Scope of Work
for the
Groundwater Investigation
at the former Plum Brook Ordnance Works
Sandusky, Ohio

30 May 1995

200-1e
01.03_0004
G05OH001826_01.03_0004_a

List of Acronyms

AE	Architect Engineer
AOC	Area of Concern
bgs	Below Ground Surface
CEORH	Huntington District Corps of Engineers
CEORN	Nashville District Corps of Engineers
COC	Contaminant of Concern
CCQC	Contractor Chemical Quality Control
CO	Contracting Officer
COE	Corps of Engineers
CSM	Chemical Surety Material
CWM	Chemical Warfare Material
DCQCR	Daily Chemical Quality Control Report
DoD	Department of Defense
DQO(s)	Data Quality Objectives
FSP	Field Sampling Plan
LeRC	Lewis Research Center
MK	Morrison-Knudsen
NASA	National Aeronautics and Space Administration
OEW	Ordnance and Explosive Waste
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PAH(s)	Polynuclear Aromatic Hydrocarbons
PBOW	Plum Brook Ordnance Works
PBS	Plum Brook Station
PCB(s)	Polychlorinated Biphenyls
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
SAP	Sampling and Analysis Plan
SI	Site Inspection
SSHP	Site Safety and Health Plan
SOW	Scope of Work
SSL(s)	Soil Screening Levels
SVOC(s)	Semivolatile Organic Compound
TNT	Trinitrotoluene
USEPA(V)	United States Environmental Protection Agency Region V
UXO	Unexploded Ordnance
VOC(s)	Volatile Organic Compound

Scope of Work for the Groundwater Investigation at the former Plum Brook Ordnance Works
Sandusky, Ohio

1.0 Introduction

Chemical contamination related to former Department of Defense (DoD) activities has been documented at the former Plum Brook Ordnance Works located near Sandusky, Ohio. The PBOW was operated from 1941 to 1945 as a manufacturing plant for 2,3,6-Trinitrotoluene (TNT), dinitrotoluene, and pentolite. Some of the areas used by the DoD were decontaminated in the 1950s and 1960s; other areas have been decommissioned, but not decontaminated. The site is currently owned by the National Aeronautics and Space Administration (NASA) and is operated as the Plum Brook Station (PBS) of the Lewis Research Center (LeRC). The NASA LeRC is located in Cleveland, Ohio.

1.1 Site Description

The area where the new monitoring wells will be installed is predominantly wooded with some brush covered and open areas. Existing monitoring wells are located within mostly grassy areas.

1.2 Purpose

The purpose of this phase of the investigation is to install four (4) monitoring wells in the vacinity of the West Area Red Water Ponds and TNT Area C, and resample twenty-seven (27) existing wells. Resampling may necessitate the redevelopment of some of these wells.

1.2.1 Data Quality Objectives

The objectives of this work is to obtain data for historical purposes to add to an existing database of groundwater levels and contaminants. The installation of additional wells will help to fill in data gaps in the western portion of the installation.

1.3 Task Summary

Task 1	Site Visit
Task 2	Preparation and Submittal of Draft/Final Site-Specific Safety and Health Plan (SSHP)
Task 3	Preparation and Submittal of Draft/Final Sampling and Analysis Plan (SAP)
Task 4	Kickoff and Coordination Meeting
Task 5	Drilling and Installation of Monitoring Wells
Task 6	Well Development

Task 7 In-Situ Permeability Testing
Task 8 Disposal of IDW
Task 9 Surveying
Task 10 Groundwater Sampling
Task 11 Analytical Work
Task 12 Preparation/Submittal of Draft Report
Task 13 Preparation/Submittal of Final Report

2.0 DETAILED DESCRIPTION OF WORK

The AE shall perform the following: a visual site inspection; submittal of a Site-Specific Safety and Health Plan (SSHP); the submittal of a Sampling and Analysis Plan (SAP) which consists of the Field Sampling Plan (FSP), the Quality Assurance Project Plan (QAPP); resampling of twenty-seven (27) existing monitoring wells; and the installation development and sampling of four (4) new monitoring wells.

2.1 (Task 1) Site Visit.

The AE shall make a site visit to obtain information that will aid in the selection of monitoring well sites and to determine any special requirements for the sampling of the monitoring wells. Two (2) days shall be allowed for this visit.

2.2 (Task 2) Preparation and Submittal of Draft/Final Site-Specific Safety and Health Plan (SSHP).

2.2.1. General. The AE shall review all available site information and develop the necessary safety and health documents sufficient to protect on-site personnel, the environment, and potential off-site receptors. The AE shall utilize the services of qualified personnel, as defined in Appendix B of ER 385-1-92, to oversee the development and implementation of required safety and health documents.

2.2.2. Regulatory Requirements. All site investigation activities and safety and health documents required by this scope of work shall comply with pertinent sections of the following regulations and reflect the following guidance publications:

(1) Federal Acquisition Regulation, F.A.R. Clause 52.236-13: Accident Prevention.

(2) U.S. Army Corps of Engineers (USACE), Safety and Health Requirements Manual, EM 385-1-1.

(3) U.S. Army Corps of Engineers (USACE), ER 385-1-92, Appendix B, Safety and Occupational Health Document Requirements for Hazardous, Toxic, and Radioactive Waste (HTRW) Activities.

(4) Nuclear Regulatory Commission Standards, 10 CFR 19 --

171.

(5) Occupational Safety and Health Administration (OSHA) General Industry Standards, 29 CFR 1910, and Construction Industry Standards, 29 CFR 1926; especially 29 CFR 1910.120/29 CFR 1926.65 - "Hazardous Waste Site Operations and Emergency Response".

(6) NIOSH/OSHA/USCG/EPA, "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities", October 1985. [DHHS (NIOSH) Publication No.85-115]

(7) Other applicable federal, state, and local safety and health requirements.

2.2.3. Documents. The following safety and health documents are required.

2.2.3.1. Safety and Health Program. The Occupational Safety and Health Administration (OSHA) requires all employers performing on-site activities at hazardous waste sites to develop and maintain an ongoing written Safety and Health Program in compliance with OSHA standard 29 CFR 1910.120(b)/29 CFR 1926.65(b). The program, including updates, shall be made available upon request.

2.2.3.2. Site Safety and Health Plan (SSHP). The SSHP required by 29 CFR 1910.120(b)(4)/29 CFR 1926.65(b)(4), and as defined by this SOW, shall be prepared and submitted. On-site activities shall not commence until the plan has been reviewed and accepted. The SSHP shall describe the site-specific safety and health procedures, practices, and equipment to be implemented and utilized in order to protect affected personnel from the potential hazards associated with the site-specific tasks to be performed. The level of detail provided in the SSHP shall be tailored to the type of work, complexity of operations to be accomplished, and hazards anticipated. The AE shall address all elements contained in Appendix B of ER 385-1-92 in preparing the SSHP. Where the use of a specific topic is not applicable to the project, the AE shall provide a negative declaration to establish that adequate consideration was given the topic, and give a brief justification for its omission. Information readily available in standard texts shall be repeated only to the extent necessary to meet the requirements of this SOW. The SSHP shall not duplicate general information contained in the Safety and Health Program which is not specifically related to this project.

2.2.3.3. Ordnance and Explosive Waste (OEW). If explosives or chemical surety and warfare material (CSM/CWM), or unexploded ordnance (UXO) are discovered at any time during operations, the AE shall immediately stop operations in the affected area, mark the location and notify the CO and all onsite personnel of the

OEW hazard and the area's restrictions. The Government shall make appropriate arrangements for evaluation and proper disposal of the device(s). The SSHP shall specifically address procedures to be followed should known or potential CSM/CWM, UXO, or other such items be encountered during any phase of field work.

2.3 (Task 3) Preparation and Submittal of and Sampling and Analysis Plan (SAP).

The Sampling and Analysis Plan (SAP) shall be composed of the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP). Guidance documents that the AE shall use to develop the SAP include Requirements for the Preparation of Sampling and Analysis Plans (EM-200-1-3) and Region V Model Quality Assurance Project Plan. A computer disk that contains the model QAPP is included with this SOW. A copy of the referenced engineering manual can be obtained upon request.

2.3.2.1 Format

The following format shall be used by the AE developing the SAP.

Title Page. The title page shall be the first page of the SAP. The following items shall appear on the title page: name of document, site name and location, USACE contract number, authority under which the activities are being performed and date of preparation.

Table of Contents. This shall be a general table of contents that outlines the layout of the SAP.

Field Sampling Plan. The following sections briefly describes the contents of the FSP:

(1) Title Page. The FSP shall have an abbreviated title page that includes the name of the document and the date it was prepared.

(2) Table of Contents. The table of contents shall include a of the FSP elements, any appendices that are required to augment the FSP, tables and figures.

(3) Project Description. This section of the FSP shall be as specific as possible. Sufficient infomation shall be included in this section to permit a technical person unfamiliar with the project to evaluate the sampling and analytical approach. A description of the location, size, and important physical features of the site shall be included. A figure showing the site location and layout shall also be included. A chronological site history including descriptions of the use of the site and use of chemicals should be provided. The historical data from

previous sampling efforts at the site should be identified and summarized. The effects of this information on the current project shall also be discussed. The site background section of the FSP shall also indicate startup and ending dates, including those for preliminary studies and field and laboratory activities.

(4) Project Organization and Responsibilities. This element of the FSP shall identify all key field personnel or organizations that are necessary for each field activity. The organizational chart shall include all subcontractors and their key points of contact. The organizational chart should also identify QA managers. This section of the FSP shall also describe the responsibilities of all project field personnel, including QA managers. This summary should designate responsibility for planning, coordination, sample collection, disposal of investigation derived waste, and sample custody.

(5) Scope and objectives. Specific objectives of a sampling effort that describes the intended uses of data shall be clearly and distintively stated. General QA/QC procedures shall be discussed.

(6) Field Activities.

(a) Rationale. This section of the FSP shall discuss the rationale for each of the field activities. Subsections of the FSP that address each of the matrices to be sampled shall include the rationale behind the required number of field samples; the strategy for selection of the particular sampling location and depth; a summary of the required number of field, and field QC samples; and the type of sample (discrete or composite). QC and QA samples shall be identified. QC samples shall be "disguised" as individual field samples by using a sample numbering system similar to that used for all field samples. This section of the FSP shall also include a list of all measurements that shall be made during the project. It is recommended that parameters planned for each sample be summarized in tabular form. This table shall indicate the total number of samples for each sample location, including Quality Assurance (Note: Please identify QA samples with the same number as the sample that they are derived from with the addition of QA designator) and quality control samples. The discussion of field QC samples shall include the rationale for the QC samples (how the data shall be used), as well as the frequency for collecting QA and QC duplicates, matrix/matrix spike/matrix spike duplicates and equipment rinsates blanks.

(b) Procedures. The subsections of the FSP that address each of the matrices to be sampled shall include the

proposed procedures for installation of equipment, field measurements, sample collection, sample homogenization and/or splitting and decontamination. Field screening procedures, the screening criteria, and the required actions based on the screening criteria shall be addressed. The specifications and requirements for field instrumentation, the initial and continuing calibration verification of the equipment, the schedule of calibration verification, as well as the requirements for field data evaluation and reporting shall be outlined in the FSP. Each subsection shall discuss the sampling procedures; a description of containers, reagents, and procedures used for each matrix' sample collection, preservation, transport, and storage; and a notation of any time constraints or other difficulties with sending samples to the laboratory, including contingencies in the event of delays and/or slippage in schedule.

(c) Subsurface Soil (any soil at depths greater than six (6) inches below grade. This section of the FSP shall discuss the rationale for each boring location, discrete and/or composite sampling, and any field analytical parameters to be measured. In addition, this section of the FSP shall sampling methods for physical and chemical analyses.

(d) Surface Soil and Sediment. This section of the FSP shall discuss the rationale for the location and frequency of discrete and/or composite samples and all drilling methods, drill logging procedures and log/sampling forms.

(7) Sample Chain of Custody/Documentation. This section of the FSP shall describe appropriate sample custody/ documentation procedures. Chain of Custody procedures shall always be used. Chain of custody procedures shall correspond to items identified in Appendix F of EM 200-1-3.

(a) Field Logbook. The AE shall include in the SAP the requirements for the field sampling logbook. The AE shall maintain a permanent bound logbook. The AE shall discuss the following: how the logbook shall be filled out, how corrections shall be made, the types of information to be included in the logbook, etc. The following items shall be included in the logbook, as applicable:

- Project Name and Number.
- Name and Title of author, date, and time of entry.
- Purpose of sample activity.
- Name and Address of Field Contact.
- Names and Responsibility of field crew members.
- Names and titles of any site visitors.
- Types of waste, suspected waste concentration if known, and sample matrix.

- Sample collection method.
- Number and volume of sample(s) taken.
- Location, description, and log of photographs of the sampling points.
- References for all maps and photographs of the sample site(s).
- Information concerning sampling changes, scheduling modifications, and change orders.
- Information concerning drilling decisions.
- Details of the sampling location.
- Date and time of sample collection.
- Field Observations.
- Any field measurements made.
- Sample identification number(s).
- Documentation of procedures for preparation of reagents or supplies that become an integral part of the sample.
- Sampling methodology, including distinction between grab and composite samples.
- Sample preservation.
- Sample distribution and transportation.
- A match list of Quality Assurance Split Samples and Field Samples.
- All sample documentation, such as:
  Bottle lot numbers as received from repository,
  Chain of Custody record numbers.
- Decontamination procedures.
- All documentation for investigation derived wastes, such as
  Contents and approximate volume of waste,
  Disposal Method,
- Summary of daily tasks (including cost) and documentation on any cost or scope of work changes required by field conditions.
- Signature and date by the personnel responsible for observations.

(b) Photographs. This section of FSP shall describe how sampling points are to be marked and prepared for photographs. It shall also discuss how photographs shall numbered and documented.

(c) Sample Identification System. The Contractor shall identify the methodology that shall be utilized to label/identify samples. A proposed methodology is shown in Table 1.

(d) Sample documentation. This section of the FSP shall discuss how each sample is to be documented in the permanent record. This section should include a discussion on sample labels or tags, sample field sheets, chain of custody records, custody seals, and cooler receipt forms. Examples of such items shall also be presented in this section.

Table 1: Sampling Identification Scheme.

Project Code	Year	Sample Type*	Well Number	Sample Number*
PBOW	95	XX	MW-21	XXXX

*Sample Type: describes the matrix of the sample. Groundwater Sample = GW;

(e) Documentation procedures. This section of the FSP shall include a checklist of step-by-step procedures of how each sample is to be documented, i.e., filling out sample container air bills, chain-of-custody records, sample tracking matrics, etc.

(f) Corrections to documentation. This section of the FSP shall discuss how changes are to be made on sample documentation forms.

(8) Sample Packaging and Shipping. In the SAP the AE shall include the SOPs for sample labeling, sample packing, sample preservation, icing, document inclusion and shipping procedures such that the sample integrity is established and maintained throughout custody process. Sample handling that is not in accordance with the protocol established in Appendix F of ER-1110-1-263 shall result in the need for the AE to resample the location from where the invalid sample was collected. No additional charge shall be incurred by the Government for this resampling.

(9) Contractor Chemical Quality Control (CCQC). The AE is required to ensure that quality is maintained throughout all field work by means of a three phase control process (ER 1180-1-6, EP 715-1-2). CCQC phase (preparatory, initial, and follow-up) shall be performed onsite by the AE whether or not a government representative is present. The AE shall summarize the activities of each CCQC phase in the daily chemical quality control report (DCQCR). The CCQC phases shall be performed for each definable feature of work. A definable feature is a task that is separate and distinct from other tasks and has separate control requirements. This section of the FSP shall contain the contractor's detailed plans for implementing the CCQC phases, including: identification of the CQC representative; listing of field equipment; description of activities during the phases; identification of the definable features of the work; and generation of a sample table that shall be used to match up primary and QA samples.

(a) Preparatory phase. The CQC representative, in conjunction with sampling team shall conduct the preparatory phase prior to beginning any definable feature of work. This phase shall include a review of all work requirements; a physical examination of all required materials and equipment; an examination of work areas to ascertain completion of all preliminary work; and a demonstration of all field activities. If new sampling or technical personnel arrive onsite during the work effort, the CQC representative must repeat this phase before new personnel begin work.

(b) Initial phase. The CQC representative is responsible for overseeing every step of the definable feature of work when that work is first initiated.

(c) Follow-up phase. The CQC representative is responsible for continued daily contract compliance until completion of the particular feature of work.

(10) Daily Chemical Quality Control Reports (DCQCR). The Contractor is responsible for providing a daily report which contains the required performance and documentation of chemical parameter measurement. The Contractors DCQCR shall contain the following elements:

(a) Job Identification and Site numbers.

(b) Weather including temperature, wind speed and direction, barometric reading, significant wind changes, etc.

(c) Chemical Data acquisition work performed including QA samples collected and calibrations.

(d) Sampling and Sample delivery problems which may affect project DQO requirements.

(e) Chemical parameter measurement problems which may affect project DQO requirements.

(f) Any sampling performed as contingency sampling and rationale.

(g) Corrective Actions and/or deviations from the identified problems including acceptance.

(h) Chemical quality control activities implemented. Confirmation that all deviations or actions jeopardizing project DQOs have been forwarded to the Contracting Officer.

(i) Signatures of responsible authority and initials of all persons conducting changes/actions.

(11) Corrective Action. The FSP shall include corrective action procedures to be taken in the event a discrepancy is discovered by field personnel, or during a desk or field audit, and/or the laboratory discovers discrepancies or problems.

(12) Project Schedule. The FSP shall include an outline of the schedule. Listed items shall include: project plan review periods, fieldwork, sample analysis, data management and validation, and investigation report writing.

(13) Sampling Apparatus and Field Instrumentation. The FSP shall include a list of all the equipment and instruments to be used in the field. This list should include a schedule for the instrument calibration and the people in the organization which have been trained to use the instuments.

Quality Assurance Project Plan. The Quality Assurance Project Plan shall be prepared using the model developed by United States Environmental Protection Agency Region V (USEPA V), which is included on the enclosed computer disk. All relevant sections shall be developed and explained.

2.4 (Task 4) Kickoff and Coordination Meeting.

A kickoff and coordination meeting shall be held at the project site prior to beginning the investigations between USACE Nashville NASA and the AE. Details of the investigations shall be discussed and all matters requiring coordination shall be accomplished at this time. Two (2) field days shall be allowed for this meeting.

2.5 (Task 5) Drilling and Installation of Monitoring Wells.

The four (4) new wells shall be drilled and installed according to USACE's EM 1110-1-4000, dated 29 August 1994. Wells shall be installed to top of rock with a ten (10) foot screen section. The surface completion shall include a concrete pad in place of a gravel pad. This pad shall be designed so as to prevent damage to the well due to frost heave. All aspcts of the drilling and installation of the wells shall be detailed in the Field Activities section of the FSP.

During drilling for the monitoring wells sampling shall be continuous for the entire boring. The geologist/geotechnical engineer shall log all samples according to the USACE's EM 1110-1-4000. Soil sampling shall be continuous for the entire boring. A minimum of ten (10) percent of the samples from each boring shall be analyzed for physical characteristics for classification as described in 2.5.1. For estimating purposes assume three (3) samples per boring.

2.5.1. Soil Classification. All soil samples shall be visually classified by the Unified Soil Classification System. The AE shall verify the classification by laboratory analyses consisting of the following:

Grain-size distribution (ASTM C117-90 & C136-92

Atterburg limits (ASTM-D 4318)

Moisture content (ASTM-D 2216)

Specific soil samples to be tested, along with type of test, shall be determined by the AE after reviewing the boring logs and samples. One of the sieve analyses shall come from a representative sample of the aquifer material in which the screen was placed. Laboratory analyses shall use equipment and methods described in EM-1110-2-1906, or ASTM manuals (most recent equivalent of those referenced above). The results of these tests shall be submitted to the CO with the field boring logs.

2.6 (Task 6) Well Development

2.6.1 Timing. The AE shall initiate well development not sooner than 48 hours after, nor longer than 7 days beyond internal mortar collar (grout) placement.

2.6.2 Pump and Bailer Usage. The AE shall accomplish well development by pumping and surging techniques. A surge block shall be raised and lowered throughout the screened area of the well to draw fine material into the well. After this is done, the well shall be pumped or bailed until the water is clear. This process shall be repeated until no fines are pulled into the well during the surging process. Bailers shall not be left inside the wells after development is completed. For new wells, development shall continue for a maximum of six (6) hours or until the well appears developed. If after this time the well has not developed, the AE shall contact the CO for further instructions. Development of the twenty-three (23) existing wells shall continue for a period of one (1) hour. If after this time the well has not developed, the AE shall contact the CO for further instructions.

Well development shall be conducted in accordance with the procedures and requirements described in EM 1110-1-4000 and in this Scope of Work. The plan for meeting those specifications shall be included in the MWI Plan.

2.7 (Task 7) In-Situ Permeability Testing

In-situ permeabilities shall be determined for each well using a "slug" test method. The details of the method and the equation

or equations shall be addressed in the Monitoring Well Installation Plan.

2.8 (Task 8) Disposal of Investigation Derived Waste (IDW)

Investigation Derived Waste (IDW). This section of the FSP shall discuss the procedures for collecting, labeling, storing, and disposing of IDW. The AE shall collect all IDW from the installation of monitoring wells. This waste shall be drummed and properly labeled according to the Safety Plan. All drums shall be labeled with the project name, date, contractor's name, USACE Nashville District, and contents. Soil and water waste should not be mixed in the same container. All PPE which can not be decontaminated shall be placed in a labeled sealable drum separated from the liquid and drill cuttings. All drums shall be kept within a secured area. (EPA/540/G-91/009) The results of the analytical analyses shall be used to evaluated the IDW material. If the analyses indicate that further evaluation of the IDW is necessary, modifications shall be made to this scope of work for the further evaluation and subsequent disposal of the IDW. The AE shall determine the optimum method for disposing of these wastes and furnish a plan with an estimated cost for this work to CEORN.

2.9 (Task 9) Surveying

All newly constructed well locations shall be located according to EM 1110-1-4000.

2.10 (Task 10) Groundwater Sampling

2.10.1 Sampling of Monitoring Wells. Groundwater samples shall be collected from all existing and newly installed wells. Certain field control samples shall be prepared as described in the following paragraphs. The number of samples and analyses are tabulated in tables 2, 3 and 4. Field tests including pH, turbidity, specific conductance, and temperature shall also be performed on groundwater from each well. A listing of the necessary equipment shall be included in the SAP. All equipment shall be calibrated as indicated in the SAP.

2.10.2 Preparation for Sampling. Before a sample is collected from a well, the water level shall be measured and recorded. Then the well shall be purged with clean, non-contaminating equipment to remove a quantity of water equal to at least three well volumes (one well volume is equal to the submerged inside volume of the riser and screen plus the volume of the interstitial water in the filter pack assuming 30 percent porosity). During purging, the purge water shall be periodically tested, and the results recorded, for pH, turbidity, specific conductance, and temperature using an appropriate device and method according to EPA 600/4-79-020: Method for Chemical

Analysis of Water and Wastes. Purging continues beyond the three well volumes until these pH, specific conductance, and temperature measurements are at equilibrium. If the well does not recharge fast enough to permit removing the minimum three well volumes within a 48 hour period, the well shall be pumped or bailed dry and sampled as soon as sufficient recharge has occurred. A listing of wells to be surveyed during this investigation is given in Appendix A.

If the sampling equipment requires flexible delivery tubing it shall be constructed of a PTFE material such as Teflon. At the time of sampling a portion of the sampled groundwater shall be tested, and the results recorded, for pH, turbidity, specific conductance, and temperature using an appropriate device and method according to EPA 600/4-79-020: Method for Chemical Analysis of Water and Wastes. Disposable PVC bailers may be used for all groundwater sampling.

2.10.3 Field Control Samples, Groundwater.

2.10.3.1 Travel Blanks. For each cooler containing samples for volatiles analysis, one travel blank shall be prepared and submitted to the analytical laboratory or to the QA Laboratory for analysis along with the primary samples and split duplicates.

2.10.3.2 Sampling (Equipment) Blank. One sampling blank per day of sampling activity shall be submitted to the contract laboratory for analysis along with the primary samples. The sampling blank may not be required if dedicated sampling equipment is utilized at each sampling location.

2.10.3.3 Duplicates and Split Samples. From each of ten percent (10%) of the groundwater monitoring wells, the volume of water taken shall be enough for three samples. One of these samples shall be submitted to the QA laboratory as a split sample and the other two shall be separately identified and sent to the contract laboratory as a primary sample/field duplicate pair (QC samples).

2.10.3.4 Source Water Sample. A sample of the water source used for equipment decontamination, well installation, and any other field activities shall be collected. This sample shall be analyzed for the same parameters as the groundwater samples.

2.10.3.5 Sample Handling. All details of sampling shall conform to the SAP, and to applicable USEPA (SW-846) and USACE requirements (Appendix F, ER 1110-1-263, October, 1990). Details include sample volumes, composition and size of containers, methods of preservation, identification and labeling, packing, transportation and shipment.

2.11 (Task 11) Analytical Work

2.11.1 Analytical Procedures.

2.11.1.1 General Analytical Requirements.

2.11.1.1.1 Analytical Methods. The AE shall establish in the SAP, to the extent not already defined in the Design Analysis, the methods and procedures used to prepare and analyze the project samples and parameter measurement. Method selection shall be consistent with project DQOs for chemical measurements. In general, the preferred methods are the methods of analysis in SW-846, Test Methods for Evaluating Solid Waste Physical/Chemical Parameters. The preferred analytical methods for the analysis of soil/sediment matrices are presented in Table 2.

2.11.1.1.2 The AE shall define in the SAP, the source (reference) of the method, the method prep, the method number and the chemical parameter to be determined for all project samples acquired for chemical analysis. The AE shall also include the Standard Operating Procedures for each method.

2.11.1.1.3 The AE shall define the source (reference) of the measurement method and method identification for all chemical parameters measured by instrumental means in the SAP.

Table 2
Approved Analytical Methods for the Ground Water Investigation.

Analytical Parameter	Analytical Method
Volatile Organic Compounds	SW-846, 8260A
SemiVolatile Organic Compounds	SW-846, 3540/8270A
Target Analyte List (TAL) Metals[1]	SW-846, 3050/6010A[2] SW-846, 3050/7471A (Hg)
Explosives	SW-846, 8330
PCBs/Pesticides	SW-846, 3540/8081

[1]TAL metals include Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, Zn.
[2]The method used for Sb preparation shall be 3005.

2.11.2 Data Reduction, Validation, Documentation and Reporting Form. The AE shall discuss methods for data reduction, validation, documentation and report format in the SAP. At a minimum the following sections shall be included in the SAP. All analytical data generated by the Contract Laboratory shall be extensively reviewed prior to report generation to assure the validity of the reported data. This internal data review process shall consist of data generation, reduction, and a minimum of three levels of data review. In each stage, the review process

shall be documented using an appropriate checklist form that is signed and dated by the reviewer. The analyst who generates the analytical data has the prime responsibility for the correctness and completeness of the data. Each step of this review process involves evaluation of data quality based on both results of the QC data and the professional judgement of those conducting the review. This application of technical knowledge and experience to the evaluation of data is essential in ensuring that the data generated is consistent and of quality. All data generated and reduced shall follow well documented AE Laboratory in-house protocols.

2.11.2.1 Level 1, Technical Data Review. Each Contract Laboratory analyst shall review the quality of their work based on an established set of guidelines. The review criteria as established in each method, in this instruction, and as stated within the Contract Laboratory Quality Management Manual shall be used. The review shall at a minimum ensure that : (1) Sample preparation information is correct and complete; (2) Analysis information is correct and complete; (3) The appropriate SOPs have been followed; (4) Analytical results are correct and complete; (5) QC samples are within established control appropriate QC limits; (6) Special sample preparation and analytical requirements have been met; (7) Documentation is complete (any anomalies have been documented and forms complete, holding times documented, etc.) Level 1 data review shall include a checklist form that has the above mentioned items and is signed and dated by the reviewer.

2.11.2.2 Level 2, Technical Review. The level 2 review shall be performed by a supervisor or data review specialist whose function is to provide an independent review of the data package. This review shall also be conducted according to an established set of guidelines and is structured to ensure that; (1) All appropriate laboratory SOPs have been followed; (2) Calibration data are scientifically sound, appropriate to the method, and completely documented; (3) QC samples are within established guidelines; (4) Qualitative identification of sample components is correct; (5) Quantitative results are correct; (6) Documentation is complete and accurate (any anomalies have been documented and forms complete, etc.); (7) The data is ready for incorporation into the final report; (8) The data package is complete and ready for data archive. Level 2 review shall be structured so that all calibration data and QC sample results are reviewed and all of the analytical results from at least ten percent of the samples are checked back to the sample preparation and analytical bench sheets. If no problems are found with the data package, the review is complete. If any problems are found with the data package, an additional ten percent of the sample results shall be checked back to the sample preparatory and analytical bench sheets. This cycle then repeats until either no errors are found in the data set checked or all data has been

checked. All errors and corrections noted shall be documented. Level 2 data review shall also be documented with a check list with the signature and date of the reviewer.

2.11.2.3 Level 3, Administrative Data Review. Level 3 review is performed by the QA Officer or the program administrator at the AE Laboratory. This review shall be similar to the review as provided in Level 2 except that it shall provide a total overview of the data package to ensure its consistency and compliance with this instruction. All errors noted shall be corrected and documented. Level 3 data review shall also be documented on a checklist with the signature and date of the reviewer.

2.11.2.4 Data Reduction. The AE shall report all data reduction procedures including the methods or equations of concentration calculations, reporting units of concentrations, moisture related data and the procedure for calculating precision and accuracy.

2.11.2.5 Data Validation. The AE shall be required to provide data validation procedures for fifty percent of all chemical data. Methodologies for validation shall be included in the QAPP. Data validation shall be provided by a qualified memeber of the AE's staff who does not report to any laboratory personnel and has no responsibility for sample collection or analysis. Analytical data shall be validated in accordance with the following USEPA guidance documents:

Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analses (July 1989);

USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, Publication 9240.1-05-01, EPA-540/R-94-013, PB94-963502, February 1994.

USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, Publication 9240.1-05, EPA-540/R-94-012, PB94-963501, February 1994.

2.11.2.5.1 Data Reporting. The AE shall submit two data packages during this project; (1) a data package shall be submitted to the USACE Quality Assurance Laboratory for CQAR generation, and (2) a fully validatable package(i.e. similar to CLP) shall be submitted to the Contracting Officer. These standard reporting formats require the reporting of all data along with the supporting QC information. The AE shall fulfillment the requirements of the memorandum on the USACE Minimum Chemistry Data Reporting and shall follow the guidance set forth in EM 200-1-3 Appendix B.

2.11.2.5.1.1 Data Reporting Format. Contract Laboratory reports shall be structured to clearly present all of the contract required items. This report shall be organized as follows.

2.11.2.5.1.1.1 General Discussion. Description of the sample types received, test performed, and problems encountered, and general comments shall be given here. This section shall include any case narratives. The project shall be clearly identifiable. A table shall be presented that clearly shows all samples received that includes the Contract Laboratory sample identification number, the sample matrix, and the tests assigned. Another table shall be presented that summarizes all failed QC parameters along with corrective actions taken by the Contract Laboratory. All pages shall be numbered and an index provided so that the Quality Assurance Laboratory can quickly and accurately review the data.

2.11.2.5.1.1.2 Analytical Data. The AE shall report data by sample or test. Pertinent information shall include, at a minimum, field sample identification number, Contract Laboratory sample number, date sample collected, date sample received at the Contract Laboratory, date(s) sample extracted/digested/analysis performed, batch number(s), dilution factors, all analytes tested for and their associated reporting limits, any data qualifiers assigned, matrix, units, percent of solids for solid samples, and sample description, including preservation. Any other factors that could affect the sample results shall also be noted. Data for solid samples shall be reported on a dry weight basis. Both the original and diluted results shall be reported or samples that are reanalyzed due to certain analytes that have exceeded the calibration ranges. Results may be combined together on a single report. Data qualifiers used shall be referenced from the guidance document for data validation.

2.11.2.5.1.1.3 Calibration Information. All initial calibration curve data shall be presented by the AE. All continuing calibration verification data to include standards and blanks shall be presented with acceptance ranges clearly shown.

2.11.2.5.1.1.4 Laboratory Performance and Matrix Specific Information. The AE shall include all of the associated method QC information, even if this information was run on samples other than those associated with this project, shall be reported. This information shall include method blanks, laboratory control samples, matrix duplicates, matrix spikes, matrix spike duplicates, and other method specific QC samples that may have been run. Spiking levels shall be clearly shown. This QC information shall be specific to the batch that the field sample analysis was associated with. Batch numbers shall be clearly shown. Method specific QC information shall be reported with all acceptance criteria clearly shown. All method QC must meet the acceptance requirements as stated within the method or in this instruction. Any deviations from this acceptance criteria shall be identified with appropriate corrective actions that have been conducted, and documented.

2.11.2.5.1.1.5 Other Information. Any other information that is pertinent to project samples shall be reported. This shall include copies of the original chain of custody forms, copies of cooler receipt forms, copies of any telephone conversation records, and copies of any other forms (i.e. corrective action forms, Level 1, 2, and 3 review checklists, and validation forms, etc.). The AE Laboratory shall maintain on file all of the supporting data and documentation for these samples. The contract laboratory shall provide, upon request, copies of raw data for specific methods and samples at no additional cost.

2.11.2.5.1.1.6 Fully Validatable Data Reporting Package Format. The AE shall utilize the reporting format specified by the Data Quality Objectives Process for Superfund, EPA 540-R-93-071, September 1993, in order to allow a full independent validation of the data. The equivalent electronic deliverable shall also be included with the hard copy report.

2.11.2.5.1.1.7 Report Turnaround Time. The AE shall have twenty-one (21) calendar days for standard delivery from the time of sample receipt, unless accelerated turnaround times are requested and agreed upon.

2.11.2.5.1.1.8 Compliance. The AE shall be required to provide procedures to confirm the compliance with documentation requirements including field documentation, daily quality control reports, daily instrument and monitor outputs, authenticity of all document entries by signed or initialed entries, data reporting packages, QC documentation and production of deliverables.

2.11.2.5.1.1.9 Quality Assurance (QA) Laboratory Functions. The QA laboratory shall be obligated to perform the following functions: (1) Inspection of QA samples to insure that sampling procedures correspond to the SAP, with regard to sample container, preservation, labeling, and chain of custody, (2) Analyses of QA samples, (3) Evaluation of data deliverables specified in the SAP, (4) Comparison of analytical results obtained by the contract laboratory from split or replicate samples. The AE shall be responsible for collecting, packaging, and shipping quality assurance samples to the quality assurance laboratory. The Quality Assurance Laboratory for this action and all sampling events associated with this action is the U.S. Army Corps of Engineers, Ohio River Division Laboratory (CEORD-PE-GL) located in Cincinnati, Ohio. Samples collected for Quality Assurance Analysis shall be sent to

U.S. Army Corps of Engineers, Ohio River Division Laboratory
Mr. John Adams
11275 Sebring Drive
Cincinnati, OH 45240-2714

The results from the analytical data shall be sent to

U.S. Army Corps of Engineers, Ohio River Division Laboratory
Mr. Sam Mansy
11275 Sebring Drive
Cincinnati, OH 45240-2714

2.11.2.6 Data Reportables. The Contractor shall be required to deliver data reportables, submittals, etc. by specified reporting formats such as EPA SW-846 and USACE Minimum Data Reporting Requirements Memorandum dated 16 August 1989 and EM 200-1-3 Guidlines.

2.11.2.6.1 SAP Deliverables. This section of the SAP shall indicate to the SAP user the required deliverables derived from the data acquired by the SAP activities and when and how the deliverables shall be reported. Deliverables include: Daily Quality Control Reports, Quality Control Summary Reports, Chemical Data Reports, Summary Chemical Data Reports and if required, Interim Chemical Data Reports.

2.11.2.7 Sample Information. Table 3 contains the number of field, QC, QA and equipment rinsate samples and the different parameters that will be tested at this site. Table 4 lists Matrix Spike and Matrix Spike Duplicate Requirements for this field effort.

Table 3
Sample Information[2]

Parameter	Field Samples	QC Samples	QA Samples	Equipment Rinsate
VOCs[1]	31	3	3	3
SVOCs	31	3	3	3
Nitroaromatics	31	3	3	3
PCB/Pesticides	31	3	3	3
Metals (filtered)	31	3	3	3
Metals (Unfiltered)	31	3	3	3

[1] Travel Blanks shall be required for each cooler containing samples for VOC analysis for cost estimating purposes six (6) travel blanks shall be analyzed for VOCs only.
[2] Reference Table 2 for methods and analytes.

Table 4
Matrix Spike/Matrix Spike Duplicate Information

Parameter	Field Samples	Matrix Spike	Matrix Spike Duplicates
VOCs	31	3	3
SVOCs	31	3	3
Nitroaromatics	31	3	3
PCB/Pesticides	31	3	3
Metals (Unfiltered)	31	3	3
Metals (filtered)	31	3	3

2.11.2.8 Detection Limits. Detection Limits for the compounds identified in Table 1 of this SOW shall be lower than the lowest value listed for each individual constituent. For volatile organic compounds that estimated quantiation limit shall be as described in Table 7 of this SOW.

2.12 (Task 12) Preparation and Submission of Draft Site Investigations Report

The AE shall prepare and submit the Draft Site Investigation Report to Corps of Engineers for review and comment. The report shall be a stand alone document with a discussion of purpose and organization of report, background information (including site description and site history), data quality assessment, conclusions, and recommendations. The data quality assessment shall compare the results with the prescribe data quality objectives. The DQOs shall be provided by COE personnel.

2.13 (Task 13) Preparation and Submission of Final Site Investigations Report

The AE shall revise the draft report to include any pertinent comments that arise from regulatory and COE review of the draft report. The AE shall formally respond in writing to all officially submitted COE and regulatory comments.

3.0 Schedule.

4.0 Submissions.

Table 7
Compound List and Reporting Limits for Volatile Organics by GC/MS (SW-846, 8260A)

Volatiles	MDL (µg/l)	EQL (µg/kg) (Soil)
Benzene	0.04	5
Bromobenzene	0.03	5
Bromochloromethane	0.04	5
Bromodichloromethane	0.08	5
Bromoform	0.12	5
Bromomethane	0.11	5
n-Butylbenzene	0.11	5
sec-Butylbenzene	0.13	5
tert-Butylbenzene	0.14	5
Carbon Tetrachloride	0.21	10
Chlorobenzene	0.04	5
Chloroethane	0.10	5
Chloroform	0.03	5
Chloromethane	0.13	5
2-Chlorotoluene	0.04	5
4-Clorotoluene	0.06	5
Dibromochloromethane	0.05	5
1,2-Dibromo-3-chlor-propane	0.26	10
1,2 Dibromomethane	0.06	5
Dibromomethane	0.24	10
1,2 Dichlorobenzene	0.03	5
1,3 Dichlorobenzene	0.12	5
1,4 Dichlorobenzene	0.03	5
Dichlorodifluoromethane	0.10	5
1,1-Dichloroethane	0.04	5
1,2-Dichloroethane	0.06	5
1,1-Dichloroethene	0.12	5
cis-1,2-Dichloroethene	0.12	5
trans-1,2-Dichloroethene	0.06	5
1,2-Dichloropropane	0.04	5
1,3-Dichloropropane	0.04	5
2,2-Dichloropropane	0.35	15
1,1-Dichloropropene	0.10	5
Ethylbenzene	0.06	5
Hexachlorobutadiene	0.11	5
Isopropylbenzene	0.15	5
p-Isopropyltoluene	0.12	5
Methylene Chloride	0.03	5
Naphthalene	0.04	5
n-Propylbenzene	0.04	5
Styrene	0.04	5
1,1,1,2-Tetrachloroethane	0.05	5
1,1,2,2-Tetrachloroethane	0.04	5
Tetrachloroethane	0.14	5
1,2,3-Trichlorobenzene	0.03	5
1,2,4-Trichlorobenzene	0.04	5
1,1,1-Trichloroethane	0.08	5
1,1,2-Trichloroethane	0.10	5
Trichloroethene	0.19	10
Trichlorofluoromethane	0.08	5
1,2,3-Trichlorpropane	0.32	15
1,2,4-Trimethylbenzene	0.13	5
1,3,5-Trimethylbenzene	0.05	5
Vinyl Chloride	0.17	10
o-Xylene	0.11	5
m-Xylene	0.05	5
p-Xylene	0.13	5

Appendix A
Well Listing and Coordinates

POINT	NORTHING	EASTING	ELEVATION	NOTE
1000	32580.1577	27844.9668	638.0465	MK-MW22 CAS
1001	32580.3630	27844.3376	635.5575	MK-MW22 GND
1002	32935.1711	29414.2443	639.4729	MK-MW23 CAS
1003	32934.0916	29414.5169	636.9500	MK-MW23 GND
1004	30493.6231	27420.8660	657.1164	MK-MW24 CAS
1005	30494.7078	27420.4812	654.4446	MK-MW24 GND
1006	32095.2811	27479.5229	640.1783	PB-TNTA-MW10 CAS *
1007	32093.1214	27478.6611	637.5025	PB-TNTA-MW10 GND *
1008	31733.6648	26832.7054	640.4990	PB-TNTA-MW11 CAS *
1009	31731.5058	26832.6482	637.8648	PB-TNTA-MW11 GND *

~~* Wells to sample~~

File: [illegible].CRS

POINT	NORTHING	EASTING	ELEVATION	NOTE
2000	24937.4730	22260.6698	674.3227	MK-MW16 CAS
2001	24938.5128	22260.1230	671.3271	MK-MW16 GND
2002	26671.1286	22021.0026	664.6425	MK-MW17 CAS
2003	26670.7095	22019.8256	660.9672	MK-MW17 GND

POINT	NORTHING	EASTING	ELEVATION	NOTE
3000	29408.6978	15531.0263	645.4149	PB-TNTC-MW3 CAS *
3001	29408.8887	15532.7451	642.5686	PB-TNTC-MW3 GND *
3002	28334.5197	14635.8790	654.4254	PB-TNTC-MW4 CAS *
3003	28332.1101	14634.9910	651.8891	PB-TNTC-MW4 GND *
3004	28645.6081	15969.9882	651.8103	PB-TNTC-MW5 CAS *
3005	28645.9387	15972.1375	649.0699	PB-TNTC-MW5 GND *
3006	28411.4613	17171.1652	659.4018	PB-TNTC-MW6 CAS *
3007	28413.0296	17169.5598	656.8196	PB-TNTC-MW6 GND *

* Wells to sample

POINT	NORTHING	EASTING	ELEVATION	NOTE
4000	30428.4220	14380.0948	639.5980	IT-MW002 CASING
4001	30428.0835	14379.8283	636.6895	IT-MW002 GND
4002	30428.3357	14379.9481	639.6292	IT-MW002 MEAS PT
4003	31783.0116	14647.2616	640.8941	MK-MW10 CAS
4004	31784.0924	14646.6469	638.0600	MK-MW10 GND
4005	31782.0442	15925.8393	637.6858	MK-MW11 CAS
4006	31782.6482	15926.8071	634.7066	MK-MW11 GND
4007	30549.5032	14060.0756	644.4319	PB-WA-MW-1 CASING
4008	30549.4006	14060.5771	642.3200	PB-WA-MW-1 GND
4009	30038.2737	14301.1938	633.6505	PB-WA-MW-2 CASING
4010	30038.9137	14301.2543	631.1569	PB-WA-MW-2 GND

[illegible] I:PEN-WELL.DAT

POINT	NORTHING	EASTING	ELEVATION	NOTE
5000	33122.3541	23074.6346	633.9861	PB-PR-MW7 CAS
5001	33122.1380	23074.6900	631.5000	PB-PR-MW7 GND
5002	33022.0426	23365.0504	635.0205	PB-PR-MW8 CAS
5003	33022.1700	23364.7000	632.5000	PB-PR-MW8 GND
5004	33229.7381	23561.4850	633.6999	PB-PR-MW9 CAS
5005	33227.1940	23564.6760	630.7000	PB-PR-MW9 GND
5006	33482.7542	23520.4311	634.9943	IT-MW05 CAS
5007	33481.1410	23518.7250	631.9147	IT-MW05 GND

[illegible] :MISCWELL.CRD

POINT	NORTHING	EASTING	ELEVATION	NOTE
6000	29006.7777	16324.7729	648.2732	PB-BED-MW13 CAS
6001	29004.7448	16324.8381	645.8093	PB-BED-MW13 GND
6002	30640.9823	14567.4105	646.0366	PB-BED-MW14 CAS
6003	30640.6739	14564.9269	643.0537	PB-BED-MW14 GND
6004	34311.2880	23307.8810	631.6394	PB-BED-MW15 CAS
6005	34311.2752	23310.1041	629.0787	PB-BED-MW15 GND
6006	31463.0050	24687.7929	636.0178	PB-BED-MW16 CAS
6007	31461.0305	24688.0338	633.6826	PB-BED-MW16 GND
6008	33666.0038	28164.0776	629.9697	PB-BED-MW17 CAS
6009	33667.9151	28164.7514	627.3369	PB-BED-MW17 GND
6010	32130.3503	29563.1857	651.5041	PB-BED-MW18 CAS
6011	32128.0488	29563.0032	648.8318	PB-BED-MW18 GND
6012	31782.9542	14256.5847	643.0705	PB-BED-MW19 CAS
6013	31780.9102	14256.3225	640.5050	PB-BED-MW19 GND
6014	20646.7145	27306.6374	676.3317	PB-BED-MW20 CAS
6015	20645.1156	27305.6314	673.5732	PB-BED-MW20 GND
6016	34874.6151	21994.7173	630.1175	REACTOR1 CAS
6017	34874.7528	21994.7061	630.2061	REACTOR1 GND *
6018	34762.4651	22017.2722	630.6801	REACTOR2 CAS *
6019	34762.6821	22017.2191	630.7188	REACTOR2 GND *
6020	34790.0318	22161.7567	630.8760	REACTOR3 CAS *
6021	34790.0394	22161.8592	630.7346	REACTOR3 GND *
6022	34735.1486	22161.2091	631.1532	REACTOR4 CAS *
6023	34735.1918	22161.2332	630.7567	REACTOR4 GND *

* Do not sample these wells