electric power operated tools must either be approved double-insulated, properly grounded, or used with ground fault circuit interrupters.

Hazard Communication

a) The purpose of the hazard communication standard is to ensure that the hazards of all chemicals produced or imported are evaluated, and that information concerning their hazards is disseminated to employers and employees. Disseminating information is accomplished by means of comprehensive hazard communication programs, which include container labeling and other forms of warning, material safety data sheets and employee training.

b) Employers must develop, implement, and maintain a written hazard communication program for their workplaces. Employers must inform their employees of the availability of the program, including the required list(s) of hazardous chemicals, and material safety data sheets required.

c) The employer must ensure that each container of hazardous chemicals in the workplace is labeled, tagged, or marked with the identity of the hazardous chemical(s) and with clearly visible hazard warnings appropriate for employee protection.

d) Chemical manufacturers and importers shall obtain or develop a material safety data sheet for each hazardous chemical they produce or import. Employers shall have a material safety data sheet for each hazardous chemical they use.

e) Employers must provide employees with information and training on hazardous chemicals in their work area at the time of their initial assignment, and whenever a new hazard is introduced into their work area. Employers must also provide employees with information on any operations in their work area where hazardous chemicals are present; and the location and availability of the written hazard communication program, including the required list(s) of hazardous chemicals, and the material safety data sheets required by the standard.

Head Protection

a) Hard hats must be worn in areas where there is a possible danger of head injuries from impact, flying or falling objects, or electrical shock and burns.

b) Hard hats for protection against impact and the penetration of falling and flying objects shall meet the requirements of ANSI Z89.1-1969.

c) Hard hats for protection against electrical shocks and burns shall meet the requirements of ANSI Z89.2-1971.

Hearing Protection

a) Feasible engineering or administrative controls must be used to protect employees against sound levels in excess of those shown in the following table.

b) When engineering or administrative controls fail to reduce sound levels within the limits, hearing protection must be provided and used.

c) Exposure to impulse or impact noise should not exceed 140 dB peak sound pressure level.

d) In all cases where the sound levels exceed the limits, a continuing, effective hearing conservation program must be administered.

e) Permissible Noise Exposures

Duration per day in hours	Sound Level dBA slow response
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

Washing Facilities

a) Each employer must provide adequate washing facilities for employees engaged in operations involving harmful substances.

b) Washing facilities must be near the work site and be equipped to enable employees to remove all harmful substances.

Drinking Water

a) An adequate supply of potable water must be provided in all places of employment.

b) Portable drinking water containers must be capable of being tightly closed and be equipped with a tap.

c) A common drinking cup is prohibited.

Housekeeping

a. Form and scrap lumber with protruding nails and all other debris must be kept clear from all work areas.

b. Combustible scrap and debris must be removed at regular intervals.

c. Containers must be provided for the collection and separation of all refuse. Covers shall be provided on containers used for flammable or harmful substances.

d. General wastes must be disposed at intervals as specified in the Remedial Action Plan.

Respiratory Protection

a. In emergencies, or when feasible engineering or administrative controls are not effective in controlling toxic substances, appropriate respiratory protective equipment shall be provided by the employer and shall be used.

b. Respirators must be approved by the Mine Safety and Health Administrative/National Institute for Occupational Safety and Health or be acceptable to the US Department of Labor for the specific contaminant to which the employee is exposed.

c. Respirators must be appropriate for the hazardous material involved and the extent and nature of the work requirements and conditions.

d. Employees required to use respirators shall be thoroughly trained in use and shall have certification of a current fit test and current respiratory test.

e. Respirators must be inspected regularly and maintained in good condition.

Eye and Face Protection

a. Eye and face protection must be provided when machines or operations present potential eye or face injury.

b. Eye and face protective equipment shall meet the requirements of ANSI Z87.1-1968, "Practice for Occupational and Educational Eye and Face Protection."

c. Employees involved in welding operations must be furnished with filter lenses or plates of at least the proper shade number.

Fire Protection

a. A firefighting program is to be followed throughout all phases of the construction work involved. It must provide for effective firefighting equipment to be available without delay, and designed to effectively meet all fire hazards as they occur.

b. Firefighting equipment must be conspicuously located and readily accessible at all times, periodically inspected, and maintained in operating condition.

c. Carbon tetrachloride and other toxic vaporizing liquid fire extinguishers are prohibited.

Medical Services and First Aid

a. Each employer must ensure the availability of medical personnel for advice and consultation on matters of occupational health.

b. When a medical facility is not reasonably accessible for the treatment of injured employees, a person trained to render first aid shall be available at the work site.

c. First aid supplies approved by the consulting physician shall be readily available.

d. The telephone numbers of the physicians, hospitals, or ambulances must be conspicuously posted.

Flaggers and Traffic Warning

a. When working in the right-of-way of public roads, signs must be provided and used in accordance with requirements with the Manual on Uniform Traffic Control Devices.

b. When signs, signals, and barricades do not provide necessary protection on or adjacent to a highway or street, flaggers or other appropriate traffic controls shall be provided.

c. Flaggers shall be provided with, and shall wear, a red or orange warning garment while flagging. Warning garments worn at night shall be of reflectorized material.

Flammable and Combustible Liquids

a. Only approved containers and portable tanks can be used for storage and handling of flammable and combustible liquids.

b. No more than 25 gallons of flammable or combustible liquids can be stored in a room outside of an approved storage cabinet. No more than 60 gallons of flammable or 120 gallons of combustible liquids can be stored in any one storage cabinet. No more than three storage cabinets may be located in a single storage area.

c. Inside storage rooms for flammable and combustible liquids must be of fire-resistant construction, have self-closing fire doors at all openings, 4-inch sills or depressed floors, a ventilation system that provides at least six air changes within the room per hour, and electrical wiring and equipment approved for Class I, Division I locations.

d. Storage in containers outside buildings cannot exceed 1,100 gallons in any one area. The storage area must be graded to divert possible spills away from building or other exposures, or it must be surrounded by a curb or dike. Storage areas must be located at least 20 feet from any building and free from weeds, debris, and other combustible materials not necessary to the storage.

e. Flammable liquids must be kept in closed containers when not actually in use.

f. Conspicuous and legible signs prohibiting smoking must be posted in service and refueling areas.

Motor Vehicles and Mechanized Equipment

a. All vehicles in use shall be checked at the beginning of each shift to ensure that all parts, equipment, and accessories that affect safety are in proper operating condition and free from defects. All defects shall be corrected before the vehicle is placed in service.

b. No employer may use any motor vehicle, earth-moving, or compacting equipment having an obstructed view to the rear unless

  - the vehicle has a reverse signal alarm distinguishable from the surrounding noise level; or
  - the vehicle is backed up only when an observer signals that it is safe to do so.

c. Heavy machinery, equipment, or parts which are suspended or held aloft must be substantially blocked to prevent falling or shifting before employees are permitted to work under or between them.

Power Transmission and Distribution

a. Existing conditions must be determined before starting work, by an inspection or a test.

b. Electric equipment and lines must be considered energized until determined otherwise by testing or until grounding.

c. Operating voltage of equipment and lines must be determined before working on or near energized parts.

d. Rubber protective equipment must comply with the provisions of the ANSI J6 series, and must be visually inspected before use.

Mechanical Power Transmission

a. Belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating, or moving parts of equipment must be guarded if they are exposed to contact by employees or if they otherwise constitute a hazard.

b. Guarding must meet the requirements of ANSI B15.1-1953 (R 1958), "Safety Code for Mechanical Power Transmission Apparatus."

Electrical Installations

a. Electrical installations made in accordance with the 1993 National Electric Code are considered to be in compliance with OSHA's electrical standards for construction, except for the following additional requirements:

  - Employers must provide either ground-fault circuit interrupters (GFCIs) or an assured equipment grounding conductor program to protect employees from ground-fault hazards at construction sites. The two options are detailed below.

    1. All 120-volt, single-phase, 15-and 20-ampere receptacles that are not part of the permanent wiring must be protected by GFCIs. Receptacles on smaller generators are exempt under certain conditions.

    2. An assured equipment grounding program covering extension cords, receptacles and cord- and plug-connected equipment must be implemented. The program must include the following:

       - A written description of the program
       - At least one competent person to implement the program
       - Daily visual inspections of extension cords and cord- and plug-connected equipment for defects

- Continuity test of the equipment grounding conductors of receptacles, extension cords, and cord- and plug-connected equipment. These tests must generally be conducted every 3 months.

b) Lamps for general illumination must be protected from breakage, and metal shell sockets must be grounded.

c) Temporary lights must not be suspended by their cords, unless they are so designed.

d) Portable lighting used in wet or conductive locations, such as tanks or boilers, must be operated at no more than 12 volts or must be protected by GFCIs.

e) Extension cords must be the three-wire type. Extension cords and flexible cords used with temporary and portable lights must be designed for hard or extra-hard usage (for example, types S, ST, and SO).

Electrical Work Practices

a. Employers must not allow employees to work near live parts of electrical circuits, unless the employees are protected by one of the following means:
   - De-energizing and grounding the parts
   - Guarding the part by insulation
   - Any other effective means

b. In work areas where the exact locations of underground electrical power lines are unknown, employees using jack hammers, bars, or other hand tools that may contact the lines must be protected by insulating gloves.

c. Barriers or other means of guarding must be used to ensure that the workspace for electrical equipment will not be used as a passageway during periods when energized parts of equipment are exposed.

d. Worn or frayed electrical cords or cables cannot be used. Extension cords must not be fastened with staples, hung from nails, or suspended by wire.

e. Equipment or circuits that are de-energized must be rendered inoperative and must have tags attached at all points where the equipment or circuits could be energized.

4.2.4 Work Hours

The work tasks will normally be completed during daylight hours. For work tasks in general site areas, the minimum illumination allowed is 5 foot-candles.

4.3 Biological Hazards

Many of the areas of the Site are overgrown with dense underbrush. To access some of the existing monitoring wells and other areas of the site, these areas must be entered. There are several potential hazards that may be encountered. They include the following:

- *Snakes* - Watch for signs of poisonous snakes on the site. In the event that poisonous snakes are observed, site personnel entering overgrown areas shall wear snake chaps or gaiters.
- *Ticks* - It is anticipated that ticks will be a problem at this site. Tick repellent or other appropriate insect repellent will be used. Long sleeves are recommended. Check often for ticks and bites. If bitten, carefully remove tick with tweezers, making certain to remove pincers, and being careful not to crush or squeeze the tick while extracting, as this could infect the wound. After removing tick, wash hands immediately. Disinfect area and dress. If the tick resists extraction or can not be completely removed, seek medical attention.
- *Other Insects* - Stinging insects such as bees, fire ants, wasps, or yellow jackets are expected to be on-site. Personnel who may have allergic reactions if stung will keep a bee sting kit on-site.
- *Poisonous Plants* - Poison ivy and poison oak may be present at the site. Personnel should avoid contact with these plants.

Section 5
Air Monitoring

During the groundwater sampling operations, ambient air and breathing zone air monitoring will be conducted with the following instrument:

- HNu Model PI-101 Portable Photoionization Analyzer, Foxboro Model OVA 128 Portable Organic Vapor Analyzer, or a Photovac Microtip MP 100 Photoionization Analyzer for volatile organic compounds.

This monitoring will serve to:

- Grossly characterize chemical contaminants encountered during field activities, and

Provide a basis for downgrading or upgrading the level of personal protection. Background readings will be determined at the upwind perimeter of the Site. The air monitoring equipment will be maintained and calibrated by the HSR.

Section 6
Required Personal Protective Equipment (PPE)

All personnel shall be provided appropriate personal safety equipment and protective clothing. Each individual shall be properly trained in the use of this safety equipment before the start of field activities. Safety equipment and protective clothing shall be used as specified in this Health and Safety Plan. All such equipment and clothing shall be cleaned and shall be maintained in proper condition by project personnel. Disposable equipment and clothing shall be properly disposed. Levels of personal protection and the selection of criteria pertinent to field activities at the Site are detailed below.

6.1 Levels of Protection for Work Activities

In general, protective clothing must be worn whenever the potential exists for employees to come in contact with, or to be exposed to, contaminated materials. All respiratory protective equipment used will be approved by NIOSH/MSHA.

Work activities will be conducted under Level D or Level C protection based on the most current information available on potential health and safety hazards on the site. If Level B or Level A protection is deemed necessary, modifications of the Work Plan and an extension of the fieldwork schedule may be required.

6.1.1 Level D Protection

Based on an evaluation of the data and information available to date, field personnel will be adequately protected from potential health hazards present using Level D protection. Hence, fieldwork will be conducted under Level D requirements unless the personal air sampling results indicate that airborne metal or particulate concentrations are exceeding one-half the PEL in employees' breathing zones.

For tasks that involve little or no potential contact with contaminants, Level D protection will apply. Level D protection for these tasks will consist of the following:

1. Work clothes (under no circumstances will shorts, muscle shirts, or going without a shirt be permitted during any type of field investigation).
2. Leather steel-toed work boots (no sneakers).
3. Nitrile gloves (required when handling samples).

4. Hard hat (if overhead hazard present).
5. Options as required:
    - Disposable outer boots or rubber steel-toed boots.
    - Hearing protection.
    - Face shield
    - Tyvek coveralls

6.1.2 Level C Protection

When sample results indicate levels of volatiles are greater than one-half the PEL in employees' breathing zones, Level C protection will be required. Level C requirements include the protective clothing and equipment specified for the various categories of tasks listed under Level D protection plus air-purifying respirators equipped with organic vapor filtration. Each person required to use a respirator must be issued the type and size of respirator as determined by that person's fit test. Full-face, air-purifying respirator equipped with appropriate canisters or cartridges (all personnel requiring respiratory protection are fit tested with the type of respirator face-piece to be used in the field).

6.2 Changes in Levels of Protection

The HSR may authorize a change in the level of protection based on an evaluation of actual field conditions after consulting with the site superintendent.

Section 7

Standard Operating Safety Procedures and Controls

7.1 General Safety Practices

The following are important personal safety precautions which will be enforced during this investigation:

1. Eating, drinking, chewing gum or tobacco, smoking, or any transfer and ingestion of material is prohibited in the contamination reduction zone and the exclusion zone.
2. Hands and face must be thoroughly washed upon leaving the work area and before eating, drinking, or any other activity.
3. Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed with soap and water as soon as possible after the protective garment is removed.
4. No facial hair that interferes with the mask-to-face seal is allowed on personnel required to wear respiratory protection equipment.
5. Contact with contaminated surfaces or with surfaces suspected of being contaminated should be avoided. Whenever possible, one should not walk through puddles, mud or other discolored surfaces; kneel on ground; lean, sit, or place equipment on drums, containers, vehicles, or the ground.
6. Medicine and alcohol can potentiate the effect from exposure to toxic chemicals. RMT personnel will be informed of the possible potentiation of effects.
7. Personnel and equipment in the contaminated areas should be minimized, consistent with effective site operations.
8. Work areas for various operational activities must be established.
9. Procedures for leaving the contaminated area must be planned and implemented prior to going to the site. Work areas and decontamination procedures must be established on the basis of prevailing site conditions.
10. Respirators will be cleaned and disinfected after each use.
11. Safety gloves and boots shall be taped to the disposable, chemical-protective suits.
12. All equipment determined to be unsafe or dangerous to operate by the Site Health and Safety Representative will be identified by a "DANGER, DO NOT OPERATE" tag, and not operated until repairs are made.
13. Noise mufflers or ear plugs will be required for all personnel working around heavy equipment. Disposable, form-fitting plugs or pre-molded plugs are preferred.

14. Cartridges for air-purifying respirators will be changed daily at a minimum.
15. When self-contained breathing apparatus (SCBA) are on-site, they will be inspected daily by the Site Health and Safety Representative. Air purifying respirators will be inspected before and after each day's work by the user.
16. Work areas shall be lighted according to minimum illumination presented in Table H-120.1, p 45670, 29 CFR Part 1910.120.
17. Facilities will be provided with potable water and at least one toilet if employees number 20 or fewer. One toilet seat and one urinal per 40 employees will be provided if the number of employees are between 20 and 200. Non-potable water will be so labeled.
18. Site excavation shall be sloped or shored in accordance with 29 CFR 1926.650.
19. Appendix C contains a copy of the applicable standard. RMT employees will not enter excavations.
20. Areas that are potentially releasing contaminants due to wind blown particulate will be wetted down to eliminate this release.
21. Whenever possible, all personnel will be upwind of contaminated areas.
22. Only those personnel deemed essential to completing site work will be allowed on-site. Those persons will remain on site only as long as required in order to complete a work task. On-site refers to the exclusion zone and the contamination reduction zone.

7.2 Communications

Field communications will be facilitated by:

1. The use of small exclusion zones; and
2. Scheduling areas of activity in close proximity.

Visual contact must be maintained by site workers when in the exclusion zone. If it cannot be maintained, radio communications should be established. As an added precaution, useful hand signals will be incorporated in site safety procedures.

A cellular telephone shall be kept in the field vehicle.

7.3 Adherence to Buddy System

No field operation is without some degree of risk. For this reason, a minimum of two people must be assigned to all task locations and must stay within voice contact at all times.

7.4 Site Safety and Health Inspections

On a daily basis or more often, the Site Health and Safety Representative or his/her representative will inspect the site, observe work practices and inspect safety equipment to determine the effectiveness of the Site Health and Safety Plan. The inspector will make sure the general safety practices are being followed by on-site RMT personnel. Any deficiencies in the effectiveness of the Site Health and Safety Plan will be corrected. Such deficiencies will be noted in the inspector's log book.

If the deficiencies involve the actions (or lack of actions) of on-site RMT personnel, the name(s), date and time, specific actions(s) and corrective actions(s) taken will be recorded in the notebook. If the deficiencies involve specific deficiencies in the Health and Safety Plan, the Plan will be amended and all personnel immediately informed of the amendments and the implications of the amendments.

7.5 Confined Space Entry

Entry into any type of confined space is not expected for this site.

Section 8
Site Security and Control

8.1 Site Control

Site control will be established to minimize the potential for exposures to employees and observers on-site, to protect the public from potential on-site hazards, and to prevent vandalism of equipment and materials.

8.2 Site Security

OSHA jobsite poster will be posted in a central and conspicuous location at the site. Any evidence of unauthorized entry will be reported to Clifford Kirchof of RMT.

8.3 Work Zones

An exclusion zone, a contamination reduction zone, and a support zone will be established at the site during work operations to prevent the spread of contaminants during the work and to minimize employee exposure to contaminants.

8.3.1 Exclusion Zone

The exclusion zone is the zone where hazardous substances are likely to be present. During field activities at the site areas, all personnel entering this zone must wear the required protective equipment and be currently trained.

8.3.2 Contamination Reduction Zone

The contamination reduction zone is a transition zone between contaminated and clean zones and serves as a buffer to reduce the possibility of the clean zone becoming contaminated.

The contamination reduction zone will be located immediately adjacent to the exclusion zone in an area that is convenient for access.

Field personnel will wear the required personal protection while working in the contamination reduction zone. Protective equipment worn in the contamination reduction zone will be removed according to the procedures presented in Subsection 5.1. Personnel working in this zone must also be current in the training specified in Subsection 6.1.

8.3.3 Support Zone

The support zone is a non-contaminated or clean area. Support equipment (clean protective equipment, supplies, etc.) will be located in this zone. Normal work clothing is appropriate in this zone. Personnel who remain in this zone are not required to have received the health and safety training for hazardous waste activities specified in 29 CFR 1910.120. However, they must be aware of the site-specific HSP requirements and standard health and safety procedures.

The location of the support zone and any support facilities will be determined based on the following factors:

- Accessibility
- Support services - electric power supply, roads, drinking water, etc.

Section 9
Personnel Decontamination Procedures

Personnel working on this investigation may become contaminated in a number of ways:

1. Inhalation of vapors, gases, mists, or particulates
2. Skin contact with soils or sludge
3. Walking through puddles of liquids or on contaminated soils
4. Using contaminated instruments or equipment

Protective clothing and respirators protect the wearer from becoming contaminated or inhaling contaminants. Good work practices help reduce the contamination of protective clothing, instruments and equipment.

Even with these safeguards, contamination may occur. Potentially harmful materials may be transferred into clean areas, exposing unprotected persons. In removing contaminated clothing, personnel may come into contact with and/or inhale the contaminants. To prevent such occurrence, decontamination procedures are developed and implemented. Such procedures must be in place before anyone enters the site and must continue (modified as necessary) throughout the period of the site operations. Decontamination involves physically removing contaminants and/or converting them into innocuous substances. How extensive decontamination must be depends upon a number of factors, the most important being the types of contaminants involved. Combining decontamination procedures, the correct removal of personal protective equipment, and the establishing work zones minimizes cross-contamination from protective clothing to wearer, from equipment to personnel, and from one area to another.

In general, decontamination involves scrubbing with an Alconox/water solution followed by clean water rinses. All disposable items will be disposed of in a dry waste drum. Certain parts of contaminated respirators, such as harness assemblies and leather or clothing components, are difficult to decontaminate. If grossly contaminated, they may have to be discarded. Rubber components can be soaked in soap and water and scrubbed with a brush. In addition to being decontaminated, all respirators, non-disposable protective clothing and other personal articles must be sanitized before they can be used if they become soiled from exhalation, body oils and perspiration. The manufacturer's instructions should be followed in sanitizing the respirator masks; sanitizing pads will be provided for this purpose. The HSR will monitor for the proper maintenance, decontamination and sanitizing of all respirator equipment by RMT site workers.

If practical, non-disposable protective clothing should be machine washed after a thorough decontamination; otherwise, it should be cleaned by hand.

- The decontamination zone layout and procedures should match the prescribed levels of personal protection.
- The previously described work zones will be established and maintained throughout site field activities. The exclusion zone will be the various sampling areas. A contamination reduction zone will be designated on-site prior to site work. The following issues will be addressed in setting up these areas and the decontamination requirements:

Site Duties: The duties performed by each individual determines the potential for contact with and, hence, potential for contamination. The CRZ at the site will be designed for those individuals requiring maximum decontamination. The Site Health and Safety Representative will, however, be able to modify the decontamination procedure at his discretion for those individuals who have not been in contact with hazards (observers, etc.).

Amount of Contamination. The appearance of visual contamination on a person or a person's protective clothing would require the most thorough decontamination. The Site Health and Safety Representative, as well as the individual, should note the occurrence of gross contamination and discuss possible methods of avoiding this contamination in the future.

Putting on personal protective clothing will consist of the following:

- Put on inner gloves and put on coveralls,
- Put on outer gloves
- Put on boots and/or boot covers,
- Secure interfaces with tape, and
- Put on respirator and fit check with the positive and/or negative pressure test.

Personal protective clothing removal will consist of the following:

- Remove tape around glove and boot interfaces,
- Remove outer gloves,
- Remove coveralls,
- Remove boot covers and/or boots,
- Remove respirator, and
- Remove inner gloves.

Section 10
Emergency Equipment

Emergency equipment available on-site shall include:

- First Aid/Bloodborne Pathogen Kits
- Portable Eyewash (15-minute flush)
- Full Face Respirators - HEPA/Organic Vapor Combination Cartridges (GMA-H),
- Telephone,
- Fire Extinguisher.

In the event of injury, the emergency shall be handled according to the procedures described in the Emergency Procedures Section. The first aid kits shall be maintained at the control access point between the decontamination and support zones and in support vehicles.

Section 11
Emergency and Contingency Procedures

Due to the limited nature of the work, and the small area involved, the emergency response plan will not be as detailed as required for more comprehensive and extensive activities.

11.1 General Emergency Procedures

In the event of a safety or health emergency at the site, appropriate corrective measures must immediately be taken to assist those who have been injured or exposed and to protect others from hazards. Emergency personnel will be notified of the incident immediately. If necessary, first aid will be rendered.

Emergency telephone numbers are found in Table 2. Copies of Table 2 will be posted and kept in field vehicles.

In the event of an emergency, the following will be conducted:

1. The local ambulance, police, fire department and/or hospital will be notified as soon as possible (see Table 2 for appropriate telephone numbers.)
2. The injured or exposed person or persons will be immediately removed from danger. The Site Health and Safety Representative will determine the need to move an injured employee based on the extent of the injury and the extent of the emergency.
3. Affected personnel will be decontaminated and first aid rendered, if necessary.
4. All other personnel on site will be removed from the affected area until the On-Site Coordinator gives the instruction to resume work. Work will not resume until the On-Site Coordinator has determined that it is safe to do so.
5. An incident report will be completed by the HSR by the end of the following shift and copies submitted to the HSC, Project Manager, and Client Representative.
6. A formal accident investigation report will be prepared by the HSC within seven days.

TABLE 3
Telephone Number List

AFFILIATION (NAME)	TELEPHONE NUMBER
RMT Project Coordinator Clifford Kirchof	(W) 864-281-0030 (H)
RMT Technical Coordinator Daniel Oman	(w) 734-971-7080 (h) 734-996-3488
On-Site Coordinator	To be determined
Site Health and Safety Representative	To be determined
RMT Regional Health and Safety Coordinator Mike Bensing	(W) (734) 971-7080 (H) (517) 424-0053
RMT Corporate Health and Safety Director Steve Skipper	(W) (864) 281-0030 (H) (864) 268-2912 (emergency beeper) (888) 576-1899
Schlumberger Emergency Coordinator Dr. Gregory Kubala	(W) (281) 285-7789
<u>Emergency</u>	911
Worcester Township Police Department	(610) 631-5933 (911)
Worcester Township Fire Department	(610) 584-6911 (911)
Ambulance	911
Hospital - Suburban General Hospital 2701 DeKalb Pike Norristown, Pennsylvania	(610) 278-2000
Poison Control Center	(800) 521-6110
National Response Center	(800) 424-8802

The North Penn Area 12 Superfund Site is located at 1547 Trooper Road, Worcester Township, Montgomery County, Pennsylvania.

Directions to Suburban General Hospital: Leaving the Site, turn right (southwest) on Church Road. After approximately 2 tenths of a mile, turn left (southeast) on Stump Road, which becomes Township Line Road. Follow Township Line Road about 2 ½ miles to Dekalb Pike (Route 202). Turn right on Route 202. Follow Route 202 about ½ mile Suburban General Hospital is on the right on the other side of the intersection of Dekalb Pike and Germantown Pike (Route 422). A hospital routing plan (Figure HSP-3) is included in this HSP for reference in an emergency.

11.2 Chemical Exposure First Aid

- Injuries from contaminant inhalation can only be treated by qualified physicians. Remove affected personnel to "fresh" air and contact emergency services.
- If the contaminant is on the skin or in the eyes, immediate measures must be taken to counteract its effect. First aid treatment usually involves flooding the affected area with water.

11.3 Contingency Procedures

Contingencies are developed for:

- Physical injury
- Chemical exposure
- Heat stress
- Cold stress
- Uncontrolled release or fire
- Physical injuries in the form of sprained ankles or backs, puncture wounds, or broken bones are possible. The preponderance of jagged metal, uneven terrain, construction debris, heavy lifting and encumbered movement due to protective equipment also increases the likelihood of physical injuries.
- Significant chemical exposures are probably less likely to occur due to the conservative precautions already taken in the form of respiratory and skin protection. For chemical injuries, on-site first aid is largely limited to the use of eyewashes. If chemical exposure occurs, the HSR will take immediate steps to determine the chemical agent(s). TCE is expected to be the only source of chemical exposure at this site.
- Heat stress incidents are a health concern at the Site. Warm temperatures coupled with the use of impermeable protective clothing would make heat stress a distinct possibility. Practical field techniques for heat stress management can vary greatly in sophistication. Determination of pulse rate and oral temperatures may be deemed appropriate in some cases, while modification of traditional work schedules may suffice in others. As a minimum, RMT site personnel will take a break at least every two hours and drink plenty of non-alcoholic fluids if warm temperatures are encountered. An average of one quart per hour over a eight hour work day is recommended. Personnel experiencing nausea,

HOSPITAL ROUTING PLAN

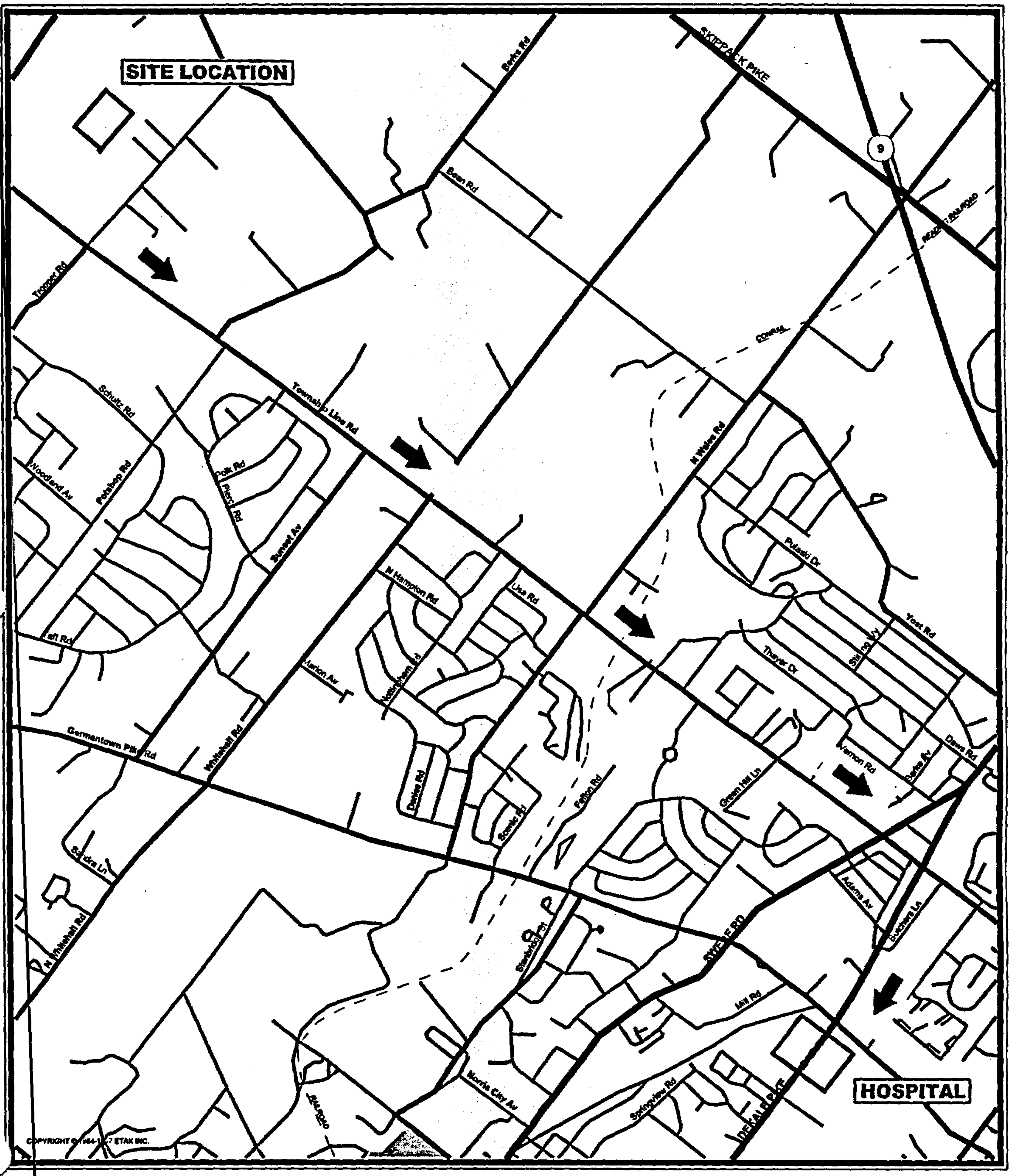


FIGURE HSP-3

dizziness, or any other common heat stress symptom should take a break immediately in a cool or shaded area and drink plenty of fluids. If symptoms are not alleviated, medical treatment should be sought.

- Cold stress incidents may be a health concern at the Site. If signs of hypothermia or frostbite, as described in Section 4.2.2, are seen, medical treatment should be sought.
- The uncontrolled release of chemical vapors or a fire that threatens site personnel or the public is clearly a worst case situation that should be anticipated. The most likely cause for evacuation is fire and/or explosion from a spark or chemical reaction, although some scenarios may also include uncontrolled releases of volatile vapors. The potential for fire and/or explosion is considered to be remote due to the non-volatile nature of suspected contaminants encountered during site investigations.

11.4 Evacuation Procedures

If conditions on-site result in situations that may warrant the evacuation of the surrounding population, the RMT Site Health and Safety Representative will notify the Schlumberger Emergency Coordinator and local emergency authorities. A determination will be made by these authorities on the need for evacuation. This Health and Safety Coordinator will provide input for this decision if requested.

The following chemical emergency information sources may be used for establishing procedures for site evacuation:

- Coast Guard Chemical Hazards Response Information System (CHRIS). This system consists of four manuals, a computer-assisted hazard-assessment system and Coast Guard technical assistance.
- CHEMTREC System, which has warning and guidance on over 3,600 items classed by chemical and trade name. CHEMTREC can be accessed through its emergency telephone number: 800/424-9300 (483-7616 in Washington, DC). Although the system is specifically oriented toward transport, it is a valuable repository of information for any incident of environmental degradation caused by a specific chemical agent, if known.

The hazards presented by hazardous materials may be either intensified or reduced by local conditions at the site. Weather conditions, fire (actual or potential) or other conditions may require modification of basic monitoring approaches. Such factors may impose additional restrictions on monitoring and cleanup operations by affecting the nature and rate of movement of materials within and beyond the immediate area, the toxicity and reactivity of hazardous substances and the monitor's mobility within the working area.

Wind increases the dispersal of toxic gases, powders and aerosols from the hazardous waste site. Therefore, steps will be taken to minimize the effect of wind dispersal as deemed necessary by the Health and Safety Representative.

Section 12
Personnel Training

Training is performed to make personnel:

- Aware of the hazardous aspects of work,
- Aware of the regulations and rules of conduct specific to on-site activities,
- Knowledgeable and comfortable with the safe operating procedures, work practices, and emergency actions established at the site, and
- Confident in knowing how to safely and effectively respond in emergency situations.

Therefore, the training program is a "preventive" measure, that if implemented and enforced, should help reduce employee injury, illness and accidents.

12.1 Pre-Entry Briefing

The site specific HSP will be reviewed with RMT personnel prior to their work on-site by the HSR. A health and safety briefing will be held by the HSR in the field prior to site work. Prior to the start of field activities, all subcontract personnel will be informed of the hazards and potential exposures related to the planned activities and the Health and Safety procedures to be followed by RMT on-site personnel. This HSP will be made available to subcontract personnel to assist them in developing their own Health and Safety Plan.

12.2 General Training Requirements

Each RMT employee at the Site shall have a valid certificate for 40-hour health and safety training as required under OSHA 1910.120, as well as having attended 8-hour annual refresher courses within less than a year.

Section 13
Medical Surveillance

A medical surveillance program has been established to identify, monitor, and minimize health risks for employees potentially exposed to hazardous materials. All field personnel participate in this program, which meets the requirements of OSHA 1910.120. This program includes baseline medical examinations to establish the individual's state of health, baseline physiological data, ability to wear personal protective equipment, and annual physicals.

The protocol for the yearly medical examination will include the following:

- Health history
- Vital signs and physical examination screen
- Pulmonary function
- Hematology survey
- Urinalysis
- Heavy metals screen
- Blood chemistry screen (SMA-20)
- Vision test
- Hearing test

The initial examination may include a maximal stress treadmill exercise test with a 12-point–lead EKG and chest x-ray, in addition to the above annual tests.

Personnel assigned to conduct on-site work tasks must have passed the required medical examination before entering either the contamination reduction or exclusion zone.

Whenever a situation occurs at a site which may pose a significantly increased health risk to any personnel, or personnel exhibit job-related health symptoms, the HSC may recommend that the individual consult with a physician for examination and treatment in accordance with good medical practice.

Section 14
Record Keeping

Logs and reports sufficient to document the implementation and execution of the personnel protection programs shall be maintained by the general contractor for all personnel involved in site activities. This documentation may include medical surveillance files, training files, daily logs and accident reports.

14.1 Medical Surveillance

Medical surveillance files for RMT site personnel are maintained in the RMT human resources department. These files document employee participation in the medical surveillance program and fitness to work on hazardous sites.

14.2 Training

Documentation of employee training is maintained in the Health and Safety files in the human resources department. These files document employee attendance, level of training and follow-up; or refresher instruction.

14.3 Work Logs

Daily work logs shall be maintained by the On-Site Coordinator. Copies of daily logs shall be forwarded to the Project Manager or the HSC on request. The daily log shall contain:

- Date,
- Area(s) or site(s) worked,
- List of employees by area and hours exposed,
- Personal protective equipment utilized by employees,
- Results of monitoring tests,
- Description of special or unusual events or incidents, including all first aid treatments not otherwise reportable.

Daily work logs shall be checked by the HSR. Any incident resulting in a work stoppage shall be fully documented in a report prepared by the HSR and submitted to the Project Manager.

14.4 Accident Reporting

In addition to descriptions in the daily log and work stoppage reports, any accident, chemical exposure, or "near-miss" incident shall be investigated, analyzed, and documented in an Incident Report submitted to the Project Manager and HSC. These reports, prepared by the HSR shall contain a full description and analysis of the incident.

First Report of Injury forms shall be completed in the event of an injury or illness.

Formal accident reports shall be prepared for any diagnosed illness or injuries that result in a lost work day or fatality. The accident report shall identify all contributing causes and recommend future hazard control measures to reduce the risk of recurrence.
Persons on site are responsible for reporting all injuries as soon as possible to the HSR.