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DOE Contract No. DE-AC05-03OR22980
Job. No. 23900
LTR-PAD/EP-DH-03-0124
September 24, 2003

Ms. Dianna Feireisel
Acting Paducah Site Manager
U.S. Department of Energy
P.O. Box 1410
Paducah, KY 42002-1410

Dear Ms. Feireisel:

DE-AC05-03OR22980: Transmittal---*Site Investigation Work Plan for the C-746-S&T Landfill at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE/OR/07-2098&D1) Secondary Document; *Quality Assurance Project Plan for the C-746-S&T Landfill Site Investigation at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (BJC/PAD-582); *Data Management Implementation Plan for the C-746-S&T Landfill Site Investigation at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (BJC/PAD-583); *Waste Management Plan for the C-746-S&T Landfill Site Investigation at the Paducah Gaseous Diffusion Plant* (BJC/PAD-584); and *Environmental, Safety, and Health Plan for the C-746-S&T Landfill Site Investigation at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (BJC/PAD-585)

Enclosed are 17 copies each of the subject documents. Also enclosed is suggested text for the transmittal letter to the regulatory agencies. Please forward 11 copies each of the enclosed documents to the following at the Commonwealth of Kentucky regulatory agencies: Ms. Gaye Brewer, Mr. Robert Daniell (7), Mr. Steve Hampson, Ms. Janet Miller, and Mr. Eric Scott. Three copies each of the enclosed documents are to be transmitted to Mr. Carl Froede at the U.S. Environmental Protection Agency. The remaining three copies are for your use. These documents are being distributed in accordance with the *Standard Distribution List for Bechtel Jacobs Company LLC Primary and Secondary Documents (07/29/03).*

The documents include the site investigation work plan and companion documents which are the quality assurance project plan, the data management implementation plan, the waste management plan, and the environmental, safety, and health plan. This project is an assessment of potential upgradient sources of trichloroethylene observed in groundwater beneath the C-746-S, T, and U landfills.

If you have any questions or require further information, please contact Larry Young of my staff at 5187.

Sincerely,

Gordon L. Dover
Paducah Manager of Projects

GLD:LEY:dm

Enclosures (6): As stated

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DOE/OR/07-2098&D1
Secondary Document

Site Investigation Work Plan for the C-746-S&T Landfill at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

I-02823-0100

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SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

CERTIFICATION

Document Identification: ***Site Investigation Work Plan for the C-746-S&T Landfill at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*** **(DOE/OR/07-2098&D1)**

I certify under penalty of law that this document 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 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.

U.S. Department of Energy (DOE)
Owner and Operator

Dianna Feireisel — 9/24/03

Dianna Feireisel, Acting Paducah Site Manager — Date Signed

I certify under penalty of law that this document 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 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.

Bechtel Jacobs Company LLC
Co-operator

9/24/03

Gordon L. Dover, Paducah Manager of Projects — Date Signed

DOE/OR/07-2098&D1
Secondary Document

Site Investigation Work Plan for the C-746-S & T Landfill at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—September 2003

Prepared for the
U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

by
Bechtel Jacobs Company LLC
managing the

Environmental Management Activities at the
Paducah Gaseous Diffusion Plant
Paducah, Kentucky 42001
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-03OR22980

090503

CONTENTS

FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
CFR	*Code of Federal Regulations*
COC	chain-of-custody
DCE	dichloroethene
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DPT	direct push technology
DWRC	dual-wall reverse circulation
Eh	oxidation reduction potential
EPA	U.S. Environmental Protection Agency
GC	gas chromatograph
HAS	hollow stem auger
MIP	membrane interface probe
MW	monitoring well
NSDD	North-South Diversion Ditch
Paducah OREIS	Paducah Oak Ridge Environmental Information System
Paducah PEMS	Paducah Project Environmental Measurements System
PGDP	Paducah Gaseous Diffusion Plant
pH	negative logarithm of the hydrogen-ion concentration
PID	photoionization detector
PPE	personal protective equipment
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RGA	Regional Gravel Aquifer
SI	Site Investigation
SMO	Sample Management Office
SWMU	solid waste management unit
TCE	trichloroethene
^{99}Tc	technetium-99
UCRS	Upper Continental Recharge System
VC	vinyl chloride
VOC	volatile organic compound
WMP	Waste Management Plan

EXECUTIVE SUMMARY

This Site Investigation (SI) Work Plan presents the basic strategies and procedures that will apply to fieldwork and groundwater sampling conducted as part of the C-746-S&T Landfill SI. This investigation will determine if upgradient sources of groundwater contamination are influencing the contamination observed in landfill groundwater monitoring wells (MWs).

The area of investigation is on the U.S. Department of Energy (DOE) reservation, north of the Paducah Gaseous Diffusion Plant (PGDP) and adjacent to the C-746-S&T Landfill area. Temporary borings will be used to collect groundwater samples from the top and base (approximately 50 ft to 100 ft below ground surface, respectively) of the Regional Gravel Aquifer (RGA) and every 10 ft within the RGA. Three transects of borings are planned. The west transect, oriented north-south along Old Waterline Road, contains four planned borings. The south transect, oriented east-west and south of Ogden Landing Road, has three planned borings. The east transect runs north to south along the power line corridor from the Shawnee Steam Plant near the Ohio River to PGDP and includes three planned borings. If required, up to seven contingency borings and three contingency groundwater wells may be installed as part of the investigation. After drilling and sampling is completed for each temporary boring, the boring will be abandoned in accordance with Commonwealth of Kentucky requirements. All boring locations will be surveyed at the end of the investigation.

Groundwater samples will be analyzed for volatile organic compounds, including trichloroethene and the radionuclide, technetium-99. Since the area of investigation may be impacted by contamination from either the Northwest Plume or the Northeast Plume, soils and groundwater recovered from the RGA will be handled as hazardous waste until waste characterization data indicate that the material is nonhazardous. After the analytical results from the investigation have been received, the data, along with data from existing groundwater MWs at the C-746 S&T and C-746-U Landfills, will be evaluated to determine if upgradient sources are responsible for the observed contamination. A report of the evaluation of data and the findings will be submitted.

1. PROJECT DESCRIPTION

This Site Investigation (SI) Work Plan presents the basic strategies and procedures that will apply to fieldwork and groundwater sampling conducted as part of the C-746-S&T Landfill SI. The following is the problem statement for this investigation.

Hazardous substances, specifically trichloroethene (TCE), have been detected above the maximum concentration limit in groundwater monitoring wells (MWs) in the area of the C-746-S&T Landfill. It is unknown if these substances are leaching from the landfill or if they are originating from upgradient sources.

This SI will determine if upgradient sources of groundwater contamination are influencing the contamination observed in landfill groundwater MWs. The primary focus of the sampling strategy will be to collect sufficient groundwater data to determine the following:

Is all of the TCE and technetium-99 (^{99}Tc) detected in the groundwater MWs in the area of the C-746-S&T Landfill originating from upgradient sources?

Possible resolutions to this question are that all of the TCE and ^{99}Tc is coming from upgradient sources, some of the TCE and ^{99}Tc is coming from upgradient sources, or none of the TCE and ^{99}Tc is coming from upgradient sources. To answer this question, a series of temporary borings will be installed south, west, and east of the landfill area to sample groundwater from the Regional Gravel Aquifer (RGA). Analytes of interest are the organic compounds TCE, 1,1-dichloroethene (DCE), *cis*-1,2-DCE, *trans*-1,2-DCE, and vinyl chloride (VC) (also known as TCE and its degradation products), as well as the radionuclide ^{99}Tc. Groundwater levels will be collected in existing MWs for the C-746-S&T Landfill, and all historical volatile organic compound (VOC) and ^{99}Tc data for the C-746-S&T Landfill will be reviewed. Due to its proximity to the C-746-S&T Landfill, analytical data from the C-746-U Landfill, located immediately north of the C-746-S&T Landfill, will be reviewed as well.

The C-746-S&T Landfill SI will be conducted within the U.S. Department of Energy (DOE)-unsecured area, north of the Paducah Gaseous Diffusion Plant (PGDP)-secured area (Fig. 1). The initial area of investigation will be south, west, and east of the landfill area. The field investigation area extends from approximately 1000 ft west of the west landfill fence to 1500 ft east of the east landfill fence and from 500 ft south of Ogden Landing Road to 1700 ft north of Ogden Landing Road. Vertically, the investigation will focus on the RGA, generally between 50 and 100 ft below ground surface (bgs). Investigation of this area will provide data on the amount of TCE and ^{99}Tc contamination, if any, that can be attributed to sources upgradient of the landfill area. The investigation consists of 10 planned borings and up to 7 contingency borings (Fig. 2). If the groundwater data from the initial borings indicate that some or all of the contamination is coming from within the landfill area, then additional borings may be required on the south or east sides of the landfill area.

If the answer to the principal study question is, yes, then no further action is required. If the answer is, no, then additional work may be required to determine how much TCE and ^{99}Tc is being contributed by sources in the landfill area.

DOCUMENT No. DOE/OR/07-2098&D1

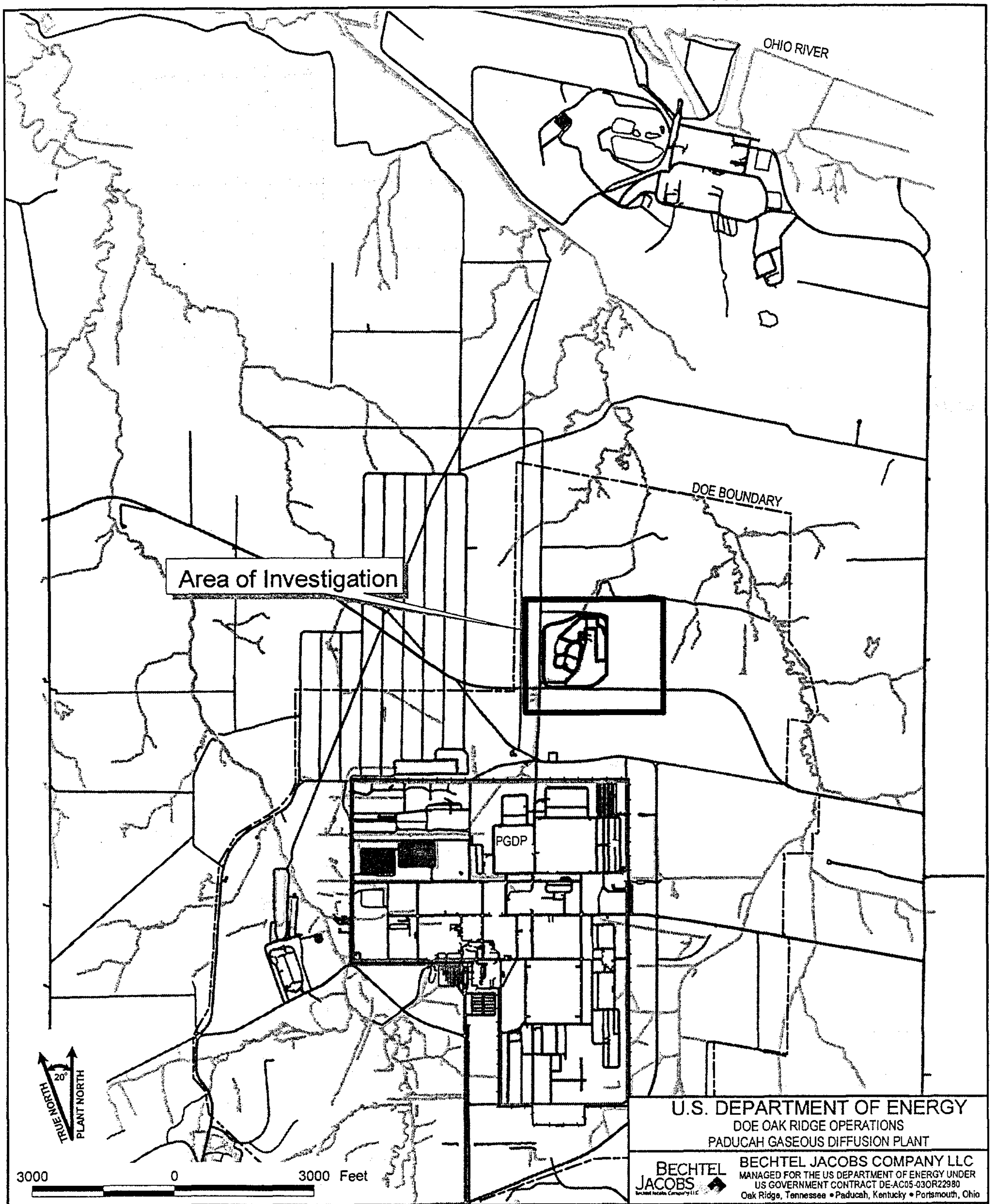
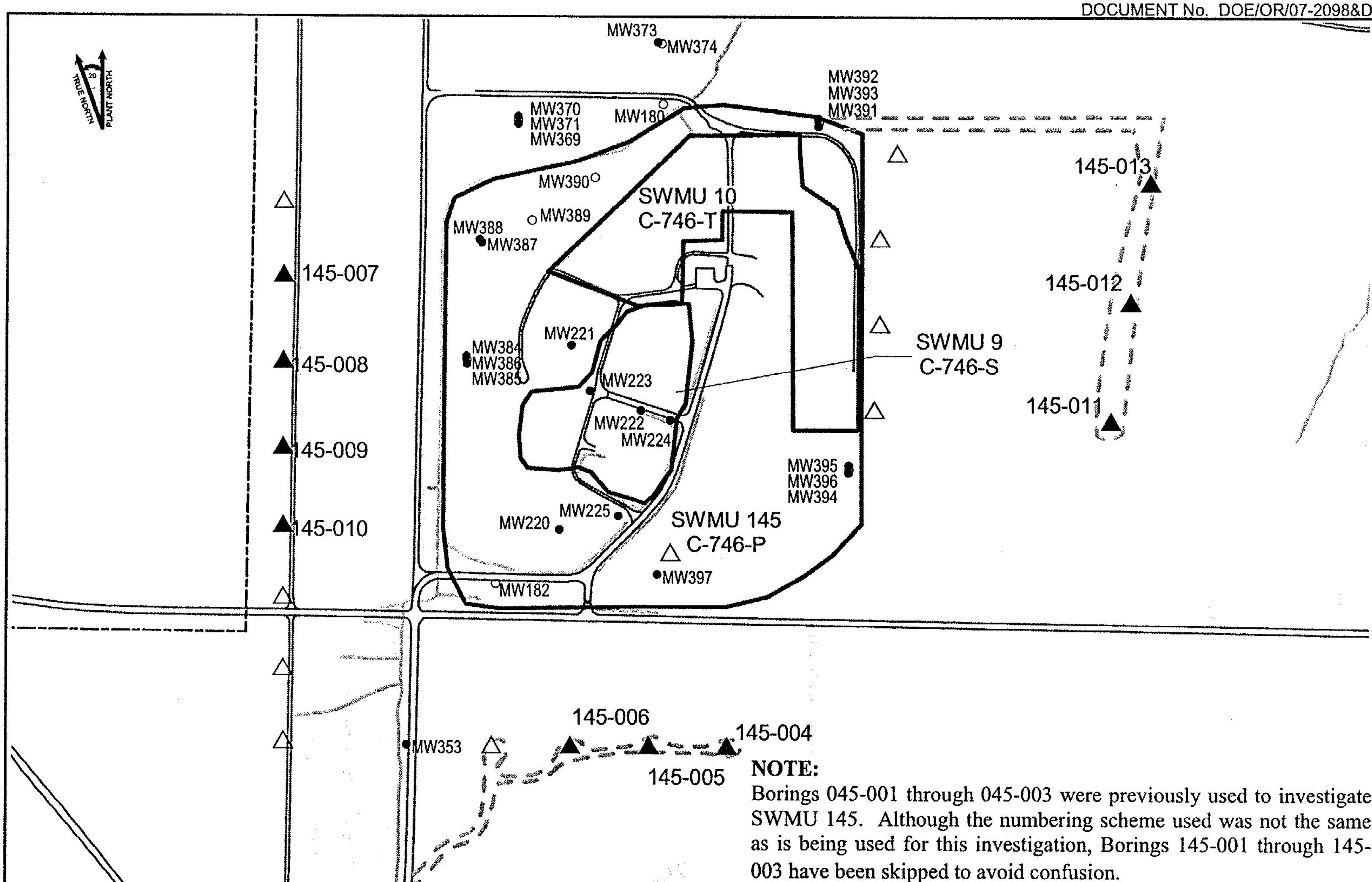


Fig. 1. SI area location.

FIGURE No. c5ac90001sk653r1.apr
DATE 09-12-03

DOCUMENT No. DOE/OR/07-2098&D1



NOTE:
Borings 045-001 through 045-003 were previously used to investigate SWMU 145. Although the numbering scheme used was not the same as is being used for this investigation, Borings 145-001 through 145-003 have been skipped to avoid confusion.

LEGEND:

- SWMU
- Temporary Road
- ● Existing/Abandoned RGA Monitoring Well
- ○ Existing/Abandoned UCRS Monitoring Well
- ▲ Planned Boring Location
- △ Contingency Boring Location

500 0 500 Feet

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC05-03OR22980
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 2. Sample locations.

FIGURE No. c5ac90001sk653R1.apr
DATE 09-12-03

2. SAMPLING AND ANALYSIS PLAN

The following sections discuss the sampling strategy and requirements.

2.1 SAMPLING MEDIA AND METHODS

This section identifies the different media to be sampled during the investigation and suggests methods for collecting the samples. Section 2.3 "Site-Specific Sampling Plans" discusses the sampling strategy in detail. Section 2.4 "Fieldwork and Sampling Methods and Procedures" describes drilling and abandonment methods and requirements as well as activities requiring formal procedures or work instructions.

2.1.1 Groundwater

The general sampling strategy for this SI focuses on collecting groundwater samples from multiple discrete depths within the RGA using temporary borings at several locations upgradient, (i.e., west, south, and east) of the landfill area. Water sampling will begin at the top of the RGA (approximately 50 ft bgs) and then continue every 10 ft until the base of the RGA is reached (approximately 100 ft bgs). This strategy results in 2 to 6 water samples from each boring, depending on the thickness of the RGA actually present in the boring. The borings will be drilled using methods that allow collection of discrete-depth water samples with minimum vertical cross-contamination. Three methods used previously at the PGDP that meet this requirement include dual-wall reverse circulation (DWRC), rotary sonic, and a combination of direct push technology (DPT) and hollow stem auger (HSA) drilling. The drilling method selected will influence the water sampling method used.

Both DWRC and rotary sonic drilling allow collection of the water sample inside the drill pipe from the sediments at the face of the drill bit. As soon as each water-sample depth is reached and drilling stops, a water-level indicator will be placed in the hole, and the water level will be monitored each minute for up to 15 minutes. The purpose is to determine how fast the water level returns to equilibrium. The faster the water level stabilizes, the more permeable the interval being sampled and the greater the potential for the interval to be a preferred pathway for contaminant migration. Purging is required to eliminate the impact of the drilling fluid (air for DWRC and potable water for rotary sonic) on the interval being sampled. The water sample will be collected after sufficient water has been purged to allow geochemical parameters (i.e., pH, dissolved oxygen, and temperature) to return to original aquifer conditions, as measured in existing MWs in the area. In previous investigations, a bladder pump and low-flow rate sampling was used to collect water samples. Groundwater samples will be collected for analysis for VOCs, including TCE and its degradation products, and ^{99}Tc. During each sampling event, the field parameters of depth to water, groundwater temperature, pH, specific conductance, oxidation reduction potential (Eh), and dissolved oxygen will be collected. Groundwater samples for analysis of metals and radionuclides other than ^{99}Tc will not be collected from the temporary borings, because the results may not represent actual groundwater conditions due to the possible presence of suspended silts and clays in the water sample as a result of drilling. Aside from the fact that metals and radionuclides other than ^{99}Tc generally are not considered potential contaminants of concern within the dissolved phase contaminant plumes, water samples from temporary borings tend to bias high the metals and radionuclides concentrations, because the drilling process may mobilize, briefly, the silts and clays in the sediments and the metals and radionuclides that may be sorbed on to them.

The HSA/DPT combination permits the use of DPT-type water sampling probes within the RGA. The drive-point water sampler is pushed or driven below the bottom of the augers, permitting collection of a relatively undisturbed water sample with minimal cross-contamination. When the drive-point sampler has reached the target depth, the mechanism allowing collection of a groundwater sample will be activated. Groundwater will be pumped to the surface, typically with an inertial pump or mechanical bladder pump, although some air- or inert gas-driven systems are available. A small amount of water, typically less than a gallon, will be purged to reduce the initial turbidity of the water sample. After purging, groundwater samples will be collected for analysis for VOCs, including TCE and its degradation products, and ^{99}Tc. During each sampling event, the field parameters of depth to water, groundwater temperature, pH, specific conductance, oxidation reduction potential (Eh), and dissolved oxygen will be collected.

An additional alternative may be used to collect VOC samples. The membrane interface probe (MIP) uses a heating element and gas permeable membrane. The element heats the material surrounding the probe, causing the VOCs contained in the material to vaporize. The vapors enter the probe through a gas permeable membrane and are transported through tubing to the surface by an inert carrier gas. The sample then is analyzed in the field with equipment appropriate to the needs of the investigation. The system is based on DPT methods, but could be deployed within a DWRC or rotary sonic boring. If the MIP is used to collect VOC samples, more traditional sampling methods will be required to collect samples for field parameters and ^{99}Tc analysis.

2.1.2 Soils

Since this investigation is focused on RGA groundwater, no soil samples will be collected to determine nature and extent of contamination. Soils will be collected every 5 ft for lithologic description.

If DWRC drilling is used, soil cuttings will be collected every 5 ft from the outlet of the cyclone separator using a large strainer lined with filter paper to catch the fine-grained fraction of the sample. Rotary sonic drilling generates a continuous core contained in a sleeve that will be recovered and laid out for inspection and description.

If the HSA/DPT combination is used, two options are available. One option will be to use the DPT to collect soil samples every 5 ft to the top of the RGA using a core barrel and acetate sleeve to contain the sample. At the top of the RGA, the sampling method will change to HSA split-spoon sampling because the large gravel in the RGA prevents material from entering the DPT core barrel. Alternatively, HSA split spoons may be used from the surface to the base of the RGA.

2.1.3 Health and Safety

Sampling to protect the health and safety of the workers is an important part of the project. During drilling and sampling operations, a photoionization detector, or PID, will be used to determine if VOCs are present in the workers' breathing zone at hazardous levels. Personal samplers also will be used to establish baseline values early in the project. Monitoring for radioactive constituents is not anticipated because the expected levels of ^{99}Tc are well below maximum contaminant levels and a radiation work permit will not be required. Additional details and requirements for health and safety sampling may be found in the project Environmental, Safety, and Health Plan (ES&HP) (BJC 2003c).

2.1.4 Investigation-Derived Waste

This project will generate soils, groundwater, decontamination water, personal protective equipment (PPE) and plastic, and miscellaneous noncontaminated trash. Some of the materials will be considered hazardous due to TCE contamination. Materials that will have to be sampled for waste characterization include soils and groundwater from the RGA, decontamination water, and PPE and plastic that come in contact with RGA soil or groundwater. These materials will be managed as hazardous waste as described in the project Waste Management Plan (WMP) (BJC 2003d). Section 1.6 of the plan covers waste characterization and sampling and analysis.

2.2 SAMPLE ANALYSIS

Sample analysis for this investigation consists of direct measurement of certain parameters in the field, analysis of groundwater samples for VOCs and ^{99}Tc, and characterization of project-generated waste materials. Specific analytical requirements, methods, and procedures are described in Sect. 2.8 of this document and in further detail in the Quality Assurance Project Plan (QAPP) for this SI Work Plan (BJC 2003a).

2.2.1 Field Parameters

Certain parameters, such as depth to water, pH, dissolved oxygen, specific conductance, Eh, and temperature will be measured in the field using appropriate field instruments such as meters and probes and in-line flow cells. Use of this equipment will be in accordance with manufacturers' operations manuals, work guides, or applicable approved procedures. These documents will be available on-site for reference by the project team members.

2.2.2 Groundwater Samples

In addition to field parameters, groundwater samples will be analyzed for VOCs and ^{99}Tc. Three options for sample analysis are available for VOCs. Two options are available for ^{99}Tc.

Decisions on the need for and placement of each boring will be based on the VOC data collected during the investigation. The sample analysis methods must be capable of rapid turnaround of analytical results to keep fieldwork moving forward and to prevent collecting unnecessary data. One option would be to send all samples to a fixed-base lab and require a maximum turnaround time of seven days, with shorter turnaround times preferable. Using this option will require careful planning of the drilling sequence to keep standby time at a minimum. The second option would be the use of a mobile field laboratory furnished with analytical equipment sensitive enough to meet the required minimum detection limits for TCE and its degradation products. If a mobile field lab is used, then 10% of the samples will be sent to a fixed-base lab for confirmation. If the MIP system is used to sample for VOCs, then use of a portable gas chromatograph (GC) or photoacoustic analyzer becomes a third option. As with the mobile field laboratory, the analytical equipment selected for use with the MIP must be sensitive enough to meet the required minimum detection limits for TCE and its degradation products. If a portable unit is used, then 10% of the samples will be collected as a liquid and sent to a fixed-base lab for confirmation.

For ^{99}Tc, the two options are a mobile field lab or a fixed-base lab. Since field decisions will not be dependent on ^{99}Tc activities in the groundwater, rapid turnaround times will not be required. The lab selection will be determined by the option that provides the best value. If a mobile field laboratory is selected, then 10% of the samples will be sent to a fixed-base lab for confirmation.

2.2.3 Waste Characterization

Analysis of waste characterization samples will not be a time-critical activity. All samples will be sent to a fixed-base lab for analysis. Details of the sampling and analytical requirements for waste characterization are described in Sect. 1.6 of the WMP (BJC 2003d)

2.3 SITE-SPECIFIC SAMPLING PLANS

This section presents the sampling plan and logic for each of the borings shown in Fig. 2. Table 1 also provides a summary for each boring.

Table 1. Summary of groundwater sampling and analysis for the C-746-S&T SI

Boring Number[a]	Sample Depth[b]	Analytical Requirements
145-004	50, 60, 70, 80, 90 ft bgs	Depth to water, pH, temperature, dissolved oxygen, specific conductance, Eh, TCE and degradation products, ^{99}Tc
145-005	50, 60, 70, 80, 90 ft bgs	Depth to water, pH, temperature, dissolved oxygen, specific conductance, Eh, TCE and degradation products, ^{99}Tc
145-006	50, 60, 70, 80, 90 ft bgs	Depth to water, pH, temperature, dissolved oxygen, specific conductance, Eh, TCE and degradation products, ^{99}Tc
145-007	50, 60, 70, 80, 90 ft bgs	Depth to water, pH, temperature, dissolved oxygen, specific conductance, Eh, TCE and degradation products, ^{99}Tc
145-008	50, 60, 70, 80, 90 ft bgs	Depth to water, pH, temperature, dissolved oxygen, specific conductance, Eh, TCE and degradation products, ^{99}Tc
145-009	50, 60, 70, 80, 90 ft bgs	Depth to water, pH, temperature, dissolved oxygen, specific conductance, Eh, TCE and degradation products, ^{99}Tc
145-010	50, 60, 70, 80, 90 ft bgs	Depth to water, pH, temperature, dissolved oxygen, specific conductance, Eh, TCE and degradation products, ^{99}Tc
145-011	50, 60, 70, 80, 90 ft bgs	Depth to water, pH, temperature, dissolved oxygen, specific conductance, Eh, TCE and degradation products, ^{99}Tc
145-012	50, 60, 70, 80, 90 ft bgs	Depth to water, pH, temperature, dissolved oxygen, specific conductance, Eh, TCE and degradation products, ^{99}Tc
145-013	50, 60, 70, 80, 90 ft bgs	Depth to water, pH, temperature, dissolved oxygen, specific conductance, Eh, TCE and degradation products, ^{99}Tc
Total	50 sample intervals planned	

[a] *Boring numbers 145-001, 145-002, and 145-003 were skipped to accommodate the first 3 borings that were collected near the landfill during the WAGs 3/8/28 and Data Gaps Investigation. The locations were mistakenly numbered 045-001, 045-002, and 045-003.*

[b] Actual sample intervals dependent on observed field conditions.

Bgs = below ground surface
TCE = trichloroethene
Eh = oxidation reduction potential
^{99}Tc = technetium-99
pH = negative logarithm hydrogen-ion concentration notation

2.3.1 General Sampling Strategy

The general sampling strategy for this SI focuses on collecting groundwater samples from multiple discrete depths within the RGA using temporary borings at several locations upgradient, (i.e., west, south, and east) of the landfill area. All borings will be drilled to the base of the RGA, approximately 100 ft below ground surface (bgs). Water sampling will begin at the top of the RGA (approximately 50 ft bgs) and then continue every 10 ft until the base of the RGA is reached. This strategy results in 2 to 6 water samples from each boring, depending on the thickness of the RGA actually present in the boring. Analytes of interest are the organic compounds TCE, 1,1- DCE, *cis*-1,2-DCE, *trans*-1,2-DCE, and VC (also known as TCE and its degradation products), as well as the radionuclide ^{99}Tc.

The borings will be drilled using methods that allow collection of discrete depth water samples with minimum vertical cross-contamination. Three methods used previously at PGDP that meet this requirement include DWRC, rotary sonic, and a combination of DPT and HSA drilling. Within the south and west transects, the planned borings are approximately 250 ft apart. This spacing balances the need for detailed information about the groundwater with the cost required to drill, sample, and abandon each boring. Spacing within the east transect is irregular due to topography and vegetation. Ten potential locations for contingency borings have been identified; however, the installation of a maximum of only seven borings is anticipated. After each boring has reached the base of the RGA and the last water sample has been collected, the boring will be abandoned using approved methods. Surface locations will be surveyed after all borings are completed. The potential drilling methods and requirements for drilling and abandonment are described in Sect. 2.4 of this work plan.

Because the intent of this SI is to determine how much of the contamination in the RGA is due to sources upgradient of the landfill area versus the landfill area itself, groundwater from the Upper Continental Recharge System (UCRS) and soils are excluded. Groundwater movement through the UCRS to the RGA is nearly vertical with little lateral spread, making the UCRS a poor integrator unit for contamination. Because of this vertical migration, if the landfill is a source of contamination, it is unlikely that the contamination has migrated beyond the boundaries of the landfill in the shallow soils or UCRS groundwater. Since no drilling is planned within the boundaries of the landfill, soil and UCRS groundwater samples from locations outside the landfill are unlikely to contain VOCs or ^{99}Tc.

In addition to the data collected from the temporary borings, results from the routine sampling of the existing MWs at the C-746-S&T and C-746-U Landfills will be incorporated into the evaluation of groundwater contamination in the landfill area. Finally, the combined data set will be used to determine the need for and placement of up to 3 contingency MWs.

2.3.2 South Transect

The south transect is designed to determine if groundwater contamination identified near the southeast corner of the C-616 Lagoons is migrating to the northeast and impacting MWs on the east side of the C-746 S&T Landfill. There are 3 temporary borings (145-004 – 145-006) planned in the south transect. This transect is east of MW353, approximately 400 ft south and parallel to Ogden Landing Road. Drilling for this transect may require the construction of a temporary road and drilling pads for access to the individual locations. The first boring (145-004) at the east end of the transect is just west of the high-voltage lines that run from the Shawnee Steam Plant, near the Ohio River, south to PGDP. The next boring, 145-005, is 250 ft west of 145-004; and the third boring, 145-006, continues the 250-ft spacing to the west. One contingency boring is tentatively located 250 ft west of 145-006, placing it midway between MW353 and boring 145-006. This contingency boring would be drilled if TCE values in 145-006 are 10 µg/L or greater. A second contingency boring tentatively is planned adjacent to MW397. MW397 is an isolated well that may be screened too deep to detect the TCE contamination that is seen in

MW394 and MW395, located 700 ft to the northeast. The contingency boring would be drilled and sampled if any but the westernmost boring (145-004) in the transect encounters TCE concentrations above 5 µg/L.

2.3.3 West Transect

The temporary borings of the west transect are intended to determine if groundwater contamination associated with the Northwest Plume is impacting the MWs at the C-746-S&T Landfill. These borings will be located along the old water line road, approximately 400 ft west of the main north-south road connecting PGDP and the landfill area. Sample locations along this road are easily accessible, while the area between the two roads is heavily wooded and wet. This transect also is far enough away from the North-South Diversion Ditch (NSDD) (a possible source of ^{99}Tc contamination) and the landfill area that the data will reflect conditions unaffected by either the NSDD or the landfill. The transect consists of 4 planned borings (145-007 – 145-010), with an approximate spacing of 250 ft between borings. One contingency boring is tentatively located at the north end of the transect. This boring would be drilled if any sample in boring 145-007 detects TCE greater than 5 µg/L. Up to three contingency borings are tentatively located south of boring 145-010, extending the transect to immediately west of MW353. As with the contingency boring on the north end of the transect, each contingency boring on the south end would be drilled only if the boring immediately north encounters TCE concentrations greater than 5 µg/L. MW353, near the south end of the transect, is screened in the middle RGA. In October 2002, the water sample from the well had no detectable TCE, although it did have 86 pCi/L of ^{99}Tc. The investigation will incorporate data from MW353 in the interpretation of the results.

2.3.4 East Transect

Temporary borings 145-011, 145-012, and 145-013 are located in a transect approximately 1500 ft east of the east landfill fence and parallel to the power lines connecting the Shawnee Steam Plant to the north, with the PGDP to the south. The intent of these borings is to determine if contamination seen on the west side of the landfill may be due to lateral expansion of the Northeast Plume. Drilling for this transect may require the construction of a temporary road and drilling pads for access to the individual locations. The topography and vegetation of the area dictates the spacing of these borings with the intent being to avoid low-lying and wooded areas as much as possible. A gap between two sets of power lines defines the location relative to the landfill.

2.3.5 Additional Contingency Borings

Four contingency borings are tentatively located along the east edge of the landfill area, between the well clusters at the southeast (MW394, MW395, and MW396) and northeast corners (MW391, MW392, and MW393) of the landfill area. Two of the three wells in each cluster have documented TCE concentrations above 10 µg/L in the RGA. These contingency borings will be drilled and sampled if TCE levels in the west, east, and south transects are below the levels seen in the two MW clusters.

2.3.6 Existing MWs

During the fieldwork portion of the project, water-level measurements will be collected weekly in area MWs. Potentiometric maps will be made using this data to determine any variation in groundwater flow directions that might impact sampling results from the temporary borings or the interpretation of the data.

Water level data will be collected weekly from the following wells.

MW220	MW222	MW224	MW353	MW373	MW391	MW397
MW221	MW223	MW225	MW370	MW385	MW395	

2.3.7 Contingency MWs

As data from the investigation becomes available, it will be added to the data from the existing landfill MWs. Interpretation of the combined data set will be used to determine the need for and location of up to three RGA MWs. The wells would be used to monitor contaminant pathways currently not monitored, either within the landfill area or in locations determined to be upgradient to the landfill. If the landfill area is determined to be the source of the groundwater contamination, then the MWs may be placed at locations determined to be downgradient of the landfill area.

After the boring has reached the base of the RGA and the last water sample has been collected, the boring will be abandoned using approved methods. Surface locations will be surveyed after all borings are completed.

2.4 FIELDWORK AND SAMPLING METHODS AND PROCEDURES

All fieldwork and sampling at PGDP will be conducted in accordance with approved medium-specific work instructions or procedures consistent with the *U.S. Environmental Protection Agency (EPA), Region IV, Standard Operating Procedures* revised last in 1996. The DOE and its Prime Contractor will approve any deviations from these work instructions and procedures. The Prime Contractor will document all changes on a Field Change Request form as detailed in the QAPP (BJC 2003a). Table 2 provides a list of investigation activities for the C-746-S&T SI that may require work instructions or procedures for guidance.

Table 2. Fieldwork and sampling procedures

Investigation Activity
Use of Field Logbooks
Lithologic Logging
Labeling, Packaging, and Shipping of Environmental Field Samples
Groundwater Sampling Procedures: Water Level Measurements
Monitoring Well Purging and Groundwater Sampling
Filter Pack and Screen Selection for Wells and Piezometers
Monitoring Well Installation
Monitoring Well Development
Temporary Boring and Monitoring Well Abandonment
Field Measurement Procedures: pH, Temperature, and Conductivity
Field Measurement Procedures: Dissolved Oxygen
Sampling of Containerized Wastes
Opening Containerized Waste
On-site Handling and Disposal of Waste Materials
Identification and Management of Waste Not From A Radioactive Material Management Area
Paducah Contractor Records Management Program
Quality Assured Data

Table 2. (continued)

Investigation Activity
Chain-of-Custody
Field Quality Control
Data Management Coordination
Equipment Decontamination
Off-site Decontamination Pad Operating Procedures
Cleaning and Decontaminating Sample Containers and Sampling Equipment
Environmental Radiological Screening
Pumping Liquid Wastes into Tankers
Archival of Environmental Data Within the ER Program
Data Entry
Data Validation

PH = negative logarithm hydrogen-ion concentration notation
ER = environmental restoration

2.4.1 Drilling Methods

The following sections briefly describe each of the three drilling methods suggested for use for the C-746-S&T SI. The MIP sampling system also is described.

Dual-Wall Reverse Circulation

Dual-wall reverse circulation drilling (DWRC) is an air rotary drilling method using two concentric strings of drill pipe. In traditional air rotary drilling, the air travels through the center of the drill pipe, exits the bit, and returns to the surface by way of the annulus between the borehole wall and the drill pipe. The DWRC method is different from air rotary drilling in that the air used to lift the drill cuttings to the surface goes down the annulus between the two strings of drill pipe, exits at or near the drill bit, and returns to the surface through the center of the drill pipe. The drill bit is only slightly larger in diameter than the outer diameter of the outer drill string, resulting in almost no annular space between the drill pipe and the borehole wall. This minimal annular space and the reverse circulation of air that prevents contact of the air with the wall of the boring results in little opportunity for cross-contamination. The upward velocity of the air returning to the surface with the drill cuttings is on the order of 100 ft per second, which means that drill cuttings caught at the outlet of the air discharge cyclone are representative of the sediments at the face of the drill bit.

When an interval for water sampling is identified, rotary drilling stops, but air circulation is maintained for a brief period to clear the hole of cuttings. After air circulation stops, water from the sample interval enters the drill pipe through the bit, allowing collection of the water sample in the protected environment of the drill pipe. The speed at which water enters the drill pipe and reaches a static water level is an indication of the hydraulic conductivity of the interval being sampled. The faster the water level stabilizes, the greater the hydraulic conductivity. Because some warm air may enter the interval being sampled, purging prior to sampling is recommended. Water temperature and dissolved oxygen, in particular, should be monitored during purging. When these return to *in situ* values, water samples may be collected. Sampling may be done using a bladder pump suitable for a 2-inch MW.

Waste generation consists of drill cuttings and water. Drill cutting volumes are near theoretical hole size, since the air circulation does not erode the borehole wall. The volume of water produced is dependent on the productive capacity of the sediments. Aquifers capable of producing large volumes of water can result in significant waste water volumes.

DWRC drilling has been used for groundwater characterization at PGDP in the Phase IV Investigation; the Northeast Plume Interim Remedial Action; the WAG 6, WAG 27, WAG 28, and WAG 3 Remedial Investigations; and the "Data Gaps" investigation.

Rotary Sonic

Like DWRC, rotary sonic drilling uses two concentric strings of drill pipe with a drill bit designed to create minimal annular space between the drill pipe and borehole wall. Like DWRC, this configuration virtually eliminates vertical cross-contamination. Water sampling, using the same methodology, also takes place within the protected environment of the drill pipe where water from the interval being sampled enters the drill pipe through the drill bit. The primary differences are the method by which the drill string is advanced and the removal of the drill cuttings.

Rotary sonic drilling uses a combination of rotational movement and sonic resonance, which vibrates the drill string down through the sediments. The vibratory motion displaces the sediments laterally. The sediments near the outside of the drill string are pushed to the side of the borehole, while the sediments nearer the center of the drill string are captured as a core in a sleeve in the inner string of drill pipe. This drilling method results in a continuous core of sediments from the surface to the total depth of the hole as a natural by-product of the drilling process, rather than as an extra step requiring special equipment.

Rotary sonic drilling can install larger diameter MWs, such as the 4-inch wells recently installed at the C-746-S&T Landfill, without requiring the installation of protective casing from the surface to the top of the RGA. This is because the inner drill pipe can be withdrawn prior to well installation, leaving the outer drill pipe in place as a temporary protective casing. The MW then is built inside the outer drill pipe, as the outer drill pipe is withdrawn from the hole. A smaller hole diameter is required and less well material is required compared to wells installed using hollow stem augers.

Waste generation consists of the soil core and water. Drill cutting volumes are near theoretical hole size since only the soils in the core sleeve are recovered at the surface. Potable water often is used while drilling above the water table to reduce friction and help displace drill cuttings and may return to the surface as waste water. The volume of purge water produced is dependent on how much water is used during drilling and how quickly groundwater parameters return to *in situ* conditions after drilling stops.

Rotary sonic drilling has been used during the WAG 6 Remedial Investigation and the Site 3A Seismic Investigation.

Hollow Stem Auger/ Direct Push Combination

The HSA/DPT combination uses traditional hollow stem auger drilling combined with a direct push groundwater sampling assembly. The augers, fitted with a temporary plate at the face of the bit to prevent the entry of cuttings, are used to drill to approximately 5 ft above the interval to be sampled. A DPT groundwater sampling assembly is lowered inside the augers to the temporary plate. Then the DPT assembly is pushed or hammered through the temporary plate and into the sediments below the auger bit to the sample depth.

When the drive point sampler has reached the target depth, the mechanism allowing collection of a groundwater sample will be activated. Groundwater will be pumped to the surface, typically with an inertial pump or mechanical bladder pump, although some air- or inert gas-driven systems are available.

A small amount of water, typically less than a gallon, will be purged to reduce the initial turbidity of the water sample. After purging, groundwater samples will be collected for analysis for VOCs, including TCE and its degradation products, and ^{99}Tc. During each sampling event, the field parameters of depth to water, groundwater temperature, pH, specific conductance, Eh, and dissolved oxygen will be collected.

After the groundwater sample is recovered, the DPT assembly is withdrawn; the augers are recovered, fitted with a new temporary plate, run back into the hole, and the hole is deepened to within 5 ft of the next groundwater sample interval.

Membrane Interface Probe

The MIP is not a drilling method, but a real-time VOC profiling and sampling method. The MIP uses a heating element and gas permeable membrane. The element heats the material surrounding the probe, causing the VOCs contained in the material to vaporize. The vapors enter the probe through a gas permeable membrane and are transported through tubing to the surface by an inert carrier gas. The sample then is analyzed in the field with equipment appropriate to the needs of the investigation. If just the detection of VOCs is important, then a simple PID is all that is required. If a qualitative estimate of VOC concentration with depth is needed, then an electron capture detector system may be deployed. When quantitative analysis of individual VOC species is needed, the surface analytical equipment consists of a GC/Mass Spectrometer, Ion Trap Mass Spectrometer, or photoacoustic analyzer. The system is based on DPT methods, but could be deployed within a DWRC or rotary sonic boring. If the MIP is used to collect VOC samples, more traditional sampling methods will be required to collect samples for field parameters and ^{99}Tc analysis.

2.4.2 Boring Abandonment

After all the sampling in each boring is completed, the boring will be plugged and abandoned. Boring abandonment will be consistent with Commonwealth of Kentucky requirements and approved site procedures. The following bullets are a synopsis of the process.

- As the drill pipe or augers are withdrawn from the hole, fine-grained sand (size) will be added to the hole by tremie pipe, allowing sufficient time for the sand to settle.
- The sand column should extend from the bottom of the boring to the top of the RGA.
- When sand placement has reached the top of the RGA, a 2 to 4-ft bentonite pellet seal will be placed at the top of the sand. Hydration time will be according to manufacturer's specifications.
- After hydration of the seal, as withdrawal of the drill pipe or augers continues, the remainder of the hole will be filled with high-solids bentonite grout, using a tremie pipe, to within 18 inches of the ground surface.
- Once the rig is moved off the hole, the area around the boring will be roped off for safety.
- After 24 hours, the grout level will be checked and additional grout added, if necessary.
- When the grout level has stabilized, the remaining 18 inches of the hole will be filled with soil to ground level and a stake will be placed with the boring number so that the location of the boring may be surveyed.

2.4.3 Requirements

All borings will be installed and abandoned by a licensed and certified driller in the Commonwealth of Kentucky or a driller working under a licensed and certified driller in the Commonwealth of Kentucky.

Upon completion of abandonment of each boring, the Kentucky Certified Driller will submit the Kentucky Well Abandonment Report to the Commonwealth of Kentucky in compliance with his/her certification.

2.5 DOCUMENTATION

Field documentation will be maintained throughout the SI in various types of documents and formats, including the field logbooks, sample labels, sample tags, chain-of-custody (COC) forms, and field data sheets. The following general guidelines for maintaining field documentation will be implemented. Additional information is contained in the Data Management Implementation Plan for this SI Work Plan (BJC 2003b).

- All entries will be written clearly and legibly using indelible ink.
- Corrections will be made by striking through the error with a single line that does not obliterate the original entry. Corrections will be dated and initialed.
- Dates and times will be recorded using the format "mm/dd/yy" for the date and the military (i.e., 24-hr) clock to record the time.
- Zeroes will be recorded with a slash (/) to distinguish them from letter Os.
- Blank lines are prohibited. Information should be recorded on each line or the line should be lined out, initialed, and dated.
- No documents will be altered, destroyed, or discarded even if they are illegible or contain inaccuracies that require correction.
- All information blocks on field data forms will be completed or a line will be drawn through the unused section, and the area will be dated and initialed.
- Unused logbook pages will be marked with a diagonal line drawn from corner to corner and a signature and date must be placed on the line.
- Security of all logbooks will be maintained by storing them in a secured (e.g., locked) area when not in use.
- Photocopies of all logbooks, field data sheets, and COC forms will be made weekly and sent to the project file.

2.5.1 Field Logbooks

Field team personnel will use bound field logbooks with sequentially numbered pages for the maintenance of field records and for documentation of any information pertinent to field activities. Field forms will be numbered sequentially or otherwise controlled. A designated field team member will record sampling activities and information from site exploration and observation in the field logbook. Field documentation will conform to approved procedures for use of field logbooks.

An integral component of Quality Assurance/Quality Control (QA/QC) for the field activities will be the maintenance of accurate and complete field records and the collection of appropriate field data forms. The primary purpose of the logbook is to document each day's field activities; the personnel on each sampling team; and any administrative occurrences, conditions, or activities that may have affected the fieldwork or data quality of any environmental samples for any given day. The level of detail of the information recorded in the field logbook should be such that an accurate reconstruction of the field events can be created from the logbook. The project name, logbook number, client, contract number, task number, document control number, activity or site name, and the start and completion dates will be listed on each logbook's front cover. Important phone numbers, radio call numbers, emergency contacts, and a return address should be recorded on the inside of the front cover.

2.5.2 Sample Log Sheets

A sample log sheet will contain sample-specific information for each field sample collected, including field QC samples. Generally, sample log sheets will be preprinted from the data management system with the following information:

- name of sampler;
- project name and number;
- sample identification number;
- sampling location, station code, and description;
- sample medium or media;
- sample collection date;
- sample collection device;
- sample visual description;
- collection procedure;
- sample type;
- analysis; and
- preservative.

In addition, all specific analytical requests will be preprinted from the data management system and will include the following for each analytical request:

- analysis/method,
- container type,
- number of containers,
- container volume,
- preservative (type/volume), and
- destination laboratory.

During sample collection, a field team member will record the remaining required information and will sign and date each sample log sheet. The following information will be recorded for each sample:

- whether or not the sample was collected;
- the date and time of collection;
- the name of the collector;
- collection methods and/or procedures;
- all required field measurements and measurement units;
- instrumentation documentation, including the date of last calibration;
- adherence to or deviation from the procedure and the SI Work Plan;
- weather conditions at the time of sample collection;
- activities in the area that could impact subsequent data evaluation;
- general field observations that could assist in subsequent data evaluation;

- lot number of the sample containers used during sample collection;
- sample documentation and transportation information, including unique COC form number, air bill number, and container lot number; and
- all relevant and associated field QC samples (for each sample).

If preprinted sample log sheets are not used, all information will be recorded manually. A member of the field sampling team (other than the recorder) will perform a QA review of each sample log sheet and document the review by signing and dating the log sheet. The Field Task Manager, as part of his/her review of the logbook, will initial all notations of deviations.

2.5.3 Field Data Sheets

Field data sheets will be maintained, as appropriate, for the following types of data:

- water level measurements,
- soil boring logs,
- monitoring well construction logs,
- sample log sheets,
- well development logs,
- well purging logs,
- groundwater sampling logs,
- COCs,
- instrument calibration logs, and
- temperature monitoring sheets.

Data to be recorded will include such information as the location, sampling depth, sampling station, and applicable sample analysis to be conducted. Field-generated data forms will be prepared, if necessary, based on the appropriate requirements. The same information may be included in the field logbook or, if not, the field logbook should reference the field data sheet. If preprinted field data sheets are not used, all information will be recorded manually in the field logbook.

2.5.4 Sample Identification, Numbering, and Labeling

In addition to field logbooks and field data sheets, the sampling team will use labels to track sample holding times, ensure sample traceability, and initiate the COC record for the environmental samples. A pressure-sensitive gummed label will be secured to each sample container at the time of collection, including duplicates and trip or field blanks, at or before the completion of collection of that sample. Sample labels will be waterproof or will be sealed to the sample container with clear acetate tape after all information has been written on the label. Generally, sample labels will be preprinted with information from the data management system and will contain the following information:

- station name,
- sample identification number,
- sample matrix,
- sample type (grab or composite),
- type or types of analysis required,
- sample preservation (if required), and
- destination laboratory.

A field sampling team member will complete the remaining information during sample collection including these items:

- date and time of collection, and
- initials of sampler.

The sample numbers will be recorded in the field logbook along with the time of collection and descriptive information previously discussed.

The sample identification protocol is outlined as follows:

sssnnnMA000

where

sss	identifies the solid waste management unit (SWMU) being investigated (in this case, 145);
nnn	identifies the sequential boring number (according to the same numbering scheme, sss-nnn identifies the location name);
M	identifies the media type (in this case, W, identifies the sample as groundwater);
A	identifies the sequential sample (usually "A" for a primary sample and "B" for a secondary sample); and
000	identifies the planned depth of the sample in ft bgs.

2.5.5 Sample COC

COC procedures will document sample possession from the time of collection, through all transfers of custody, to receipt at the laboratory and subsequent analysis. COC records will accompany each packaged lot of samples; the laboratory will not analyze samples that are not accompanied by a correctly prepared COC record. A sample will be considered under custody if it is (1) in the possession of the sampling team, (2) in view of the sampling team, or (3) transferred to a secured (i.e., locked) location.

COC records will follow the requirements as specified in a DOE Prim Contractor-approved procedure for keeping the records. This form will be used to collect and track samples from collection until transfer to the laboratory. Copies of the signed COCs will be faxed or delivered to the DOE Prime Contractor Sample Management Office (SMO) within three days of sample delivery.

The Sampling Team Leader is responsible for reviewing and ensuring the accuracy and completeness of the COC form and for the custody of samples in the field until they have been properly transferred to the Sample Coordinator. He or she is responsible for sample custody until the samples are properly packaged, documented, and released to a courier or directly to the analytical laboratory. If samples are not immediately transported to the analytical laboratory, they will remain in the custody of the Sample Coordinator where they will be refrigerated and secured either by locking the refrigerator or by placing custody seals on the individual containers.

Each COC form will be identified by a unique number located in the upper-right corner, recorded on the sample log sheet at the time of sample collection. The laboratory COC will be the "official" custody record for the samples. Each COC form will contain the following information:

- the sample identification for each sample;
- collection data for each sample;
- number of containers of each sample;
- description of each sample (i.e., environmental matrix/field QC type);

- analyses required for each sample; and
- blocks to be signed as custody is transferred from one individual to another.

The airbill number will be recorded on the COC form if applicable. The laboratory COC form will be sealed in a resealable plastic bag and taped to the inside of the cooler lid if the samples are to be shipped off-site. A copy will be retained in the laboratory, and the original will be returned to the Sample Manager with the completed data packages.

At each point of transfer, the individuals relinquishing and receiving custody of the samples will sign in the appropriate blocks and record the date and time of transfer. When the laboratory sample custodian receives the samples, he or she will document receipt of the samples, record the time and date of receipt, and note the condition of the samples (e.g., cooler temperature, whether the seals are intact) in the comments section. The laboratory then will forward appropriate information to the Sample Manager. This information may include the following:

- a cover memo stating sample receipt date and any problems noted at the time of receipt; and
- a report showing the field sample identification number, the laboratory identification number, and the analyses scheduled by the laboratory for each sample.

2.5.6 Sample Shipment

Aliquots of investigative samples will be screened by an on-site laboratory before shipment to an off-site laboratory. Results from the screening process will be recorded in Paducah's Project Environmental Measurements System (Paducah PEMS) and will be reviewed prior to preparation for sample shipment off-site. Sample containers will be placed in the shipping container and packed with ice and absorbent packing for liquids. The completed COC form will be placed inside the shipping container unless otherwise noted. The container then will be sealed. In general, sample containers will be packed according to the following procedures.

- Glass sample containers will be wrapped in plastic insulating material to prevent contact with other sample containers or the inner walls of the container.
- Logbook entries, sample tags and labels, and COC forms will be completed with sample data collection information and names of all persons handling the sample in the field before packaging.
- Samples, temperature blanks, and trip blanks will be placed in a thermally-insulated cooler along with ice that is packed in resealable plastic bags. After the cooler is filled, the appropriate COC form will be placed in the cooler in a resealable plastic bag attached to the inside of the cooler lid.
- Samples will be classified according to U.S. Department of Transportation (DOT) regulations pursuant to 49 *CFR* 173. All samples will be screened for radioactivity to ensure that DOT limits of 2.0 nCi/ml of liquid waste and 2.0 nCi/g for solid waste are not exceeded.

2.5.7 Field Planning Meeting

A field-planning meeting will occur before work begins at the site so that all involved personnel will be informed of the requirements of the fieldwork associated with the project. Additional planning meetings will be held whenever new personnel join the field team or if the scope of work changes significantly. Each meeting will have a written agenda and attendees must sign an attendance sheet, which will be maintained on-site and in the project files. The following topics will be discussed at these meetings:

- project- and site-specific health and safety,
- objectives and scope of the fieldwork,
- equipment and training requirements,
- procedures,
- required QC measures, and
- documents covering on-site fieldwork.

2.5.8 Readiness Checklist

Before implementation of the field program, all personnel will review the work control documents to identify all field activities and materials required to complete the activities, including:

- task deliverables,
- required approvals and permits,
- personnel availability,
- training,
- field equipment,
- sampling equipment,
- site facilities and equipment, and
- health and safety equipment.

Before fieldwork begins, appropriate DOE Prime Contractor personnel will concur that readiness has been achieved.

2.6 DECONTAMINATION PROCEDURES

Decontamination of all sampling equipment, drilling-related equipment, pumps, bladders, or other downhole sampling equipment, such as Teflon® tubing, will be in accordance with DOE Prime Contractor-approved procedures.

Personal protective equipment, clothing, and decontamination procedures for the implementation of the SI will be addressed in the Environmental, Safety, and Health Plan for this SI Work Plan (BJC 2003c).

2.7 WASTE MANAGEMENT PROCEDURES

PGDP waste management practices for the activities below will follow DOE Prime Contractor-approved procedures during the implementation of the SI:

- Off-Site Decontamination Pad Operation;
- Pumping Liquid Wastes Into Tankers;
- Sampling of Containerized Waste; and
- Opening Containerized Waste.

A detailed description of waste management procedures is presented in the WMP for this SI Work Plan (BJC 2003d).

2.8 PROCEDURES FOR SAMPLE ANALYSES

All laboratories performing analyses for the SI will be DOE-regulated or will be required to hold a current Nuclear Regulatory Commission or Agreement State License for handling radioactive materials. The DOE-Oak Ridge SMO must audit and accept all laboratories before mobilization for fieldwork.

When available and appropriate for the sample matrix, SW-846 methods will be used. When SW-846 methods are not available or are not appropriate, other nationally recognized methods such as DOE, EPA, and American Society for Testing and Materials methods will be used.

The following standardized procedure manuals are recommended references for radiological analysis:

- *Prescribed Procedures for Measurement of Radioactivity in Drinking Water*, EPA-600/4-80-032, 1980.
- *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, EPA SW-846, 1986.
- Eastern Environmental Radiation Facility, *Radiochemistry Procedures Manual*, EPA 520/ 5-84-006, 1984.
- *Environmental Measurements Laboratory Procedures Manual*, DOE HASL-300, 1982.

All groundwater samples will be analyzed for TCE and its degradation products and for ^{99}Tc. Analytical methods, method detection limits, sample container requirements, and sample preservation requirements for all environmental and waste characterization sampling required during this SI are addressed in the QAPP (BJC 2003a).

2.9 SAMPLE LOCATION SURVEYING

Surveying of sampling locations will be conducted upon completion of SI field activities. Where possible, permanent markers consisting of flagging or of wooden or metal stakes will be used to mark all boring locations. Brass markers will be incorporated as part of pad installation for all MWs; however, a thorough description of each location will be made during field sampling activities and will be documented using field maps. This documentation will be used for the survey effort if permanent sampling location markers are disturbed or if permanent markers cannot be placed at the time of sampling. A member of the field sampling crew will accompany the survey crew to provide information regarding the location of sampling points. Each sample point will be surveyed for its horizontal and vertical location using the PGDP coordinate system for horizontal control. Additionally, State Plane Coordinates will be provided using the U.S. Coast and Geodetic Survey North American Datum of 1983. The datum for vertical control will be the U.S. Coast and Geodetic Survey North American Vertical Datum of 1988. Accuracy for this work will be that of a Class 1 First Order survey. Work will be performed by or under responsible charge of a Professional Land Surveyor Registered in the Commonwealth of Kentucky. All coordinates will be entered into Paducah PEMS and will be transferred with the station's ready-to-load file to Paducah's Oak Ridge Environmental Information System (Paducah OREIS).