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Final Phase I Report and Phase II Work Plan: QuickSite® Investigation, Centralia, Kansas

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Final Phase I Report and Phase II Work Plan: QuickSite® Investigation, Centralia, Kansas

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Notation

AGEM	Applied Geosciences and Environmental Management
AMSL	above mean sea level
ASTM	American Society for Testing and Materials
BGL	below ground level
BTEX	benzene, toluene, ethylbenzene, and xylene
°C	degree(s) Celsius
CCC	Commodity Credit Corporation
CLP	Contract Laboratory Program
COC	chain of custody
cpm	count(s) per minute
DOE	U.S. Department of Energy
ECPT	electronic cone penetrometer
EPA	U.S. Environmental Protection Agency
ESC	expedited site characterization
ft	foot (feet)
GC-MS	gas chromatograph(y)-mass spectrometer(-metry)
hr	hour(s)
ICP	inductively coupled plasma
in.	inch(es)
KDHE	Kansas Department of Health and Environment
µg/kg	microgram(s) per kilogram
µg/L	microgram(s) per liter
µS/cm	microsiemen(s) per centimeter
MCL	maximum contaminant level
mg/L	milligram(s) per liter
mi	mile(s)
min	minute(s)
mL	milliliter(s)
mm	millimeter(s)
MS/MSD	matrix spike/matrix spike duplicate
NAD	North American Datum
ng	nanogram(s)
NGVD	North Geodetic Vertical Datum
psi	pound(s) per square inch
PVC	polyvinyl chloride

QA/QC	quality assurance/quality control
RPD	relative percent difference
RWD	Rural Water District
SDG	sample delivery group
TU	tritium unit(s)
USDA	U.S. Department of Agriculture
VOC	volatile organic compound

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1 Introduction

The city of Centralia, Kansas, is located in Nemaha County, in the northeastern corner of the state (Figure 1.1). The town lies about 40 mi northeast of Manhattan, Kansas. The current population of Centralia is approximately 530.

The Commodity Credit Corporation (CCC), an agency of the U.S. Department of Agriculture (USDA), formerly operated a grain storage facility approximately 1,100 ft north of Centralia (Figure 1.2). The CCC/USDA operated this facility from 1949 until 1971. None of the CCC/USDA structures remain. Two additional grain storage facilities currently exist in and near Centralia: the Nemaha County Co-op, approximately 4,000 ft south of the former CCC/USDA facility, and a private grain storage facility near the Don Morris residence, 3,500 ft north of the former CCC/USDA facility. Prior to 1986, commercial grain fumigants containing carbon tetrachloride were commonly used by the CCC/USDA and the grain storage industry to preserve grain.

In April 1998, the Kansas Department of Health and Environment (KDHE) sampled the domestic well at the Don Morris residence near Centralia (Figure 1.2) as part of the CCC/USDA Private Well Sampling Program, which was initiated to determine whether carbon tetrachloride was present in domestic wells located near former CCC/USDA grain storage facilities in Kansas. Carbon tetrachloride was detected in the Morris well at 19.3 μg/L and confirmed at 25.4 μg/L, both concentrations above the maximum contaminant level (MCL) of 5 μg/L for carbon tetrachloride in drinking water. On the basis of the detection of carbon tetrachloride in the Morris well, the KDHE in August-September 1998 conducted preliminary investigations at the former CCC/USDA facility. For the details of previous investigations in the area and a summary of their findings, see the QuickSite® Phase I *Work Plan* for Centralia (Argonne 2002a).

Because the KDHE found carbon tetrachloride at the former CCC/USDA facility at Centralia that might, in part, be linked to historical use of carbon tetrachloride-based grain fumigants at the facility, the CCC/USDA is conducting an environmental site investigation at Centralia. However, the KDHE established in 1998 that the probable groundwater flow direction at the former CCC/USDA facility is not toward the Morris well, and thus the former facility is not

responsible for the carbon tetrachloride measured in that well. The town of Centralia and all residents near the former CCC/USDA facility currently obtain their water from Rural Water District #3 (RWD 3). Therefore, these local residents are not drinking and using contaminated groundwater.

The investigation at Centralia is being performed by the Environmental Research Division of Argonne National Laboratory. Argonne is a nonprofit, multidisciplinary research center operated by the University of Chicago for the U.S. Department of Energy (DOE). The CCC/USDA has entered into an interagency agreement with DOE, under which Argonne provides technical assistance to the CCC/USDA with environmental site characterization and remediation at its former grain storage facilities.

At these facilities, Argonne is applying its QuickSite® environmental site characterization methodology. QuickSite® is Argonne's proprietary implementation system for the expedited site characterization (ESC) process. Argonne's Environmental Research Division developed the ESC process to optimize preremedial site characterization work at hazardous waste sites by obtaining and then applying a thorough understanding of a site's geology, hydrogeology, and hydrogeochemistry (e.g., Burton 1994). This approach is fundamental to successful site characterization because the geology and hydrogeology of a site largely govern the mobility and fate of contaminants there. Argonne's ESC process has been used successfully at a number of former CCC/USDA facilities in Kansas and Nebraska and has been adopted by the American Society for Testing and Materials (ASTM 1998) as standard practice for environmental site characterization.

The QuickSiteâ process for the CCC/USDA program begins after a preliminary assessment/site inspection or an equivalent investigation has identified carbon tetrachloride contamination in an area thought to be associated with a former CCC/USDA grain storage facility.

The purposes of a QuickSiteâ Phase I investigation for the CCC/USDA are (1) to verify an association of carbon tetrachloride contamination with a former CCC/USDA facility and (2) to delineate subsurface features at the former facility and its surroundings and thus identify the migration pathway(s) by which carbon tetrachloride (if it is present) is most likely to move away from the facility. A geologic/hydrogeologic model developed for the Phase I work plan guides the identification of migration pathways. The Phase I investigation eliminates potential migration pathways from consideration and retains other potential pathways for further investigation, subject to continuing linkage of the carbon tetrachloride contamination to the former CCC/USDA facility.

The purpose of Phase II work for the CCC/USDA is to delineate the contamination present in both soil and aquifers along the potential migration pathway(s) identified in Phase I. If no carbon tetrachloride is found in association with the former CCC/USDA facility during Phase I or if evidence is found that indicates no linkage between the former facility and carbon tetrachloride contamination in the immediate area, a Phase II investigation is not automatically conducted, and the site is referred back to the KDHE for discussion, with a full report. The results of a QuickSiteâ investigation are intended to provide a technically defensible, scientific basis for evaluating the potential health risks — and hence the possible remediation needs — of a site, a basis compatible with the site characterization requirements specified under a variety of alternative regulatory environments. For the investigations at Centralia, the results of the Phase I and Phase II studies would together provide information that is included under the KDHE scope of work for a comprehensive investigation.

A preliminary geologic/hydrogeologic model for Centralia was developed in the *Work Plan* (Argonne 2002a). Approximately 115 ft of Pleistocene age section was inferred to lie unconformably on Permian bedrock (Figures 1.3 and 1.4). The Upper Independence Formation makes up the Pleistocene section and is composed of glacial till and glaciofluvial outwash. Sand lenses and laterally limited sand beds are found within the till and outwash. The laterally limited sand lenses and beds, when saturated, are considered to be the permeable aquifer at Centralia.

Analysis of present and historical drainage in the Centralia area (Argonne 2002a) and subsurface bedrock topography placed the former CCC/USDA facility area on the south side of what appeared to be a drainage divide. These factors led to the conclusion by the KDHE and Argonne that groundwater flow in the area of the former facility was most likely toward the southwest, away from the Morris well. Because of limited data, however, the actual groundwater flow direction and hence the pathway for contaminant transport — if contamination is found in the groundwater at the former facility — was not known.

On the basis of the goals for a QuickSite® Phase I investigation and the preliminary geologic/ hydrogeologic model for Centralia, four technical objectives were developed to guide the field investigation. These technical objectives are to:

1. Verify an association of carbon tetrachloride contamination with the former CCC/USDA facility;

2. Characterize the nature and extent of the geologic units composing the aquifer or aquifers at and in the vicinity of the former Centralia CCC/USDA facility;

3. Establish the direction(s) of groundwater flow at the former CCC/USDA facility; and

4. Identify the contaminant migration pathway(s) at the former CCC/USDA facility.

Field work for the QuickSite® Phase I investigation of Centralia began on March 19, 2002.

This report documents the findings of the Phase I activities at Centralia. Section 1 provides a brief history of the area and the QuickSite® process, a summary of the geologic/hydrogeologic model, objectives of the Phase I investigation, and a brief description of the sections contained in this report. Section 2 describes the investigative methods used during the Phase I investigation. Section 3 presents all of the data obtained during the investigation. Section 4 describes the interpretation of the pertinent data used to meet the technical objectives of the investigation, including the contaminant migration pathways in soil and groundwater. A summary of the findings is also provided in Section 4. Section 5 presents the conclusions of the investigation relative to the technical objectives and outlines recommendations for Phase II. To streamline the reporting process, materials from the *Work Plan* (Argonne 2002a) and relevant sections of the *Master Work Plan* (Argonne 2002b) are not repeated in detail in this report. Consequently, these documents must also be consulted to obtain the complete details of the Phase I investigative program.

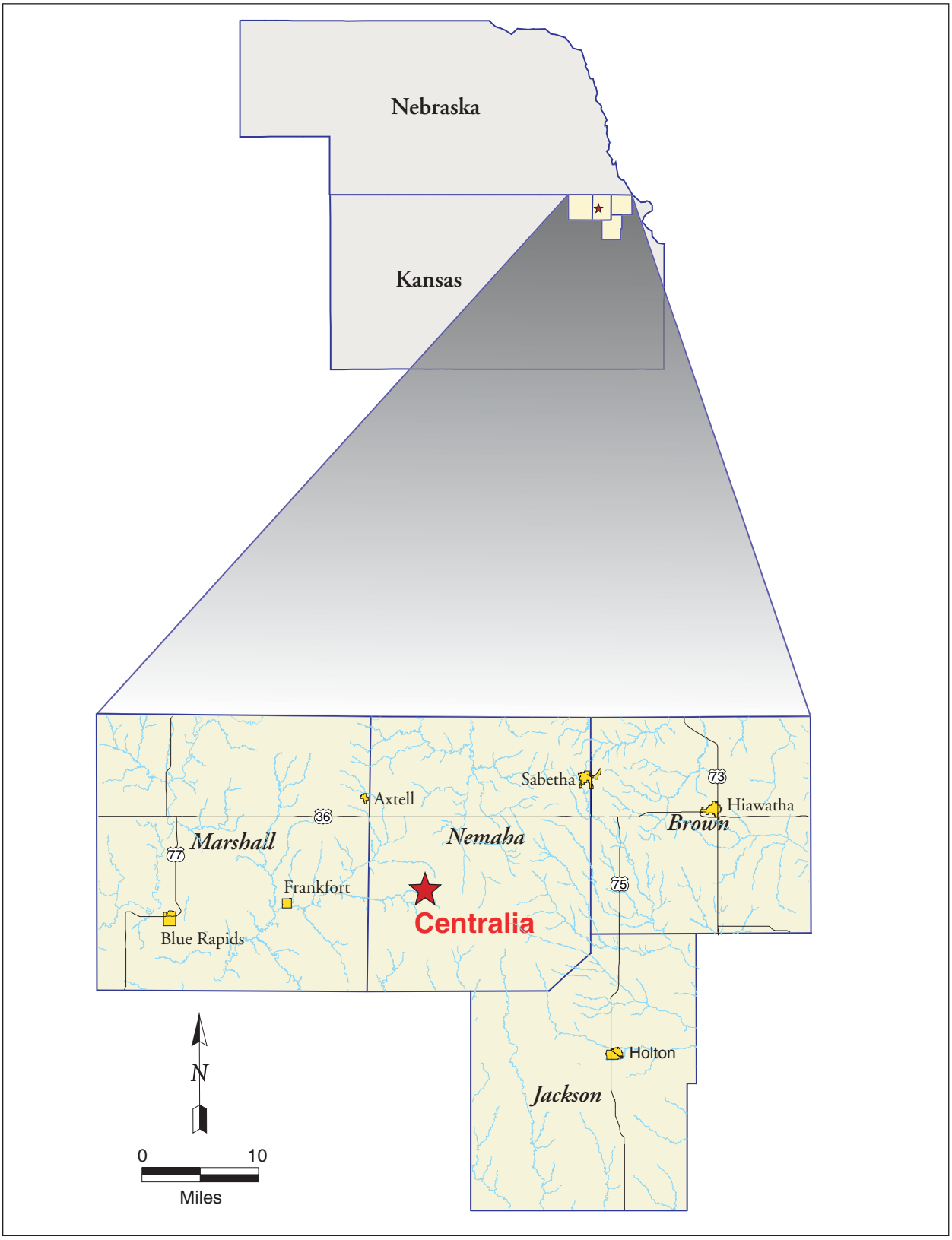

FIGURE 1.1 Location of Centralia, Kansas.

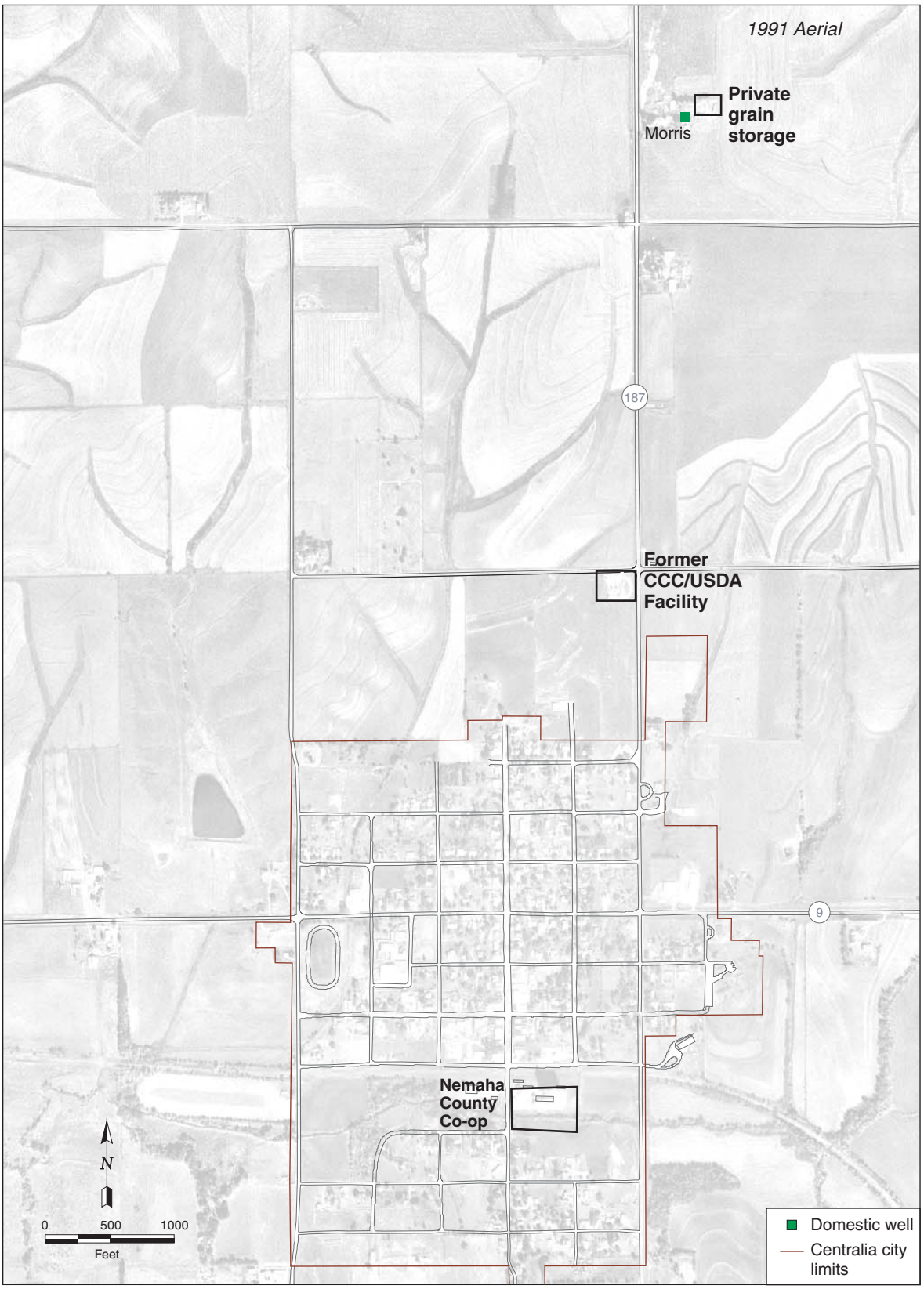

FIGURE 1.2 Locations of the former CCC/USDA grain storage facility at Centralia, other local grain storage facilities, and the contaminated Morris private well.

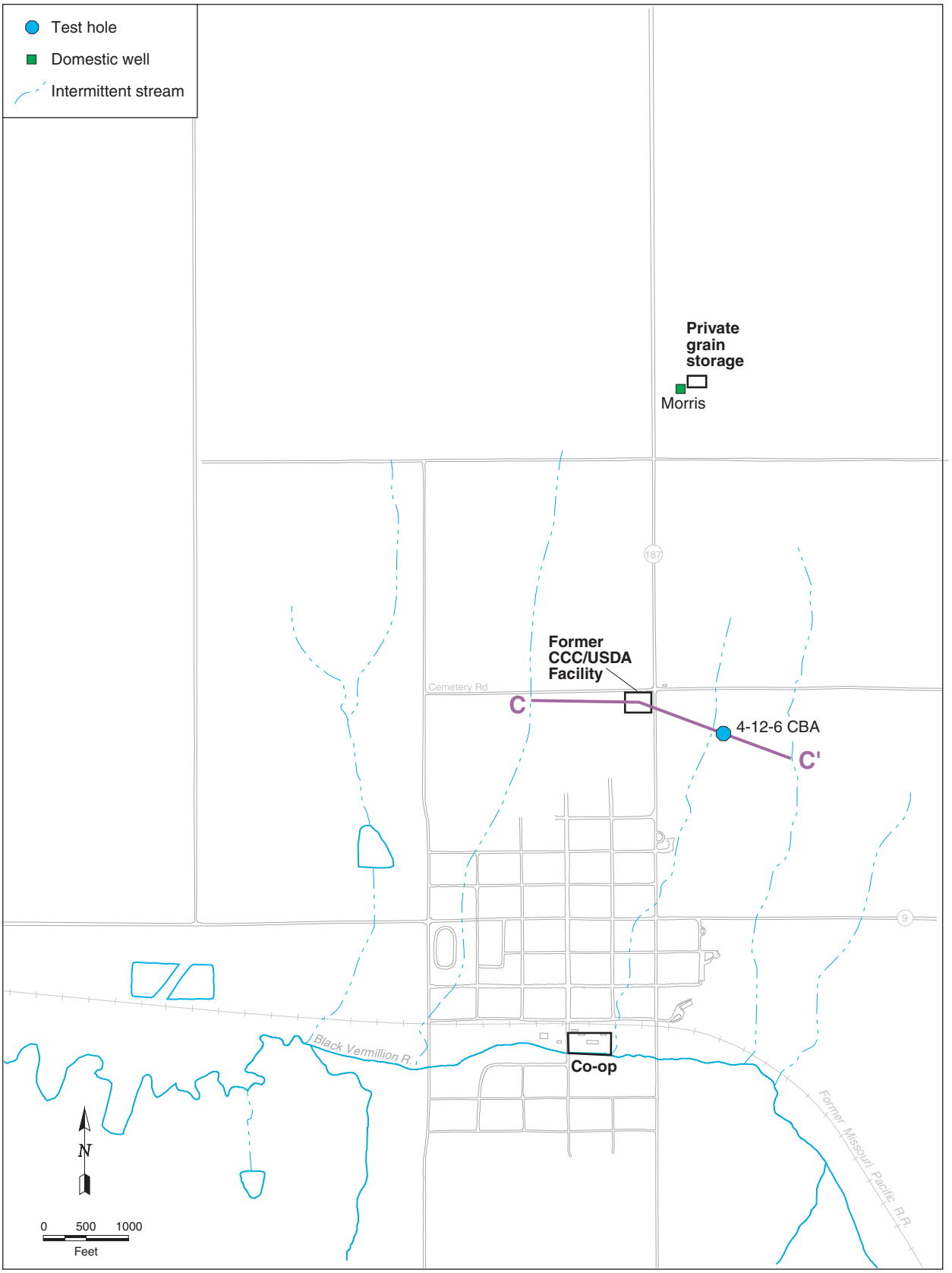

FIGURE 1.3 Location of west-to-east geologic cross section C-C´ at Centralia (Argonne 2002a).

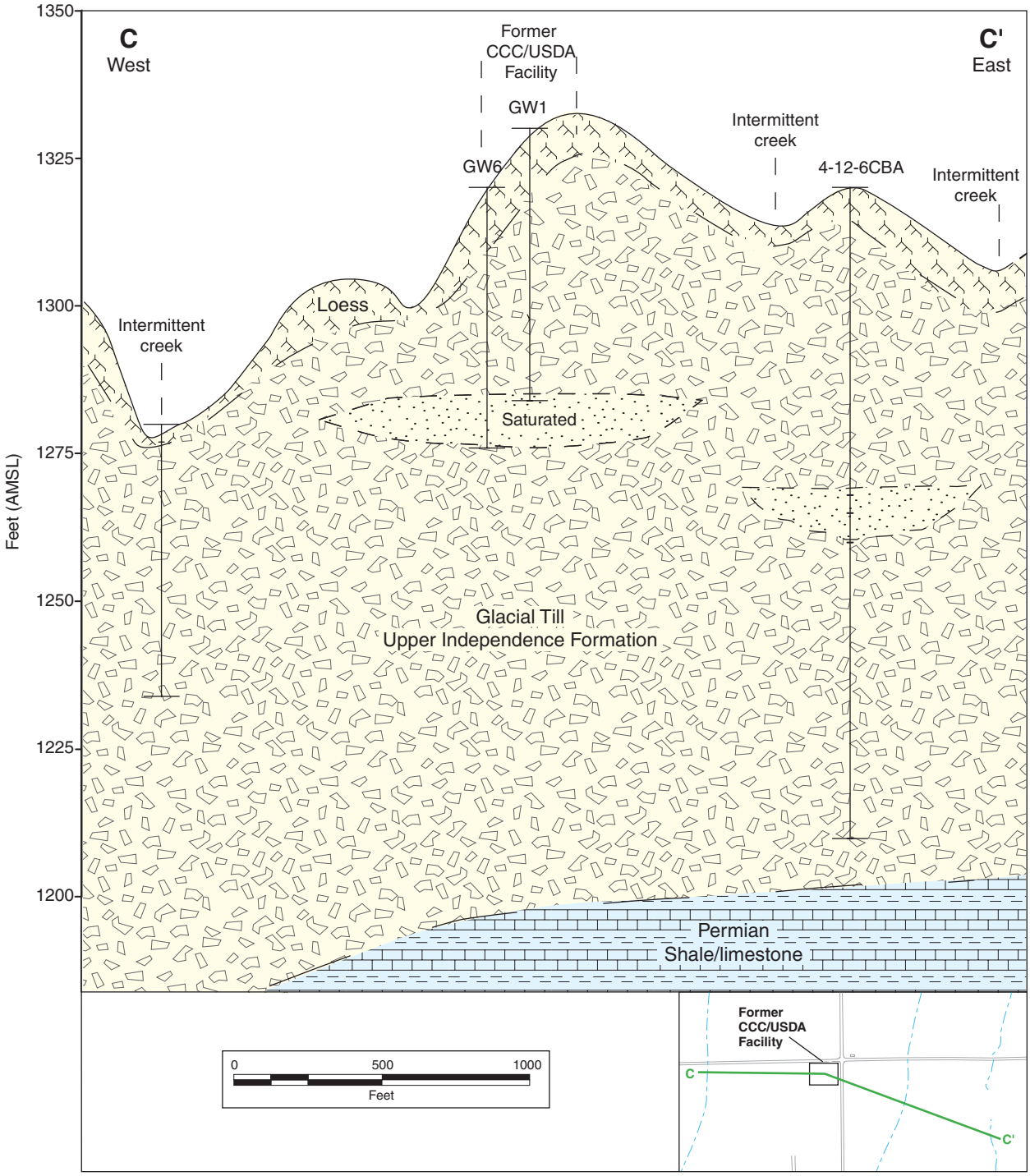

FIGURE 1.4 Interpretive west-to-east geologic cross section C-C´ (vertically exaggerated) at Centralia, constructed for the *Work Plan* (Argonne 2002a).

2 Investigative Methods

The Centralia Phase I investigation was performed by using an iterative process of data collection, evaluation, and interpretation *during the field program*, to ensure that all data necessary to achieve the specific technical objectives defined for the site were obtained. Fundamental to this approach is the use of multiple complementary investigative techniques to acquire data relevant to each of the specific technical objectives, so that the interpretations being developed can be tested independently against multiple lines of evidence. Individual data sets acquired by a particular technique can also be interpreted in multiple ways to yield information addressing more than one specific technical objective. Throughout the field program, a comprehensive quality assurance/quality control (QA/QC) program is implemented to confirm the reliability of all information as it is accumulated. With this procedure, an integrated, technically defensible model of the geologic and hydrogeologic features controlling groundwater flow — and hence potential contaminant migration at the site — is assembled as the specific technical objectives are addressed.

The specific technical objectives and the investigation program developed for Phase I at Centralia were discussed in Section 5 of the site-specific *Work Plan* (Argonne 2002a). Procedures for the individual techniques employed by Argonne at this site are in the *Master Work Plan* (Argonne 2002b). This section provides a brief overview of the methods used to implement Phase I at Centralia, and it identifies certain modifications that were made to the field program (relative to the *Work Plan* [Argonne 2002a]) in response to the new information obtained during the course of the study.

2.1 Method to Verify an Association of Carbon Tetrachloride Contamination with the Former CCC/USDA Facility

Previous Argonne investigations have shown that analysis of vegetation and near-surface (vadose zone) soils for carbon tetrachloride by the headspace method (a modification of U.S. Environmental Protection Agency [EPA] Method 5021) is a sensitive and positive indicator of potential deeper vadose zone soil contamination. In this application, the headspace data are not used quantitatively but are examined for distribution patterns in order to prioritize areas for additional, followup subsurface soil sampling and analysis. In conjunction with the headspace analyses, the near-surface soils are also examined by using purge-and-trap sample preparation with analysis by gas chromatography-mass spectrometry (GC-MS; EPA Methods 5030B and 8260B) as

a quantitative basis for the evaluation of potential health risks associated with the near-surface soils.

Argonne experience has also demonstrated that the distribution of carbon tetrachloride concentrations in shallow soils can be affected by differences in soil types across a site, as well as by the history of land use at the site, potentially complicating interpretation of the contaminant analysis results. For this reason shallow soils are not collected randomly; sample locations are selected only after an evaluation of the past facilities and activities at each site and after characterization of the local soil types.

Near-surface soil and vegetation sampling originally planned for the former CCC/USDA facility property at Centralia is described in Section 5.3.1 of the *Work Plan* (Argonne 2002a). Targeted near-surface soil sampling as described above was completed at Centralia in keeping with the *Work Plan*; however, no vegetation sampling was performed because of the poor quality of the available vegetation, most of which was dormant when the field investigations took place in late March and early April.

Headspace data for the near-surface soils were used to guide the selection of a location for preliminary sampling and analysis for volatile organic compounds (VOCs) in subsurface soils, to investigate further the possible association of carbon tetrachloride contamination with the former CCC/USDA facility.

The results of the soil analyses for VOCs are presented in Section 3.3. The results are discussed in relation to this technical objective in Section 4.1.

2.2 Method to Characterize the Nature and Extent of the Geologic Units Composing the Aquifer or Aquifers at and in the Vicinity of the Former Centralia CCC/USDA Facility

As noted previously, this objective to characterize the aquifer(s) is central to the Phase I investigation approach. This objective must be addressed in the context of the regional and local hydrogeologic setting. The task requires detailed characterization of (1) the stratigraphic and areal distribution of lithologic units at the site and (2) the hydraulic properties of and relationships among groundwater-bearing zones within these units, in order to determine the site-specific hydrostratigraphy.

Multiple investigative techniques were used to determine the spatial distribution and characteristics of the geologic units at Centralia, including coring and electronic profiling of soils by using the electronic cone penetrometer (ECPT); visual description and physical analyses of cored materials; and the evaluation and display of these data in logs, maps, and cross sections to aid in their interpretation. The hydraulic relationships among the geologic units were examined by the installation of temporary and permanent piezometers and the measurement of groundwater levels, by the collection of groundwater samples for geochemical and tritium isotope analyses, and by the analysis of groundwater samples for VOC contamination. At this stage of the investigation, groundwater VOC analyses are not intended for plume delineation. Instead, contaminant levels are examined as potential independent "tracer" information that can assist in defining aquifer and surface water relationships, groundwater flow patterns, and contaminant migration pathways.

The program of activities performed at Centralia to address this objective is described in Section 5.3.2 of the *Work Plan* (Argonne 2002a). A series of up to nine investigative locations was proposed in the *Work Plan*, with the selection of later locations in the sequence to be based on the initial findings. Five initial locations were investigated as described in the *Work Plan*. Five additional locations (for a total of ten) were subsequently investigated, in order to adequately characterize localized lithologic variations identified in the saturated geologic sequence within the limits of the former CCC/USDA facility. The results of these investigations are presented in Sections 3.1-3.5 and are discussed in Section 4.2.

2.3 Method to Establish the Direction(s) of Groundwater Flow at the Former CCC/USDA Facility

The investigation addressing this objective to establish the groundwater flow direction is inherently linked to and builds on the findings of the geologic and hydrostratigraphic investigations described in Section 2.2. Therefore, all of the field activities discussed in Section 2.2 are relevant to the consideration of this objective.

As noted above, temporary and permanent piezometers were installed at Centralia to provide information on groundwater levels and apparent hydraulic gradients across the investigation site. In accordance with Section 5.3.3 of the *Work Plan* (Argonne 2002a), installation locations and depths for the piezometers were based on the geologic and hydrostratigraphic interpretations developed during the field program. Water levels were measured initially by hand to provide data for use during the field program. Water level recorders were

installed near the end of the field activities to gather information on the range and variability of water levels and flow directions that might affect groundwater (and contaminant) migration at the site over time.

The resulting water level data were analyzed in the context of the identified geology, hydrostratigraphy, and groundwater geochemical and isotopic relationships in order to determine the directions of and controls on groundwater flow. The results of the water level measurements are summarized in Section 3.4. An analysis of groundwater flow directions at Centralia is presented in Section 4.3.

2.4 Method to Identify the Contaminant Migration Pathways at the Former CCC/USDA Facility

The consideration of this objective to identify contaminant migration pathways draws on all of the data sources and interpretations described in Sections 2.1-2.3. Analysis of the migration pathways at Centralia, as outlined in Section 5.3.4 of the *Work Plan* (Argonne 2002a), required integration of the Phase I data within the constraints of the regional and local hydrogeologic setting identified in the *Work Plan* (Argonne 2002a), to develop an internally consistent picture (based on multiple lines of evidence) of the mechanisms for contaminant migration from source area(s) into and through the groundwater and/or surface water systems at this site.

The results of VOC analyses of groundwater samples were used to independently test and refine the interpretations of migration pathways developed during the Phase I studies. The results of these analyses are presented in Section 3.5.2. The contaminant migration pathways examined at Centralia are discussed in Section 4.4.

3 Field and Laboratory Data

The investigative methods used in Phase I of the characterization studies at Centralia are described in Section 2. In this section, the data obtained in the Phase I field and laboratory studies are summarized. These results, together with the information contained in the *Work Plan* for Centralia (Argonne 2002a), provide the quality-assured data required to address the specific technical objectives of this investigation.

The suite of investigative technologies implemented during Phase I of the Centralia program was selected to provide multiple, independent lines of evidence that could be used to address each of the technical objectives. To meet this goal effectively and efficiently, individual technologies and activities were therefore chosen, whenever possible, that would generate data critical to the consideration of more than one objective. For example, groundwater levels measured in piezometers installed as part of the field program yielded information useful in characterizing the hydrogeologic nature of the aquifer(s) at the site (objective 1), as well as in defining groundwater flow direction(s) (objective 2) and identifying probable contaminant migration pathways (objective 3).

For organizational simplicity, the data in this section are presented in general categories reflecting the type of media investigated and the activities performed, without detailed references to the technical objectives to which they are applied. The integration of these data and their interpretation in the context of each of the Phase I technical objectives are discussed fully in Section 4.

The results of all analyses are contained in Appendices A-H.

3.1 Soil Boring and Cone Penetrometer Sensor Data

Subsurface geologic coring with direct-push technologies and ECPT electronic sensor logging were used to identify the types of lithologies present at the site, to define the local stratigraphic sequence and the heterogeneity in the distribution of the lithologies, and to determine the distribution of saturated permeable and less permeable zones and hence the local hydrostratigraphy. The locations of all subsurface soil borings are shown in Figure 3.1.

Soil boring SB01 was placed near the location where the KDHE had previously sampled soil at 21.5 ft below ground level (BGL) and obtained carbon tetrachloride concentrations of 12.8-68 µg/kg (KDHE 1998; Argonne 2002a). Boring SB01 was continuously cored from the ground surface to bedrock at 116 ft BGL to determine the geology and to identify water-bearing zones. The location was logged electronically with the ECPT over the same interval. The results were used to establish a reference for local stratigraphic correlation of the geologic section and for evaluating the correlation between the lithologic sequence determined from cores and the corresponding ECPT tip and sleeve sensor responses.

The complete lithologic log for SB01 is in Appendix A, and the log is summarized in Figure 3.2. A highly plastic yellow-brown clay unit is present from the surface to 4 ft BGL. Below 4 ft BGL and continuing to about 25.7 ft BGL is a calcareous silty clay unit with a trace of pebbles and sand, as well as local accumulations of manganese and iron. This entire unit was described as moist.

Below 25.7 ft BGL and continuing to about 34.5 ft BGL is a unit composed predominantly of clayey sand, described as moist to wet. From 34.5 ft BGL to about 47 ft BGL is a wet unit of primarily brownish yellow clay and silty clay with a few thin sand lenses. This wet unit is referred to here as the *shallow aquifer*, although its water yield capacity has not been determined. Below 47 ft BGL down to 85.4 ft BGL is a fine grained unit composed predominantly of silty clay and clayey silt. The upper portion of the unit is yellowish brown and brownish gray, becoming dark grayish brown to very dark gray with increasing depth. Small sedimentary structures remnant of bioturbation are found in the upper portion of the unit, whereas laminations are more prevalent at depth. The portion of the fine grained unit at about 74-85 ft BGL is described as dry to damp.

From 85.4 ft BGL to 96 ft BGL is a unit composed primarily of very fine grained sand and silt. The unit is described as dark gray, laminated, and wet. It is referred to here as the *deeper aquifer*. From 96 ft BGL to refusal of the ECPT to penetrate at 116 ft BGL is a dark gray, calcareous clay unit with up to 5% sand and gravel.

The relationship between the ECPT sensor logs and the geology at SB01 was examined to determine whether sensor logs could subsequently be used at nearby boring locations for preliminary interpretation of the stratigraphy, thereby reducing or eliminating the need for continuous coring at every location investigated. The lithologic and ECPT sensor logs for SB01 are compared in Figure 3.2. The correlation between the sensor logs and the lithologic zones is

only fair. However, general pattern recognition enabled targeted sampling to identify lithologies and evaluate the continuity of units.

Additional continuous measurements of tip and sleeve stress were made at nine locations (SB02-SB10; Figure 3.1) by using Argonne's 22-ton track-mounted ECPT vehicle and 40-ton truck-mounted ECPT. The general pattern of major ECPT sensor profile characteristics for the geologic sequencing observed in core samples at SB01 was substantiated by comparison of core lithologic descriptions and sensor responses at the other locations. Complete ECPT sensor profiles and lithologic descriptions of core samples for each location are in Appendix A.

The Geoprobe was initially used to augment the subsurface investigations as an additional means of continuous geologic sampling. (The Geoprobe has no electronic sensor capabilities.) However, the Geoprobe was able to penetrate only the top approximately 40 ft at the first two locations where it was used (SB05 and SB09), and so all further investigation was done with the ECPT units. The ECPT and Geoprobe operations were performed in accordance with procedures outlined in the *Master Work Plan* (Argonne 2002b, Section 6). All ECPT and Geoprobe holes were abandoned by using a tremie pipe to fill the holes with bentonite grout.

Core was taken from selected intervals at locations SB02-SB10 to visually confirm the nature and extent of the shallow aquifer identified in SB01 at 25.7-47 ft BGL or from about 1,277 to 1,299 ft above mean sea level (AMSL). Visual observation of core showed a variation in the grain size of the geologic material in this zone across the investigation area. Materials of coarser grain size, including sand and gravel, were found in greater abundance in cores at SB04, SB06, and SB08 than in the core at SB01. For example, see the comparison in Figure 3.3 between SB01 and SB04. Sand and silty sand were found in core at SB05, and silty clayey sand and silt were found in core at SB07. (See geologic logs, Appendix A.)

Selected core was also taken from the damp to dry, fine grained, gray clay and silt found below the shallow aquifer (at 74-85 ft BGL in SB01). The purpose was to verify the presence of this unit at this and other locations. The visual geologic evidence in core from SB07, SB08, SB09, and SB10 confirmed the presence of this unit in the investigation area. (See geologic logs, Appendix A.)

On the basis of the lithologic and hydrostratigraphic observations described above, the soil borings at six locations (SB01, SB04, SB05, SB07, SB08, SB09) were completed as

permanent piezometers in the shallow aquifer. The installation of these piezometers is discussed further in Section 3.4. Construction data for the piezometers is in Appendix B.

3.2 Coordinates Survey Data

Accurate location information for the activities performed in the field is required to provide horizontal and vertical control for stratigraphic correlation and water level measurement.

All piezometer locations and selected borehole and groundwater sample locations were surveyed by professional surveyors, Schwab-Eaton of Manhattan, Kansas. The coordinates of other sampling locations were estimated by Argonne personnel with a hand-held differential global positioning system. Results of the coordinates survey are in Appendix C.

3.3 Soils Analysis Data

3.3.1 Contaminant Data for Near-Surface Soils

Sampling of near-surface soils was performed at Centralia to determine whether carbon tetrachloride contamination is associated with the property formerly occupied by the CCC/USDA facility, and hence to identify the possible origin(s) of the pathways controlling contaminant migration in groundwater within the subsurface. As noted in Section 2.1, vegetation sampling originally proposed for this purpose (Argonne 2002a) was not conducted because of the poor quality of available vegetation, most of which was dormant in late March and early April, when the field investigations took place.

Locations for the collection of near-surface soils were chosen after an investigation of the current and former facilities and practices at this property and after the determination of near-surface soil types, to ensure that comparisons of results across the site would be based on materials of similar types. Former cultural features at the property were mapped with the aid of historical aerial photographs and shallow probing to locate possible buried features. Current conditions were determined by visual reconnaissance and shallow probing.

Identified features connected with the former CCC/USDA activities include the former grain bin locations and the locations of old gravel roads associated with both the CCC/USDA facility and later cement plant operations on this property. Additional features associated with the cement plant included buried foundations of former buildings and scales. Current cultural features at the site include an erosion control channel and a small area in the northeast corner of the property being used for farm equipment storage. These cultural features, in addition to the former CCC/USDA facility property boundaries and the current neighboring public roads, are shown in Figure 3.4.

The near-surface soil sampling focused primarily on the locations of the former CCC/USDA grain bins. Samples were collected at 43 locations (shown in Figure 3.5 and designated SU01-SU43 in data tables) across the former CCC/USDA facility by using direct-push technology, including the Geoprobe and the ECPT. Details of the soil sampling procedures are in the *Master Work Plan* (Argonne 2002b, Section 6.1.1). At each near-surface location, a shallow sample was collected at 0.5-2.6 ft BGL; a deeper sample was also collected, typically at 4.5-6.0 ft BGL. The shallow sampling was targeted at an organic-rich brown topsoil, while the deeper sampling was targeted at a yellowish to grayish brown silty clay soil (Table D.1, Appendix D).

The near-surface soil samples were placed in jars, sealed, preserved on dry ice, and shipped to the Applied Geosciences and Environmental Management (AGEM) Laboratory at Argonne National Laboratory for analysis. The samples were analyzed (Argonne 2002b, Section 6.3.1) by (1) a headspace method with a gas chromatograph and electron capture detector (modified EPA Method 5021) and (2) a purge-and-trap sample preparation method with analysis by GC-MS (EPA Methods 5030B and 8260B).

The headspace analysis was used to achieve the low detection limits required to establish a contaminant distribution pattern to guide subsurface soil sampling. The results of the headspace analyses for carbon tetrachloride in the shallow and deeper near-surface soils are summarized in Table D.2, Appendix D, and are shown in Figures 3.6 and Figure 3.7, respectively.

The purge-and-trap data were used to support risk assessment calculations for these soils (Section 4.1.3). Neither carbon tetrachloride nor chloroform was detected above a quantitation limit of 10 μg/kg in any of the near-surface soil samples analyzed by the purge-and-trap method (Table D.3, Appendix D).

3.3.2 Contaminant Data for Subsurface Soils

Subsurface soils collected during this phase of the Centralia investigation were analyzed to provide a preliminary indication of possible carbon tetrachloride and chloroform levels remaining in the deeper vadose zone beneath the former CCC/USDA facility.

The headspace data described in Section 3.3.1 were used to interpret patterns of carbon tetrachloride contamination in the near-surface soils. These patterns, in turn, were used to guide the selection of location SB06 (see Figures 3.1 and 3.5) for the subsurface investigation.

The ECPT was used for vertical-profile soil sampling for VOC analysis at SB06 and also at SB01 (Figures 3.1 and 3.5), according to procedures described in the *Master Work Plan* (Argonne 2002b, Section 6.1.1). In all, 42 soil samples were collected at approximately 2-ft intervals from 2 ft BGL to 28 ft BGL in SB01 and from 1 ft BGL to 55.2 ft BGL in SB06. Upon recovery, the samples were put into jars, sealed, placed on dry ice, and transported to the AGEM Laboratory for analysis of VOCs according to EPA Methods 5030B and 8260B (Argonne 2002b, Section 6.3.1).

Carbon tetrachloride was not detected above a quantitation limit of 10 μg/kg at SB01, where the KDHE had obtained carbon tetrachloride concentrations of 12.8-68 μg/kg in soil at 21.5 ft BGL. Thus, the quality-controlled results of Argonne's Phase I investigation could not reproduce the earlier KDHE results. At SB06, carbon tetrachloride values ranged from not detected to 135 μg/kg. Figure 3.8 shows the data for carbon tetrachloride in soil above the saturated zone at SB06 as a function of depth and lithology.

3.3.3 Physical Property Data for Soils

A modified Wentworth-based geologic classification system (Argonne 2002b, Section 4.3.1.3) was used for geologic logging (Appendix A) at Centralia. This classification system and the criteria used for lithologic descriptions in the field are described in Appendix E.

In all, 25 soil samples were selected from cores collected at four locations (SB01, SB06, SB09, and SB10; Figure 3.9) for grain size analysis in accordance with ASTM Method D422-63 (1998), as described in the *Master Work Plan* (Argonne 2002b, Section 4.3.1.3). The analyses

were made on samples taken from a variety of lithologic types, to objectively confirm the lithologic descriptions prepared by the site geologists in the field.

The grain size data are in Tables D.4 and D.5, Appendix D. Almost 100% verification of lithologic descriptions was found.

3.4 Groundwater Level Data

Groundwater levels were measured in borings completed in the shallow aquifer, to provide information on the hydrogeologic nature of this unit and the pattern(s) of groundwater flow, recharge, and discharge affecting this aquifer.

Initially, eight temporary piezometers were installed with the ECPT (SB01t and SB03t-SB09t; see Figure 3.10) by using a slight modification of the standard procedure for groundwater sampling with slotted polyvinyl chloride (PVC) pipe (Argonne 2002b, Section 6.4.6). Sand was placed as a filter pack around the screened interval, and bentonite grout was used to seal the remainder of the annulus from the top of the filter pack to the surface. The temporary piezometers were left in place for less than 30 days.

Water levels in the temporary piezometers were measured manually to the nearest 0.01 ft, from a surveyed reference mark, by using an electronic water level sensor (Argonne 2002b, Appendix F, Section F.2.2). These data are in Table F.1, Appendix F, of the present report.

At the end of the field investigation, a monitoring network of six 1-in.-diameter PVC permanent piezometers was installed (SB01, SB04, SB05, SB07, SB08, SB09; see Figure 3.10) to replace the temporary piezometers, in accordance with Kansas regulations for long-term monitoring of water level fluctuations. The permanent piezometers were installed by using the direct-push capability of the ECPT vehicle. A 0.010-in. slotted screen section and blank PVC riser casing were attached to a sacrificial tip and advanced to the desired depth inside the 2.25-in. cone penetrometer rods. Five of the piezometers were made with 10-ft screen sections (SB01, SB04, SB05, SB08, and SB09); the sixth, SB07, was made with a 7-ft screen section. At the desired depth, the rods were withdrawn, leaving the sacrificial tip, screen, and casing in place. A filter pack was then placed across the screened interval. The remainder of the annular space was grouted with a 100% high-solids bentonite slurry by using a tremie. All of the permanent

piezometers were completed as flush mounts. Construction details for the permanent piezometers are in Appendix B. Specifications are summarized in Table F.2, Appendix F.

Pressure transducers connected to programmable data recorders were installed in the permanent piezometers. Water level measurements were recorded every 4 hr beginning on April 25, 2002. Data recorded until June 3, 2002, are in Table F.3, Appendix F.

3.5 Groundwater Analysis Data

Groundwater samples were collected by using the ECPT vehicle at nine locations (SB01 and SB03-SB10; Figure 3.11). To establish a continuous vertical profile of the groundwater characteristics in the shallow aquifer at each location investigated, samples were collected at 3- to 5-ft intervals through the shallow-aquifer zone. Groundwater was also sampled from deeper hydrostratigraphic intervals at selected locations within the groundwater flow system. The groundwater samples collected at Centralia are described in Table G.1, Appendix G.

Samples were collected by pushing cone penetrometer rods with a disposable tip to the target water-bearing zone. The rods were then withdrawn slightly to expose an internal filter screen section into which groundwater passed. Groundwater was sampled by using a bailer inserted through a PVC riser attached to the filter screen. At SB01, insufficient volumes of groundwater were initially available for all of the desired chemical analyses. The groundwater entering the screen within the first 45 min or less was sampled for analysis for VOCs. The screen was subsequently left in place for 10-24 hr to allow additional groundwater to accumulate if other analyses were warranted.

All ECPT water sampling holes were abandoned by grouting with a tremied bentonite slurry.

3.5.1 Field Measurements

Selected parameters (temperature, pH, and conductivity) were measured in the field during groundwater sampling by using a Checkmate field meter system after calibration with the appropriate standard solutions (Argonne 2002b, Section 6.3.2.2). The results of these analyses are in Table G.2, Appendix G.

3.5.2 Contaminant Data for Water Samples

Samples collected for VOC analyses were preserved in the field by cooling to 4°C (Argonne 2002b, Section 6.2) and shipped to the AGEM Laboratory for analysis with EPA Method 524.2. Replicate groundwater samples were collected for verification analyses with EPA Contract Laboratory Program (CLP) methodology.

Carbon tetrachloride was detected above the MCL of 5 μg/L in groundwater from seven of the nine shallow-aquifer locations sampled at the former CCC/USDA facility (Figure 3.12). The highest concentration of carbon tetrachloride, 176 μg/L, was found in a sample collected at 58-62 ft BGL at SB08, in the northeast portion of the former CCC/USDA facility. Chloroform was detected in groundwater above 5 μg/L at three of the nine shallow-aquifer locations sampled (Figure 3.13). The highest concentration of chloroform, 31 μg/L, was found in a sample collected at 40-45 ft BGL at SB01. No carbon tetrachloride or chloroform was found in the deeper aquifer at the former CCC/USDA facility.

The results of VOC analyses on groundwater samples are in Table G.3 in Appendix G. The QA/QC results, including results for samples analyzed with EPA CLP methodology, are discussed in Appendix H.

3.5.3 Major Element Data for Water Samples

Groundwater samples collected for inorganic analyses were preserved in the field (Argonne 2002b, Section 6.2) as appropriate for the analysis method and shipped to Severn-Trent Laboratory, Colchester, Vermont, for analysis. The results of the inorganic analyses of groundwater samples are in Table G.4, Appendix G.

Analyses for dissolved metals (aluminum, calcium, iron, magnesium, manganese, phosphorus, potassium, silicon, sodium, and zinc) used EPA Method 6010. Alkalinity was calculated with EPA Method 310.

Results for chloride and sulfate anions were determined by EPA Method 300. The samples analyzed for anions and cations were filtered and acidified in the laboratory. Because these samples were not preserved with acid within 24 hr of collection, the results determined in

the Method 300 analysis for phosphate and for nitrate as nitrogen were not considered acceptable for quantitative characterization and are not reported here.

To allow more time for nitrogen analysis, separate samples were collected for total nitrogen analyses by EPA Method 353. These samples were preserved in the field by acidifying to pH < 2 with sulfuric acid before shipment. This method of preservation extended the holding time for analysis beyond 24 hr. Total nitrogen concentrations in groundwater ranged from 0.02 mg/L (in SB01 at 86-91 ft BGL) to 8.16 mg/L (in SB04 at 60-65 ft BGL).

3.5.4 Tritium Isotope Data for Water Samples

Selected groundwater samples were analyzed for tritium to aid in characterization of potential variations in the relative ages of groundwater within the flow system. The analyses were run at the Tritium Laboratory of the University of Miami, Miami, Florida. Tritium in groundwater ranged from -0.08 TU to 10.5 TU, but the level exceeded 1 TU at only two locations, SB06 and SB09 (see Figure 3.14). Complete analytical results are in Table G.5, Appendix G.

3.6 Quality Control Data for Soil and Groundwater Analyses

The QA/QC procedures followed for collection, handling, and analysis of soil and groundwater during Centralia Phase I work are described in detail in the *Master Work Plan* (Argonne 2002b). Results of the QA/QC activities are summarized as follows:

- Sample integrity was maintained successfully throughout the collection, shipping, and analysis activities by the use of custody seals and chain-of-custody records. A few minor discrepancies were resolved by comparison of the various records.

- All samples shipped to the AGEM Laboratory and to verification laboratories were received with custody seals intact and at appropriate temperature. All samples were analyzed within required holding times.

- Carbon tetrachloride and chloroform were not detected (1) in trip blanks accompanying samples shipped for organic analyses to the AGEM Laboratory or Severn-Trent Laboratory or (2) in laboratory method blanks analyzed with the samples at either laboratory.

- Low surrogate recoveries in the organic analyses of three trip blanks sent with water samples to the AGEM Laboratory did not compromise the results for the investigative samples.

- Carbon tetrachloride and chloroform were not detected in rinsates from decontaminated reusable sampling bailers and ECPT rods.

- For the headspace analysis of near-surface soil samples for carbon tetrachloride and chloroform at the AGEM Laboratory with modified EPA Method 5021, an 11-point calibration was established for the gas chromatograph system. A background near-surface soil sample was collected to provide a baseline value. Results of dual analyses of samples from 20 locations were consistent. The data are acceptable for qualitative determination of contaminant distribution.

- For the purge-and-trap analysis of near-surface and subsurface soil samples for carbon tetrachloride and chloroform at the AGEM Laboratory with EPA Methods 5030B and 8260B, calibration checks were run with each sample delivery group to verify proper calibration of the gas chromatograph throughout the analyses, and surrogate standard determinations were performed. Results of dual analyses for samples from 31 locations were consistent. The data from the AGEM Laboratory are acceptable for quantitative determination of contaminant distribution and for risk analysis.

- Quality control limits were met in verification purge-and-trap analyses of replicate soil samples with EPA Methods 5030B and 8260B at Severn-Trent Laboratory. The results support the AGEM Laboratory data.

- Groundwater samples were analyzed for carbon tetrachloride and chloroform at the AGEM Laboratory by using EPA Method 524.2 (the purge-and-trap

method). Quality control limits were met for the analyses, and results of dual analyses for samples from 18 locations were consistent. The data are acceptable for quantitative determination of contaminant distribution.

- Quality control limits were met in verification analyses of replicate groundwater samples for carbon tetrachloride and chloroform with EPA CLP methodology at Clayton Laboratory, Novi, Michigan. The results support the AGEM Laboratory data.

- In the collection of two groundwater samples for inorganic analyses, a pump was used rather than a bailer, the piezometer was purged before sampling, or both. Use of these techniques caused noticeable differences in results of duplicate analyses for total nitrogen. The data involved are marked with a footnote in Table G.4 in Appendix G.

- Groundwater samples were analyzed at Severn-Trent Laboratory for inorganic materials. The results are acceptable on the basis of recoveries of known concentrations of analytes in quality control samples and demonstrated precision in duplicate analyses.

- For the tritium analyses at the University of Miami Tritium Laboratory, the instrument was calibrated with a standard, and dual analyses of eight samples gave comparable results. The data are acceptable for age dating of groundwaters.

A detailed QA/QC report addressing activities related to sample collection, handling, and analysis is in Appendix H.

3.7 Waste Characterization, Handling, and Disposal

A blank of the water used during the Phase I field investigation for equipment decontamination was collected, as was a sample from each of two drums containing the equipment decontamination waste water. Carbon tetrachloride and chloroform, contaminants of concern in this investigation, were not detected in these samples.

3.8 Summary

The following are key results of the Phase I investigation at Centralia:

- A thick, unconsolidated geologic section was documented beneath the former CCC/USDA facility, by continuous coring of boring SB01 from the ground surface down to bedrock at 116 ft BGL.

- Two water-bearing zones were found at SB01: (1) a shallow unit from 25.7 to 47 ft BGL, composed of clayey sand, silty sand, silt, and clay, and (2) a deeper unit from 85.4 to 96 ft BGL, composed of very fine sand and silt. These zones are subsequently considered aquifers for the purposes of this investigation.

- Additional borings indicate that the lithology and grain size of the materials composing the shallow aquifer vary dramatically across the investigation area, from very fine sands and silts to coarse gravelly sands.

- A dry to damp (not saturated) silty clay and clayey silt unit, identified in SB01 at 47 to 85.4 ft BGL, vertically separates the two aquifers. This intervening unit and the underlying deeper aquifer are relatively uniform in character throughout the area of the investigation.

- Carbon tetrachloride was detected in some near-surface soils at the former CCC/USDA facility, based on headspace analyses (modified EPA Method 5021). These results were used to prioritize areas of the facility for potential follow-up investigation of the underlying subsurface soils. Neither carbon tetrachloride nor chloroform was detected above a quantitation limit of 10 μg/kg in any of the near-surface soils analyzed by the purge-and-trap method (EPA Methods 5030B and 8260B).

- Subsurface soils were collected for VOC analyses at location SB06 on the basis of patterns of headspace results observed in the near-surface soils. Carbon tetrachloride was detected in the subsurface soil at SB06 at a maximum concentration of 135 μg/kg.

- No carbon tetrachloride was detected (by EPA purge-and-trap Methods 5030B and 8260B) above a quantitation limit of 10 μg/kg in the subsurface soil at SB01, where the KDHE had previously obtained carbon tetrachloride concentrations of 12.8-68 μg/kg in soil sampled at 21.5 ft BGL. Thus, the quality-controlled results of Argonne's Phase I investigation could not reproduce the earlier KDHE results.

- Eight temporary piezometers were installed and used for manual measurements of water levels, to obtain initial data on groundwater flow patterns in the shallow aquifer. The temporary piezometers were replaced by a network of six permanent piezometers installed in accordance with KDHE regulations, and a long-term monitoring program using automatic recorders to document water level fluctuations over time was begun.

- Carbon tetrachloride was detected at levels above the MCL of 5 μg/L in groundwater from seven of the nine shallow-aquifer locations sampled at the former CCC/USDA facility, with a maximum concentration of 176 μg/L. Chloroform was detected at levels above 5 μg/L at three of the nine shallow-aquifer locations sampled, with a maximum of 31 μg/L. No carbon tetrachloride or chloroform was found in the deeper aquifer at the former CCC/USDA facility.

- Tritium in groundwater ranged from -0.08 TU to 10.5 TU, but it exceeded 1 TU at two locations only: SB06 and SB09.

- The QA/QC activities demonstrated that the analytical data reported by the various laboratories are acceptable for the purposes of this investigation.

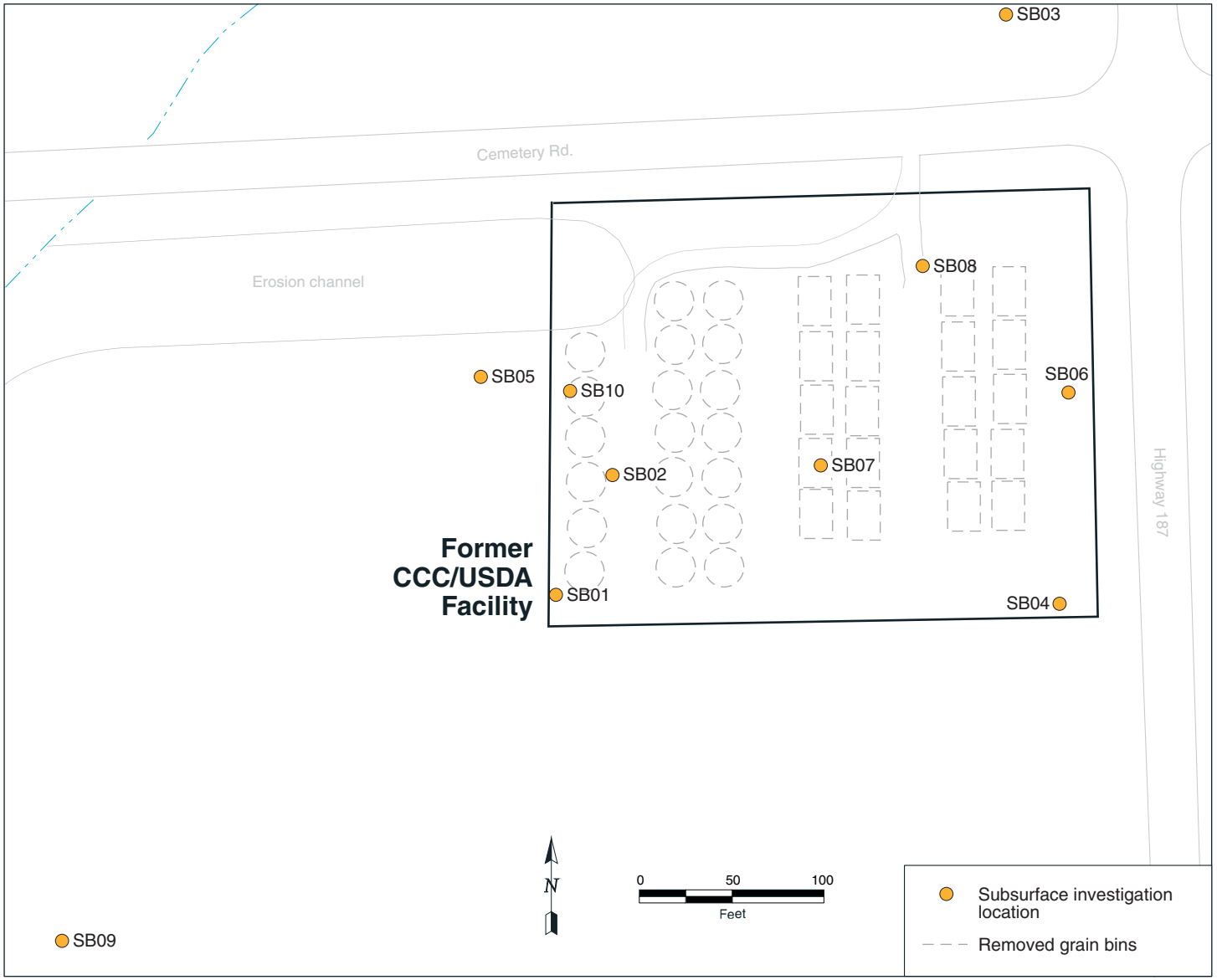

FIGURE 3.1 Locations of subsurface lithologic boring activities in the investigation area at Centralia.

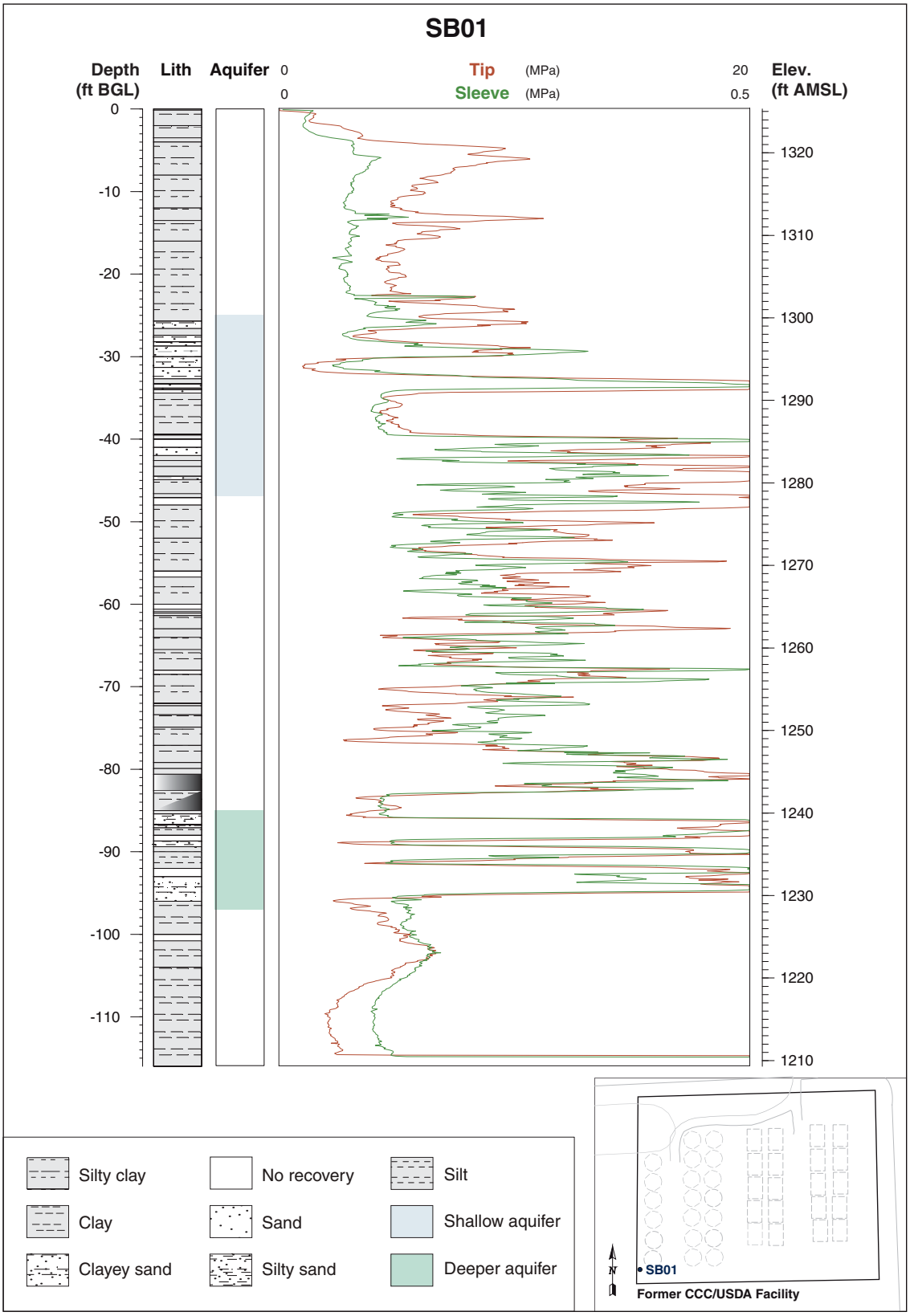

FIGURE 3.2 Geologic log and ECPT sensor response for SB01.

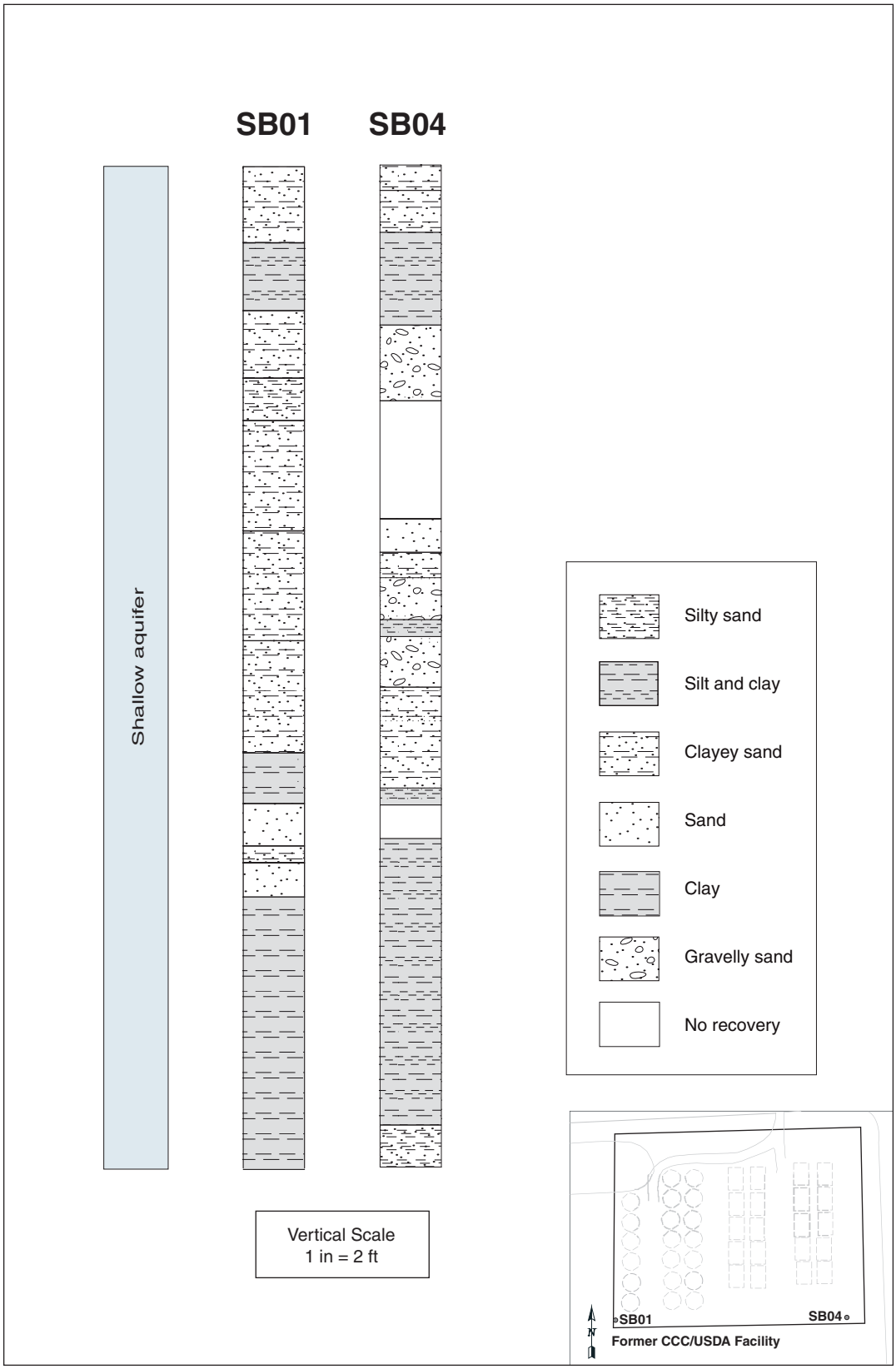

FIGURE 3.3 Geologic logs for SB01 and SB04, showing the differences in grain size of the geologic materials composing the shallow aquifer.

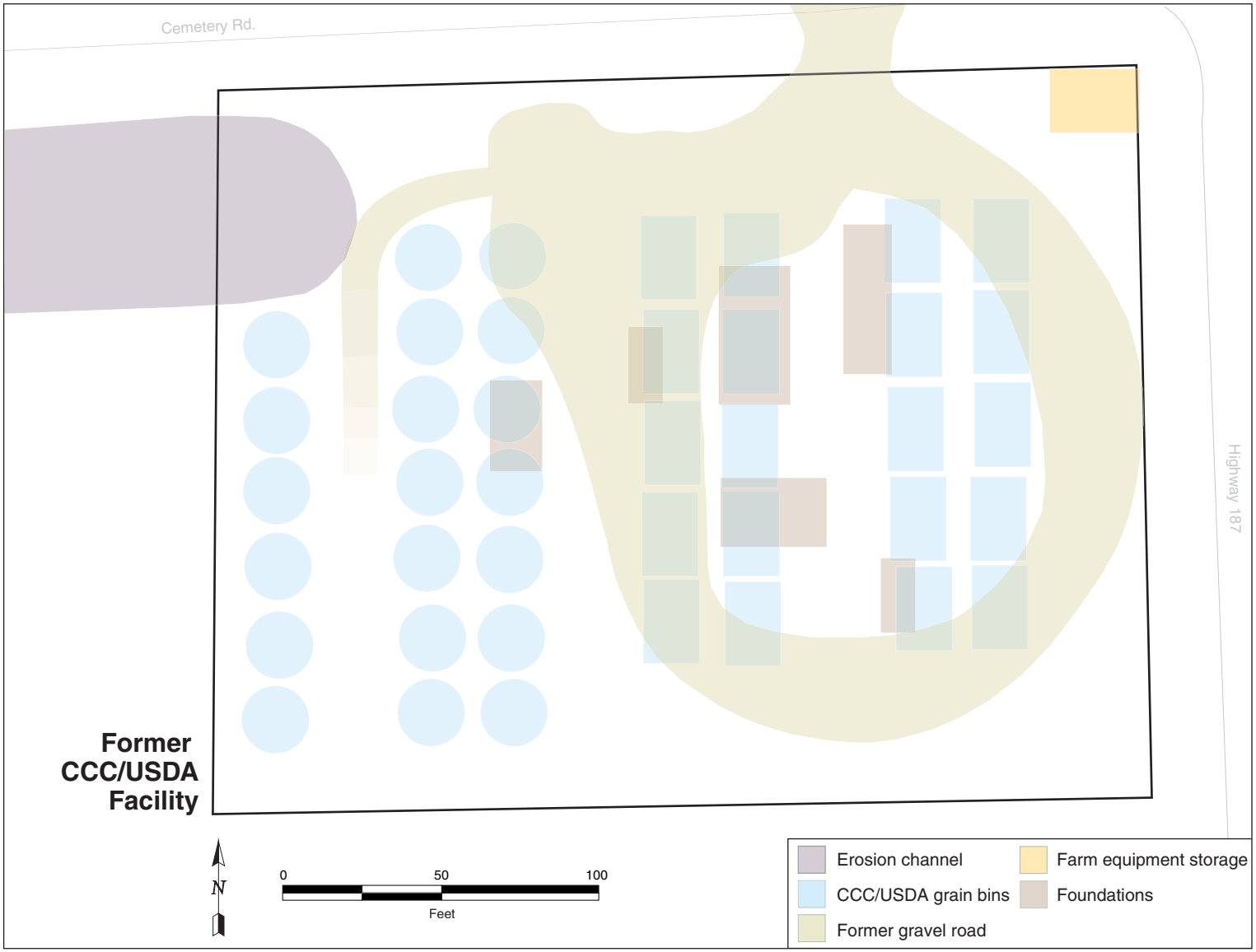

FIGURE 3.4 Historical and current cultural features identified at the former CCC/USDA grain storage facility at Centralia.

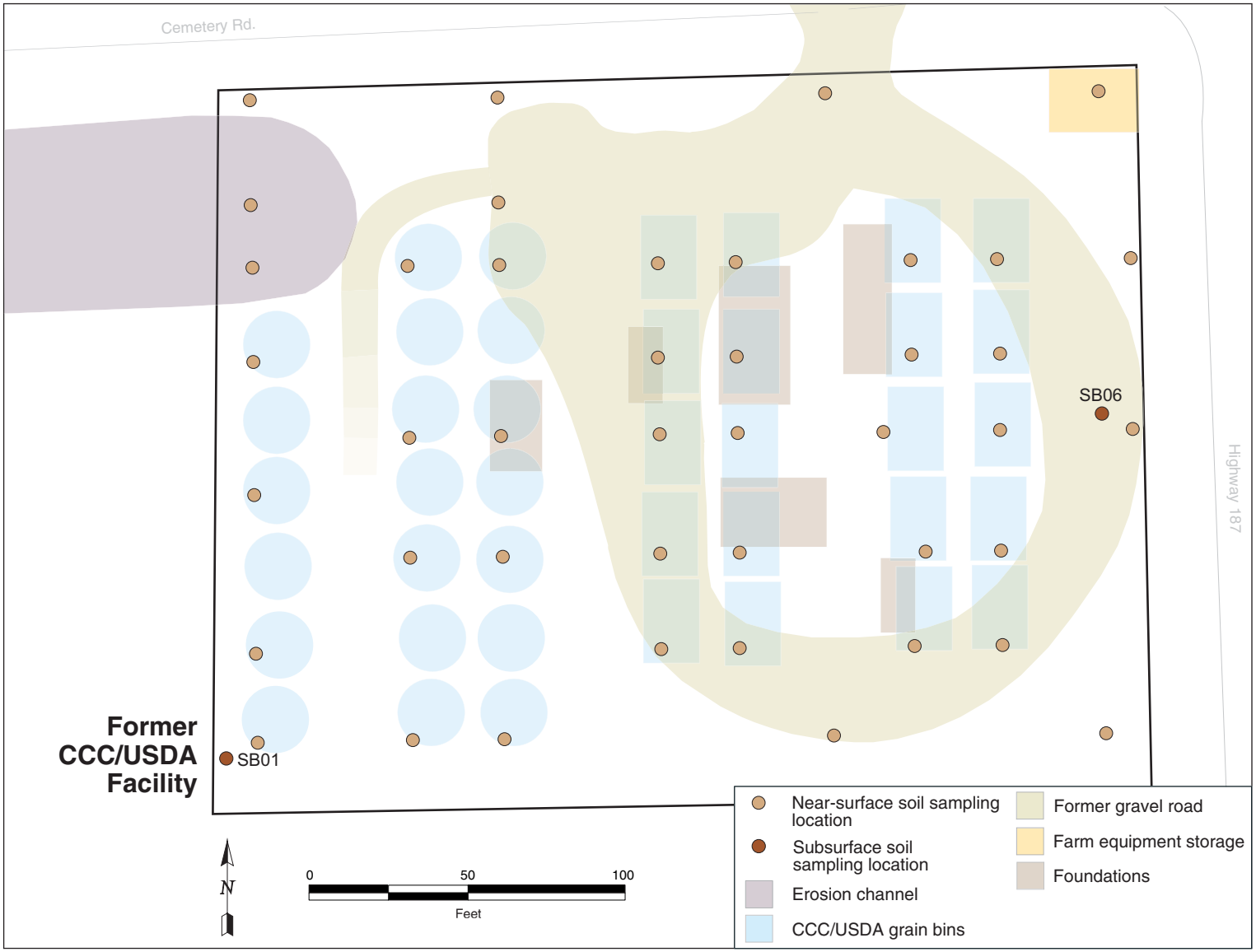

FIGURE 3.5 Locations of near-surface and vertical-profile subsurface soil sampling for contaminant analysis at the former CCC/USDA facility at Centralia.

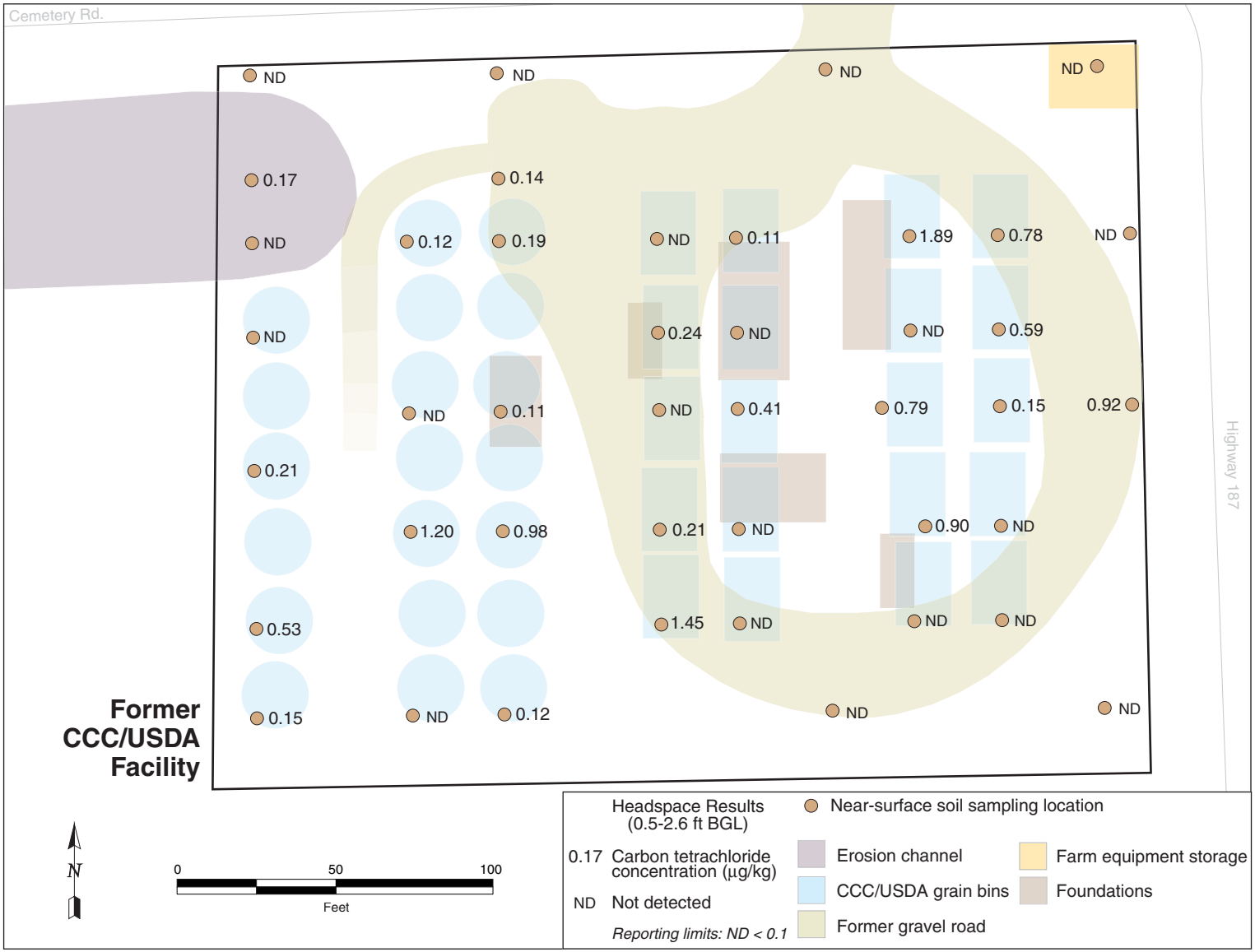

FIGURE 3.6 Results of headspace analyses for carbon tetrachloride in shallow near-surface soil samples from the former CCC/USDA facility.

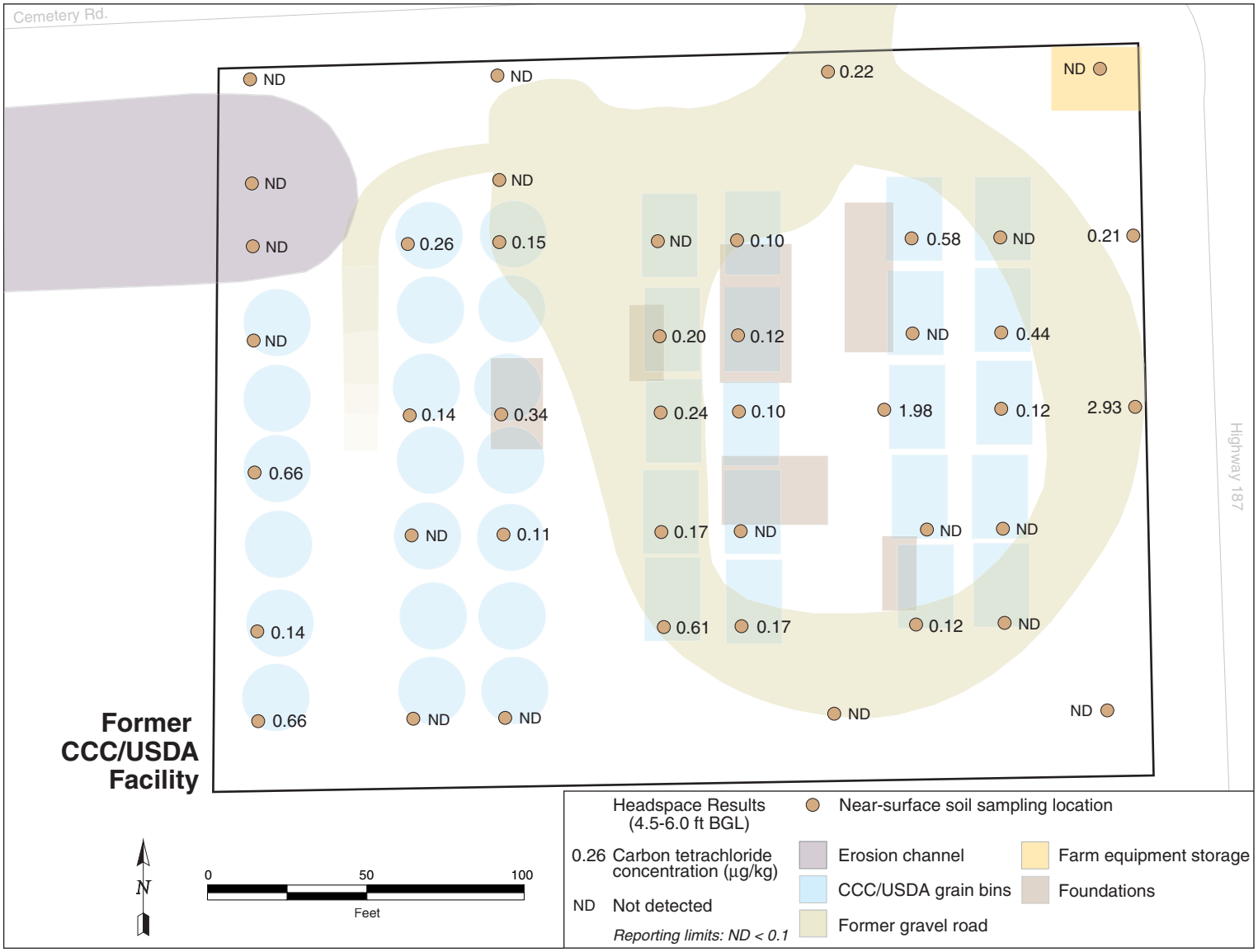

FIGURE 3.7 Results of headspace analyses for carbon tetrachloride in deeper near-surface soil samples from the former CCC/USDA facility.

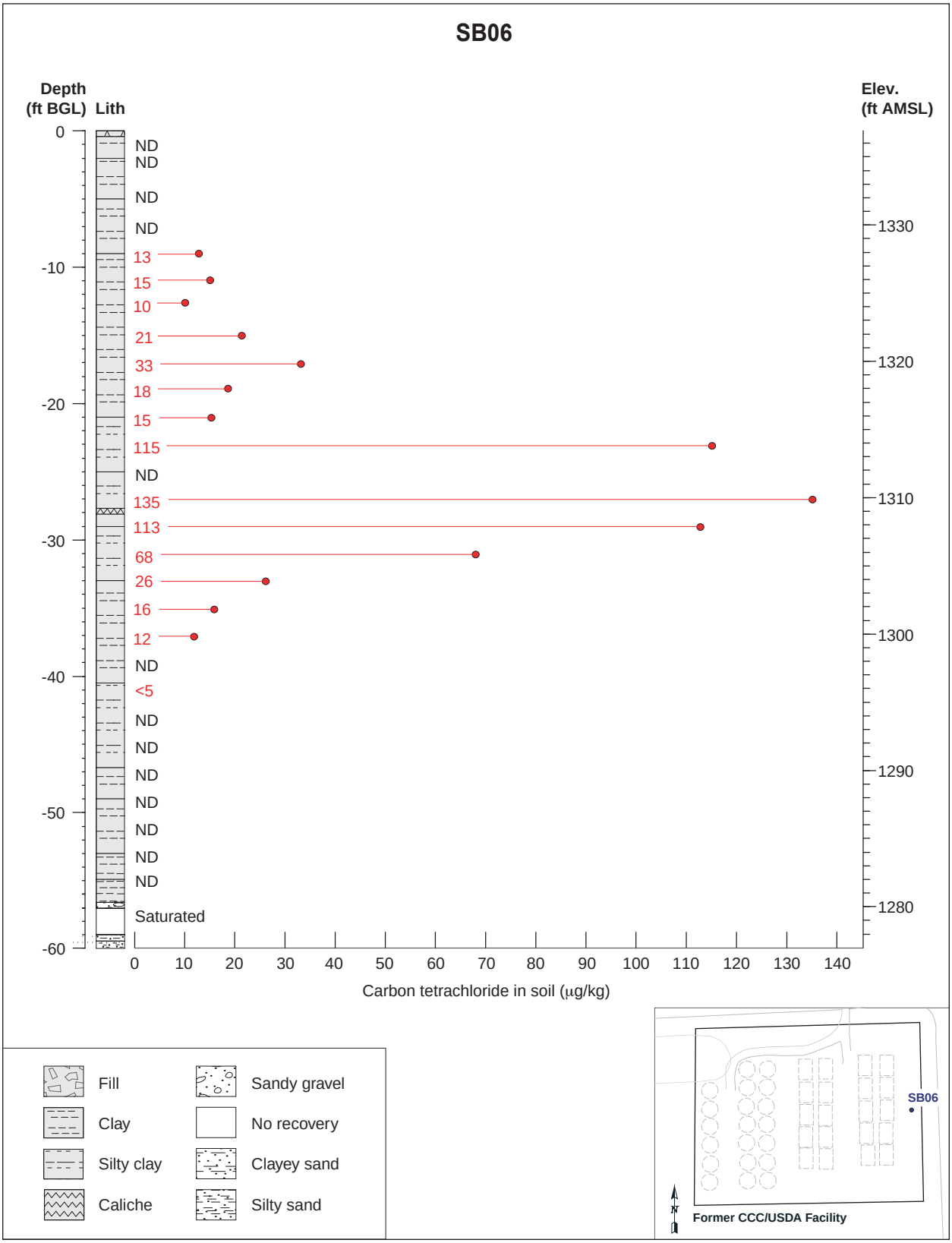

FIGURE 3.8 Lithologic sequence in the geologic log of the subsurface soil from boring SB06, with carbon tetrachloride concentrations.

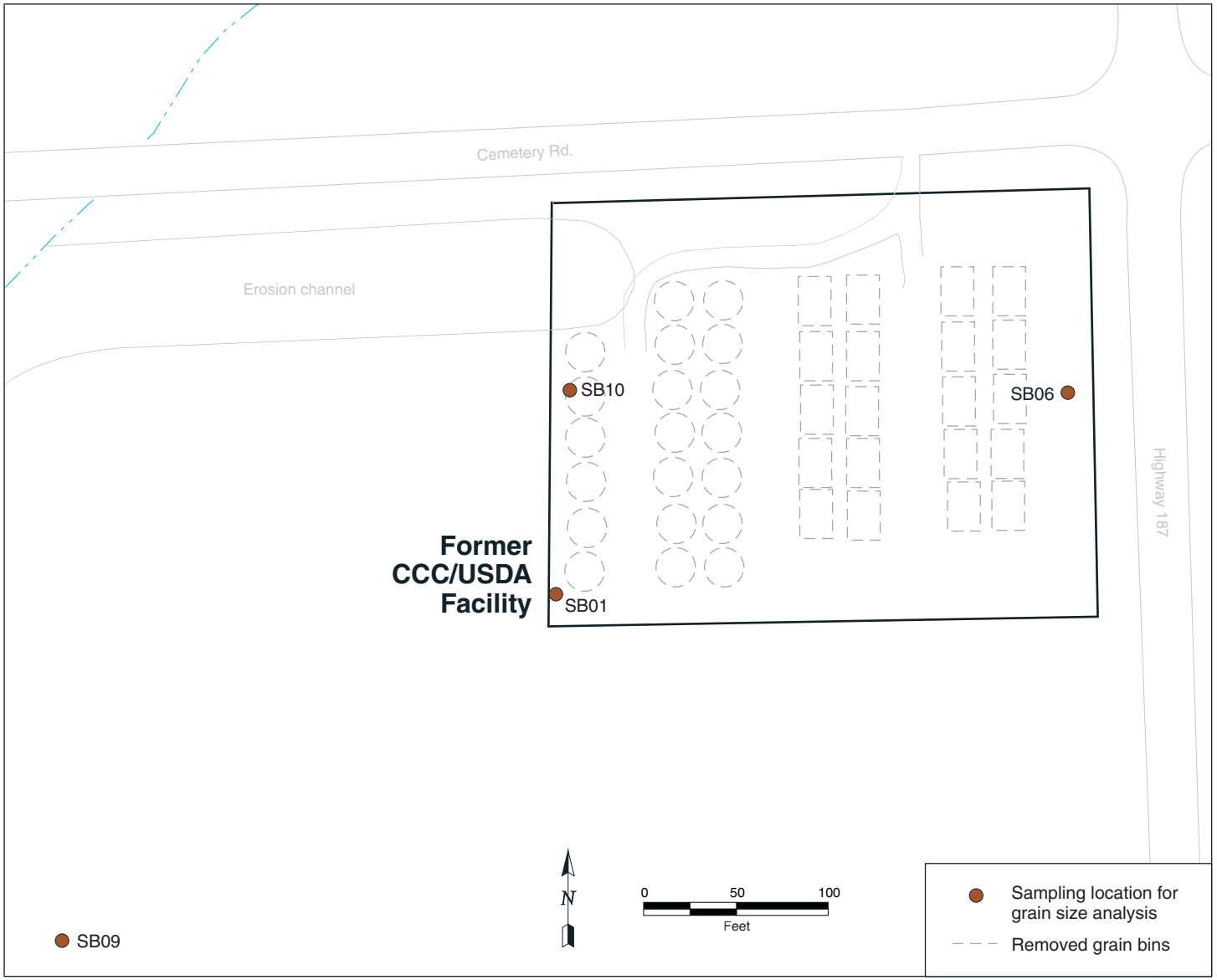

FIGURE 3.9 Locations of subsurface soil sampling for grain size analysis in the investigation area at Centralia.

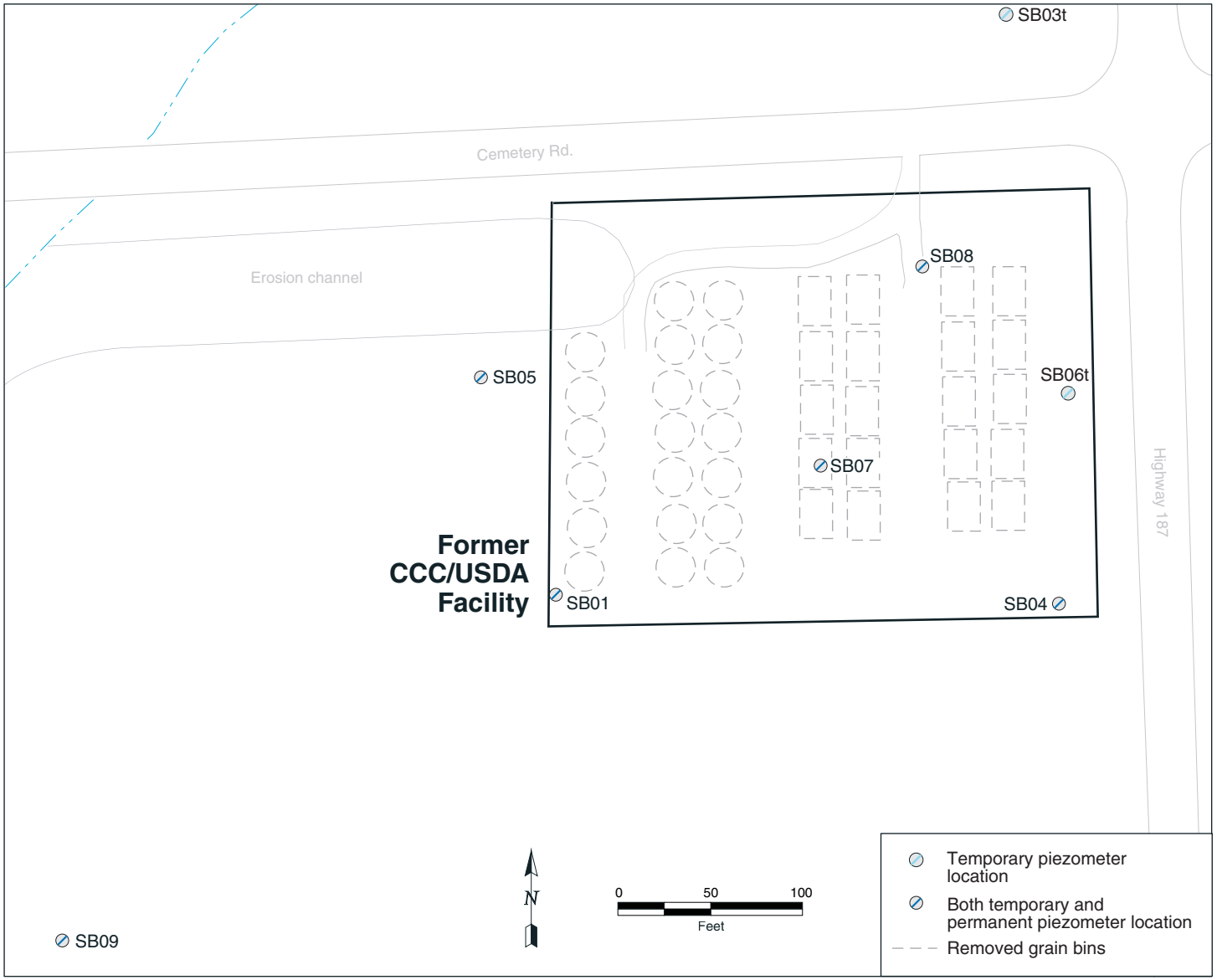

FIGURE 3.10 Locations of piezometers in the investigation area at Centralia.

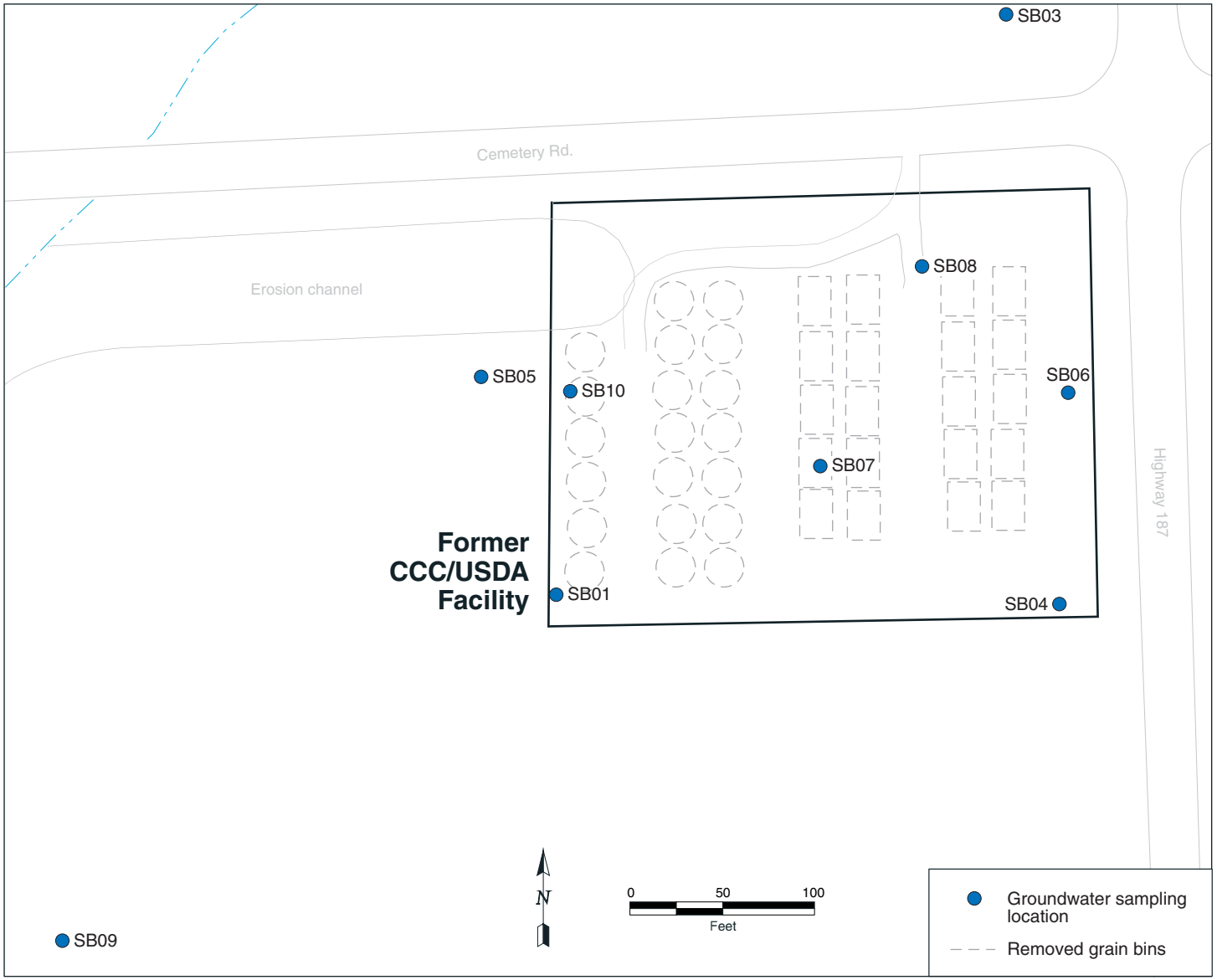

FIGURE 3.11 Locations of groundwater sampling in the investigation area at Centralia.

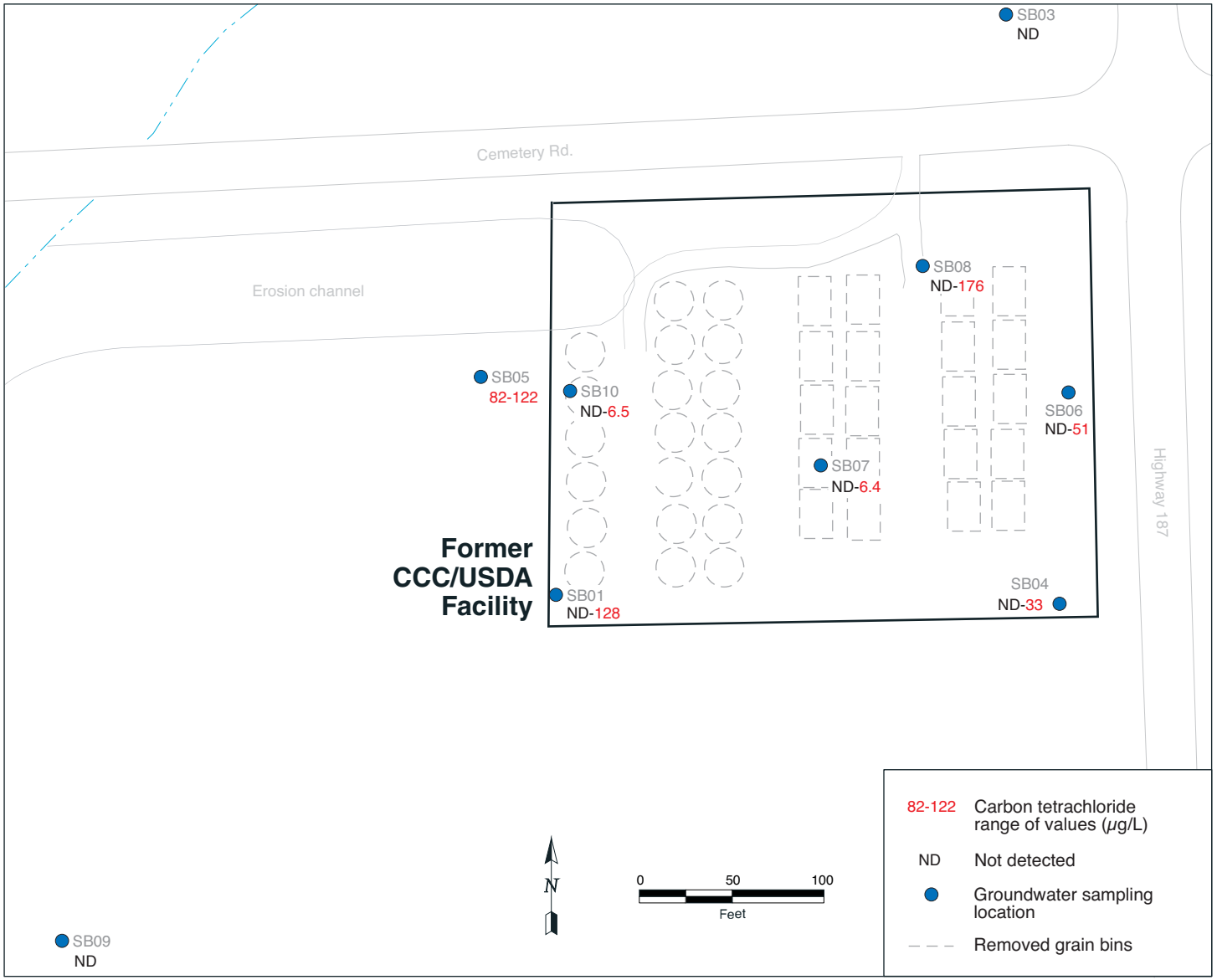

FIGURE 3.12 Carbon tetrachloride concentrations in groundwater in the investigation area.

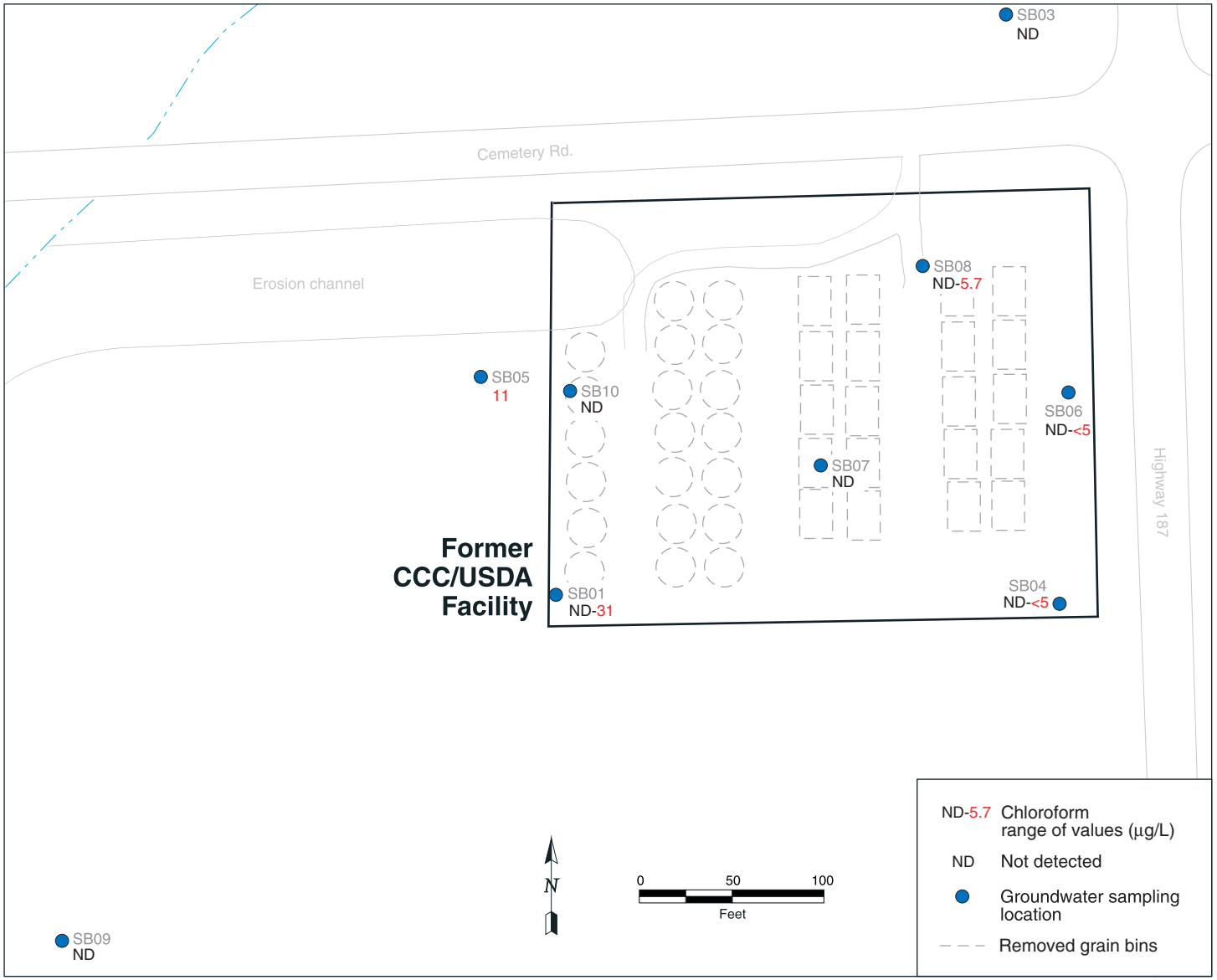

FIGURE 3.13 Chloroform concentrations in groundwater in the investigation area.

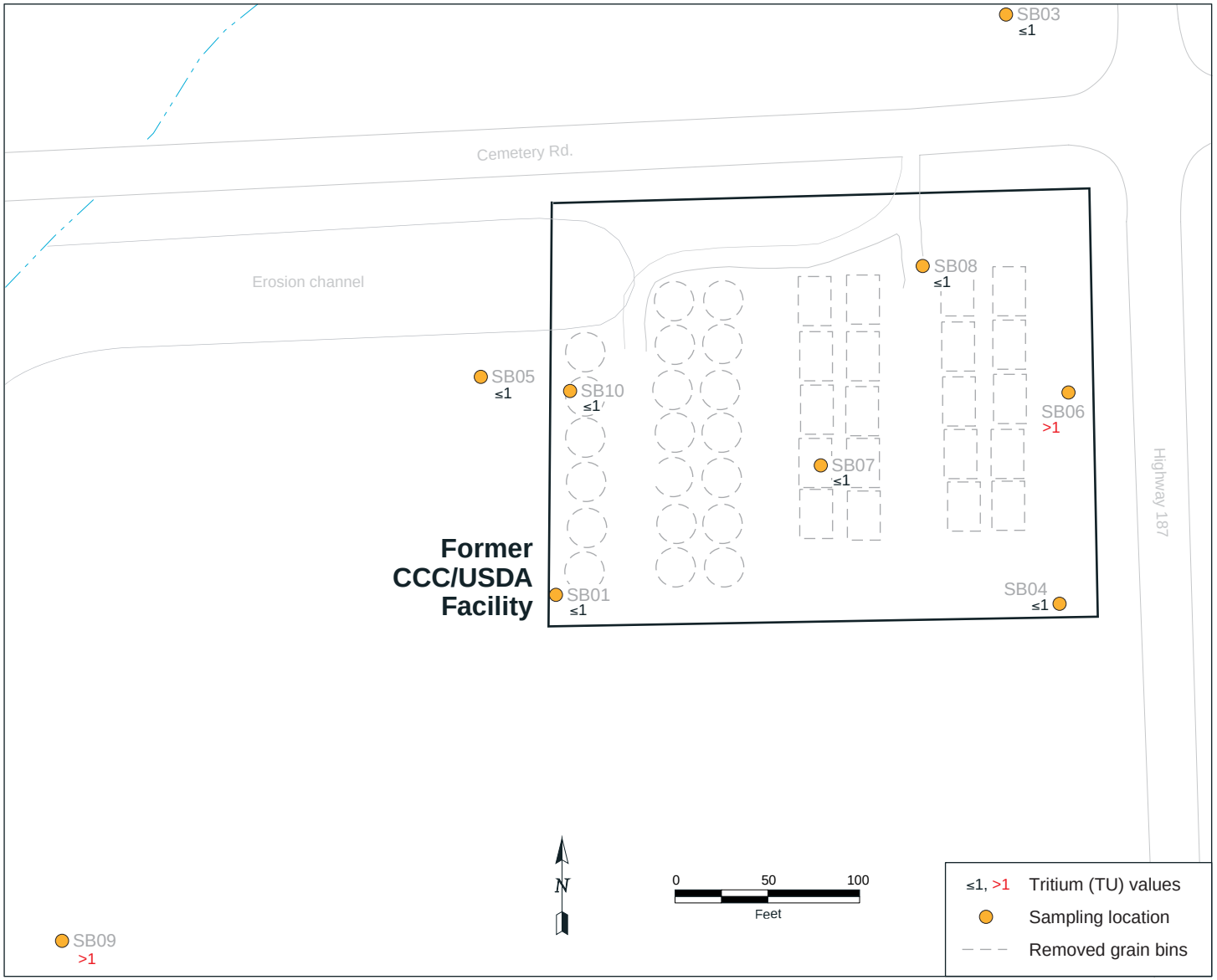

FIGURE 3.14 Locations of higher and lower tritium concentrations measured in groundwater in the investigation area.

4 Interpretation of Results

The purposes of a QuickSiteâ Phase I investigation for the CCC/USDA are (1) to verify an association of carbon tetrachloride contamination with a former CCC/USDA facility and (2) to delineate subsurface geologic and hydrogeologic features at the former facility and its surroundings and thus identify the pathway(s) by which carbon tetrachloride (if it is present) is most likely to migrate away from the facility. A geologic/hydrogeologic model developed for the site-specific Phase I work plan guides the identification of migration pathways. The Phase I investigation eliminates some potential migration pathways from consideration and retains other potential pathways for further investigation, subject to continuing linkage of the carbon tetrachloride contamination to the former CCC/USDA facility.

To meet these purposes, four technical objectives were established for the Centralia Phase I field investigation (Argonne 2002a). The data gathered in the context of these objectives are interpreted here within their framework. The technical objectives for the Phase I field work are to accomplish the following:

1. Verify an association of carbon tetrachloride contamination with the former CCC/USDA facility.

2. Characterize the nature and extent of the geologic units composing the aquifer or aquifers at and in the vicinity of the former Centralia CCC/USDA facility.

3. Establish the direction(s) of groundwater flow at the former CCC/USDA facility.

4. Identify the contaminant migration pathway(s) at the former CCC/USDA facility.

The discussions of the data in this section are directly related to these technical objectives.

4.1 Verify an Association of Carbon Tetrachloride Contamination with the Former CCC/USDA Facility

4.1.1 Contamination in Near-Surface Soils

As discussed earlier in this report (Section 3.3.1), near-surface soil samples were collected at the former CCC/USDA facility for carbon tetrachloride analysis by modified EPA Method 5021 (headspace method). Results are given in Section 3.3.1 for *shallow* near-surface soils (0.5-2.6 ft BGL) and *deeper* near-surface soils (typically 4.5-6.0 ft BGL). The headspace concentration data were examined, and the distributions of the more elevated concentrations were noted first for the shallow near-surface soils and then for the deeper near-surface soils. The patterns or groupings of more elevated near-surface headspace concentrations of carbon tetrachloride are interpreted to indicate areas of potential subsurface soil contamination.

The highest relative carbon tetrachloride concentrations observed in the headspace analyses of shallow near-surface soils were detected in two areas of the former facility. The pattern, shown in Figure 4.1 in relationship to present and former cultural features, indicates higher concentrations in the eastern portion and in the southwestern portion of the former facility. The cultural features most consistently associated with these carbon tetrachloride values are the former grain storage bins.

The pattern of headspace data for carbon tetrachloride in the deeper near-surface soils is superimposed in Figure 4.2 on the cultural features. The four highlighted areas of higher relative concentrations are in the eastern and southwestern portions of the former facility, in the same general locations identified for shallow near-surface soils in Figure 4.1. The cultural features most consistently associated with higher carbon tetrachloride concentrations in the deeper near-surface soils are again the former grain storage bins.

Combining the shallow and deeper near-surface headspace data patterns gives the composite of the relative carbon tetrachloride concentrations in the near-surface soils. The composite, shown in Figure 4.3 superimposed on the cultural features map, is interpreted to indicate the most likely areas for subsurface soil contamination at the former facility. This interpretation was used in Phase I to select one location for further investigation and verification of subsurface soil contamination at the former CCC/USDA facility. The selected boring, SB06,

is in the eastern portion of the former facility (Figure 4.3). The interpretation of the subsurface soil analyses from soil boring SB06 and also boring SB01 is discussed in Section 4.1.2.

4.1.2 Contamination in Subsurface Soils

Soil samples from cores collected in the unsaturated (vadose) zone at SB01 and SB06 were analyzed by EPA Methods 5030B and 8260B (purge and trap GC-MS), as discussed in Section 3.3.2. The results are given in Section 3.3.2 and in Appendix D. Soil boring SB01 was located to verify the carbon tetrachloride concentration previously found in the vadose zone by the KDHE. Boring SB06 was located at the point of the highest carbon tetrachloride concentrations found in the present investigation in near-surface soils at the former CCC/USDA facility (Section 4.1.1).

No carbon tetrachloride was detected above the quantitation limit of 10 μg/kg in the subsurface soils at SB01. Thus, Argonne's investigation was unable to reproduce the results of earlier KDHE sampling (KDHE 1998). In contrast, concentrations of carbon tetrachloride in SB06 ranged from not detected to 135 μg/kg (at 27 ft BGL). Figure 4.4 shows the lithologic log of the unsaturated subsurface soils in SB06 and the corresponding purge-and-trap GC-MS results for carbon tetrachloride. The vertical distribution of carbon tetrachloride shows elevated concentrations in the highlighted interval from 9 ft BGL to about 41 ft BGL. Therefore, an association between carbon tetrachloride contamination in soils and the former CCC/USDA facility has been verified.

4.1.3 Health Risks Associated with Exposure to Near-Surface Soils

As discussed in Section 3.3.1, the near-surface soil samples collected at the former CCC/USDA facility were analyzed by EPA Methods 5030B and 8260B (purge-and-trap GC-MS) to support a health risk assessment. Neither carbon tetrachloride nor chloroform was detected above a quantitation limit of 10 μg/kg in any of these samples.

Levels of soil contamination required to surpass EPA limits for risks due to ingestion and inhalation of carbon tetrachloride in soils have been calculated by using parameters defined as reasonable maximum exposures for average Americans (EPA 1989a, 1991). The pathways

considered were direct ingestion of contaminated soil, inhalation of contaminated dust (indoors and outdoors), and ingestion of vegetables and fruits grown in contaminated soil.

The results show that a carbon tetrachloride concentration of 5,800 μg/kg in soil would be required to yield a carcinogenic risk of 1E-4, the maximum risk within the acceptable range of 1E-4 to 1E-6 (EPA 1990). The concentration of carbon tetrachloride in soil required to yield the maximum allowable hazard index is 2,333 μg/kg. Because none of the near-surface soil samples (from approximately the surface to the frost line) contained carbon tetrachloride at or near this level, there is no health risk from contaminated soil at the former Centralia CCC/USDA facility.

4.2 Characterize the Nature and Extent of the Geologic Units Composing the Aquifer or Aquifers at and in the Vicinity of the Former Centralia CCC/USDA Facility

The collection of core and electronic data to identify the geologic units composing the aquifers is discussed in Section 3.1, and the data are in Appendix A. Two recognizable water-bearing permeable zones or aquifers found in the investigation area at Centralia are both in Pleistocene age sediments. The *shallow aquifer* is interpreted as being in the Upper Independence Formation. The *deeper aquifer* is interpreted as being in the Atchison Formation. The nature of the geologic units and the stratigraphy found at Centralia are consistent with the generalized stratigraphic section for Nemaha County, Kansas (Figure 3.2 in Argonne 2002a). Figure 4.5 shows the generalized local stratigraphic section found during the Phase I investigation and the interpreted positions of the shallow and deeper aquifers.

4.2.1 The Shallow Aquifer in the Upper Independence Formation

Evidence of the nature and extent of the Upper Independence Formation and the shallow aquifer was obtained from direct observation of continuous core, selected core samples in the aquifer, and electronic logs from the ECPT. (For detailed descriptions, see Appendix A.)

The Upper Independence Formation occurs laterally throughout the investigation area; however, the sediments within the lower portion of this unit vary from coarser grained sands to fine grained silts and clay materials. For example, at SB01 the aquifer is composed of fine to very fine clayey sand, silty sand, and silt (Figure 3.3). In contrast, at SB04, the aquifer is composed of gravely medium to coarse sand underlain by fine to medium sand (Figure 3.3). At

SB03, penetration of the ECPT piezometer emplacement equipment was halted by cementation beneath the till. However, the ECPT sensor probes were able to penetrate to depths commensurate with the shallow aquifer at this location. The ECPT sampling equipment was also unable to penetrate this same section to confirm the presence or absence of the shallow aquifer. The temporary piezometer at SB03 was therefore not installed in the shallow aquifer but in silty sand lenses within the till. This piezometer was abandoned as not representative of the shallow aquifer in this area.

The vertical and lateral relationships of materials in the shallow aquifer are illustrated in three cross sections constructed at the locations shown in Figure 4.6. Cross sections E-E´, F-F´, and G-G´ are shown in Figures 4.7-4.9, respectively. The shallow aquifer occurs in the lower portion of the Upper Independence Formation (shown in blue), below a thick section (24-54 ft thick) of till deposits that is not water bearing. However, as discussed above, water was found at SB03 in coarse material left behind by local washing of the till. This water appears not to be connected to the shallow aquifer (if present), which could not be penetrated at SB03 by the ECPT piezometer emplacement equipment. Water levels in the temporary piezometer at SB03 were very much lower than those in the shallow aquifer.

Predominantly fine grained silt and clay were identified in the lower portion of the Upper Independence Formation at three locations (SB01, SB02, and SB07) beneath the central to southwestern portion of the former CCC/USDA facility, as well as potentially at location SB03 (on the basis of sensor data only) to the north of the former facility (Figures 4.7-4.9). At the remaining investigative borings (SB04-SB06 and SB08-SB10), the corresponding stratigraphic interval consists primarily of fine to coarse gravely sands that are thicker beneath the southeastern portion of the former facility. The interpreted cross sections indicate that lateral transitions between these predominantly coarse grained versus fine grained intervals can occur over distances of 100-200 ft or less (see Figure 4.8).

The sediments characteristic of the Upper Independence Formation, which are believed to be related to and derived from glacial processes, include glacial moraine, till, and glaciofluvial outwash, consistent with the regional geology described in the *Work Plan* (Argonne 2002a). The glaciofluvial outwash materials typically have characteristics similar to those of stream-related deposits, such as coarse grained sand and gravel deposits of the stream channel, which give way laterally to silt and clay deposits of the bars and overbank deposits of the stream (Reineck and Singh 1975). On the basis of their observed stratigraphic occurrence, lithologic characteristics, and areal distribution across the site, the sands in the lower portion of the Upper Independence

Formation at Centralia are interpreted as glaciofluvial channel sands. The coarse grained channel sands in the shallow aquifer range from at least 15 ft to about 35 ft in thickness.

Groundwater level, geochemical, and contaminant distribution data presented in Sections 4.3 and 4.4 demonstrate that hydraulic continuity exists between the water-bearing sands and finer grained sediments (silt and clay) identified in the lower portion of the Upper Independence Formation beneath and to the southwest of the former CCC/USDA facility, indicating that these deposits represent the single shallow aquifer highlighted in blue on Figures 4.7-4.9. The Phase I results indicate, however, that the till and the silty sand lenses within the till at SB03 to the north of the former CCC/USDA facility (Figures 4.7 and 4.8) appear not to be hydraulically connected with the water-bearing sediments of the shallow aquifer described above; hence, these materials are not interpreted as part of the shallow aquifer.

The interpreted configuration of the shallow aquifer channel sand deposits in the vicinity of the former CCC/USDA facility is illustrated in Figure 4.10, a planar slice through the subsurface at an elevation of approximately 1,275 ft AMSL. The orange colored portion shows the locations where sand was found in the Phase I investigation at the former facility.

Permeability within the aquifer is expected to vary in association with the grain size of the deposited material; the sand deposits tend to have higher permeability than do the fine grained deposits found at SB01, for example. The potential effect of these lithologic and permeability variations on groundwater flow conditions, and hence on contaminant transport, is discussed further in Section 4.3.

4.2.2 The Deeper Aquifer in the Atchison Formation

Sediments characteristic of the Atchison Formation are thinly laminated, very fine grained sand, silt, and clay, which according to published reports were deposited in Pleistocene Lake Atchison and were restricted to deeper preglacial valleys (Denne et al. 1998). Because Centralia is not in a deeper preglacial valley, the Atchison Formation and the underlying Lower Independence Formation were not expected, prior to our investigation, to be found at Centralia. The preliminary geologic/hydrogeologic model developed in the *Work Plan* (Argonne 2002a) did not, therefore, predict the deeper aquifer found in the Atchison Formation.

Evidence of the Atchison Formation occurred throughout the investigation area in core and in ECPT logs. The deeper aquifer is a very fine grained sand in the lower portion of the Atchison Formation that is very uniformly about 10 ft thick. The deeper aquifer is highlighted in green in Figure 4.11. The deeper aquifer is illustrated only on cross section F-F´, although it was found to be laterally consistent throughout the investigation area.

4.2.3 Separating Layer between the Shallow and Deeper Aquifers

Throughout the investigation area, the shallow and deeper aquifers are separated by a fine grained unit of clay and silt that represents the upper part of the Atchison Formation. Observed geologic evidence in core from SB01, SB07, SB08, SB09, and SB10 confirms the presence of a grayish clay and silt near the base of the unit that is dry to moist only (*not saturated*). This clay and silt unit appears to represent a hydraulic barrier to vertical flow between the shallow and deeper aquifers. The unit also appears to confine the underlying deeper aquifer; where the clay and silt unit was penetrated during boring, groundwater from the deeper aquifer rose above the base of the unit to within 25 ft of the ground surface. The clay and silt unit is shown in Figure 4.12, shaded in gray.

4.3 Establish the Direction(s) of Groundwater Flow at the Former CCC/USDA Facility

4.3.1 Horizontal Groundwater Flow in the Shallow Aquifer

Groundwater levels were measured by hand in temporary piezometers in the shallow aquifer, as discussed in Section 3.4. Results are in Table F.1 in Appendix F. From the measured water levels, groundwater elevations (or hydraulic heads) were determined, plotted, and contoured (Figure 4.13). The contours show the apparent gradient of the potentiometric surface for the shallow aquifer at the former facility. Groundwater is generally interpreted to flow perpendicular to the gradient; in Figure 4.13 flow would be primarily to the west-southwest.

The potentiometric surface is not continued north of the former facility to SB03. As mentioned in Section 4.2.1, the shallow aquifer was not penetrated at SB03 with ECPT piezometer emplacement equipment, and the temporary piezometer installed at this location was in sand stringers within the till above the shallow aquifer.

Though horizontal groundwater flow, as interpreted from the gradient in Figure 4.13, would be to the west-southwest, the magnitude of the gradient, particularly in the more permeable sand deposits, also influences the actual flow of groundwater. In Figure 4.13, the interpreted distribution of permeable sand deposits (as depicted on Figure 4.10) is superimposed on the potentiometric surface contour map. The gradient in the eastern portion of the former facility appears to be relatively flat (with contour lines widely spaced), compared with the central to southwestern portion of the former facility. Furthermore, the relatively flat gradient is found in association with the permeable channel sand deposit (Figure 4.13). Note that the relatively flat gradient indicates a *low potential for flow*, even though the material is considered permeable. *If groundwater flow rates are in fact low, there may be little driving force for contaminant transport away from the former facility.*

A further indication that groundwater flow in the shallow aquifer may be limited came from the analysis of tritium isotope data. The tritium data, plotted in Figure 4.14, show that most of the samples analyzed had values near zero. Such values are characteristic of relatively “old” groundwater. The tritium data are consistent with the interpretation that little recent (post-1951) water is entering the shallow aquifer beneath the former CCC/USDA facility by vertical infiltration (recharge) of precipitation or by flow within the aquifer from upgradient. The only probable indication of recharge was observed at SB09, where the observed enriched tritium isotope value (9.2-10.5 TU) suggests mixing of recent water with the older groundwater. Location SB09 lies downgradient of the former facility, and it might be influenced by infiltration from the nearby stream. A slightly enriched tritium value observed at SB06 (2.45 TU) might also suggest mixing of older groundwater with a small component of more recent water, presently of uncertain origin, near the eastern boundary of the former CCC/USDA facility.

As indicated in Section 3.4, permanent piezometers were installed to measure water level fluctuations in the shallow aquifer over time. The data recorded for each location and corresponding barometric pressure data, measured at Centralia from April 25, 2002, to June 3, 2002, are shown in Figure 4.15, along with daily precipitation (rainfall) data for this time period. Only in SB09 is a distinct rise in water level associated with each of two major rainfall events. This observation is consistent with the interpretation made above with respect to the tritium data, that SB09 is locally affected by recent surface water recharge. However, all of the water level traces in Figure 4.15 show gentle rises during the period of monitoring, suggesting that other parts of the shallow aquifer are not completely isolated from all external influences.

4.3.2 Vertical Groundwater Flow or Connection between the Aquifers

The hydrogeologic and geologic data collected to date are consistent with the interpretation that no vertical groundwater flow occurs between the shallow and deeper aquifers. The characteristics of the geologic layer (silt and clay unit) separating the two aquifers that support this conclusion are discussed in Section 4.2.3. Geochemical data, particularly nitrogen data, also indicate a lack of vertical groundwater flow between the two aquifers. As Figure 4.16 shows, concentrations of nitrogen (measured as total nitrogen, but presumed to be primarily from nitrate) in the groundwater system decrease by several orders of magnitude with depth, becoming extremely low in the deeper aquifer.

Strong support for the finding of a lack of vertical communication between the shallow and deeper aquifers is provided by the observed distribution of carbon tetrachloride within the groundwater system. Carbon tetrachloride has been identified only in the shallow aquifer, and primarily in the upper portions of the shallow aquifer. No contamination was detected in the deeper aquifer. This point is discussed and illustrated further in Section 4.4.

4.4 Identify the Contaminant Migration Pathway(s) at the Former CCC/USDA Facility

Prior to the Phase I field investigation, a preliminary geologic/hydrogeologic model was developed incorporating two possible contaminant migration pathways. The possible pathways, shown schematically in Figure 4.17, were as follows:

- *Pathway 1* — Vertical movement of contaminant from a source at the former facility into the shallow aquifer only, with lateral migration within the shallow aquifer to the west-southwest and south.

- *Pathway 2* — Vertical movement of contaminant from a source at the former facility into both the shallow and deeper aquifers, with subsequent lateral migration in each aquifer.

Contaminant migration pathway 1 (Figure 4.17) is the only one of the two alternatives that can be documented on the basis of Phase I investigation results. Pathway 2 is not supported by the data. The evidence supporting this interpretation is as follows:

- Argonne's analyses of near-surface and subsurface soils have documented the presence of carbon tetrachloride contamination in soils beneath the former CCC/USDA facility at Centralia, thus identifying this property as a potential origin for carbon tetrachloride entry into the local groundwater system.

- The occurrence of the fine grained Upper Atchison layer between the shallow and deeper aquifers (both beneath and outside the former facility; Figures 4.18-4.20) is consistent with a hydraulic barrier to vertical flow between these units, preventing direct vertical groundwater (and hence contaminant) migration from the shallow to the deeper aquifer. Geochemical relationships between groundwater samples from the shallow and deeper aquifers further support the interpretation that these units are hydraulically isolated from each other within the limits of the Phase I study area. This observation discounts pathway 2.

- The Phase I investigation found carbon tetrachloride contamination in groundwater beneath the former facility in only the shallow aquifer and not in the deeper aquifer, at the deeper aquifer locations investigated to date (SB01, SB04, and SB07). This observation (Figures 4.18-4.20) is consistent with pathway 1, but it again rules out pathway 2.

Contaminant migration pathway 1 is illustrated in Figure 4.21 on the map of the geology at 1,275 ft AMSL.

4.5 Summary

The Phase I investigation at Centralia accomplished the technical objectives established in Section 1, as indicated below:

- *Objective 1* — Verify an association of carbon tetrachloride contamination with the former CCC/USDA facility.

  - Patterns of carbon tetrachloride (determined by headspace analysis) in near-surface soils at the former CCC/USDA facility showed two general areas of potential subsurface soil contamination, one in the eastern portion and the other in the southwestern portion of the former facility. These two general areas are associated with the locations of grain storage bins formerly at the facility.

  - Subsurface soil analyses (by purge-and-trap GC-MS) at soil boring SB06 in the eastern portion of the former facility confirmed carbon tetrachloride contamination in the soil from 9 ft BGL to about 41 ft BGL.

  - Calculations indicate that there is no health risk from near-surface soils at the former CCC/USDA facility.

- *Objective 2* — Characterize the nature and extent of the geologic units composing the aquifer or aquifers at and in the vicinity of the former Centralia CCC/USDA facility.

  - Two aquifers were found at and in the vicinity of the former CCC/USDA facility: a shallow aquifer in the Upper Independence Formation and a deeper aquifer in the Atchison Formation.

  - The nature of the shallow aquifer varies laterally, from coarser grained sand channel deposits to finer grained silt and clay material. The sand channel deposits are expected to be more permeable.

- Evidence summarized under objective 4 indicates that groundwater does not flow from the shallow aquifer to the deeper aquifer at the former facility.

- *Objective 3* — Establish the direction(s) of groundwater flow at the former CCC/USDA facility.

  - Within the context of the findings summarized for objective 2, the apparent hydraulic gradient in the shallow aquifer indicates a general direction of horizontal groundwater flow toward the west-southwest.

  - It was not considered necessary to determine the groundwater flow direction in the deeper aquifer because of its lack of connection to the shallow aquifer and the absence of contamination in it.

- *Objective 4* — Identify the contaminant migration pathway(s) at the former CCC/USDA facility.

  - The sand channel deposits discussed under objective 2 are expected to have higher permeability than the fine grained silt and clay in the shallow aquifer. If groundwater flow and contaminant migration occur, the preferential path is expected to be through the more permeable sand material (Figure 4.21).

  - The relatively flat hydraulic gradients and generally low tritium isotope concentrations observed for the shallow aquifer suggest that groundwater movement throughout this aquifer, and hence contaminant migration from the former facility, may be limited, despite the presence of sand channel deposits.

  - The existence of a fine grained (silt and clay) layer in the upper Atchison Formation between the shallow and deeper aquifers, the lack of contamination in the deeper aquifer, and the reduction by orders of magnitude in the distribution of total nitrogen concentrations in the groundwater with depth all support the interpretation that there is no hydraulic communication, and hence no vertical contaminant transport, between the shallow and deeper aquifers.

- If any contaminant migration is occurring at the former facility, the contaminant is most likely moving vertically from a source on the property and into the shallow aquifer, then migrating laterally within the shallow aquifer (pathway 1 in Figure 4.17).

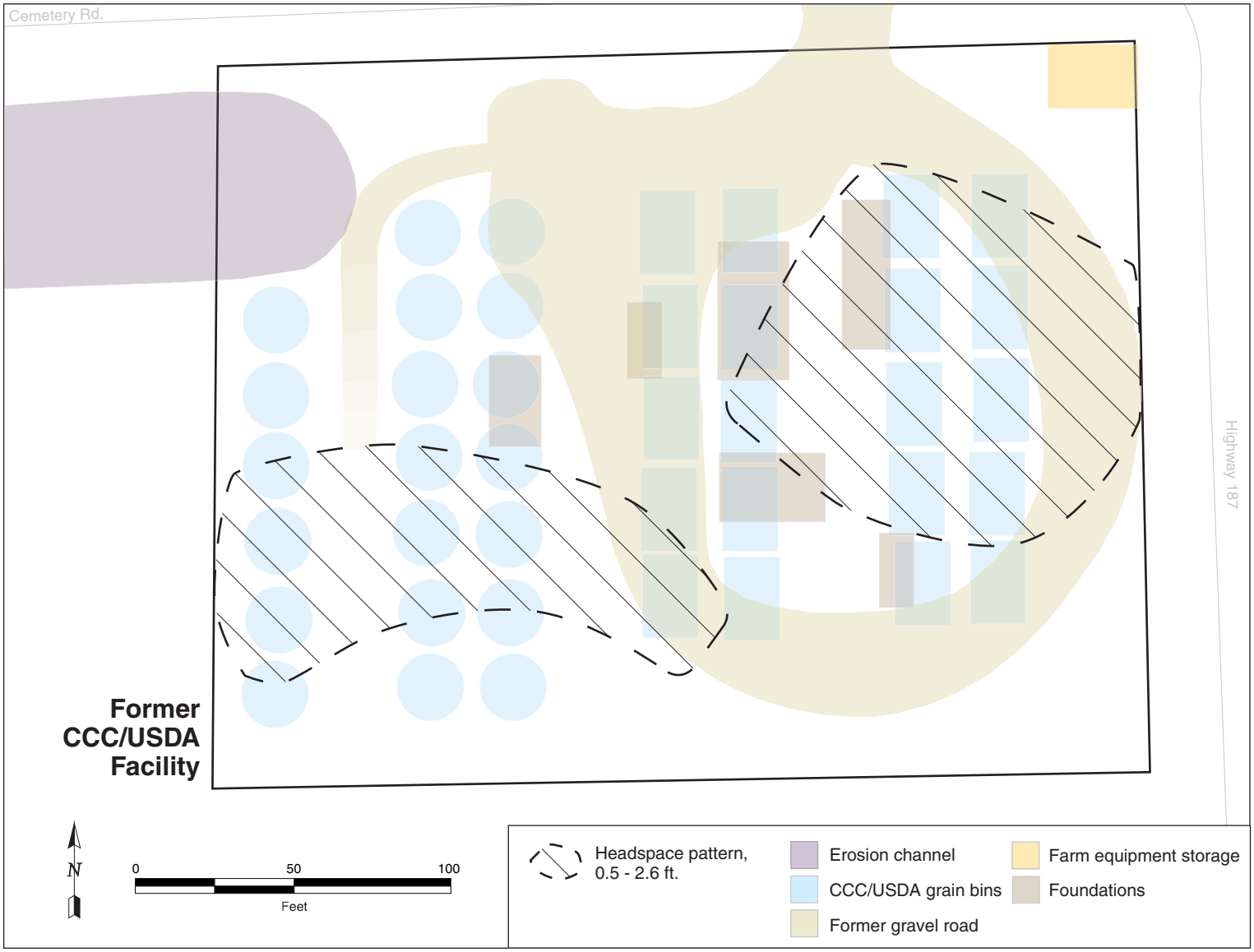

FIGURE 4.1 Present and historical cultural features at the former CCC/USDA facility at Centralia, Kansas, with interpreted pattern of carbon tetrachloride from headspace analyses of shallow near-surface soil samples.

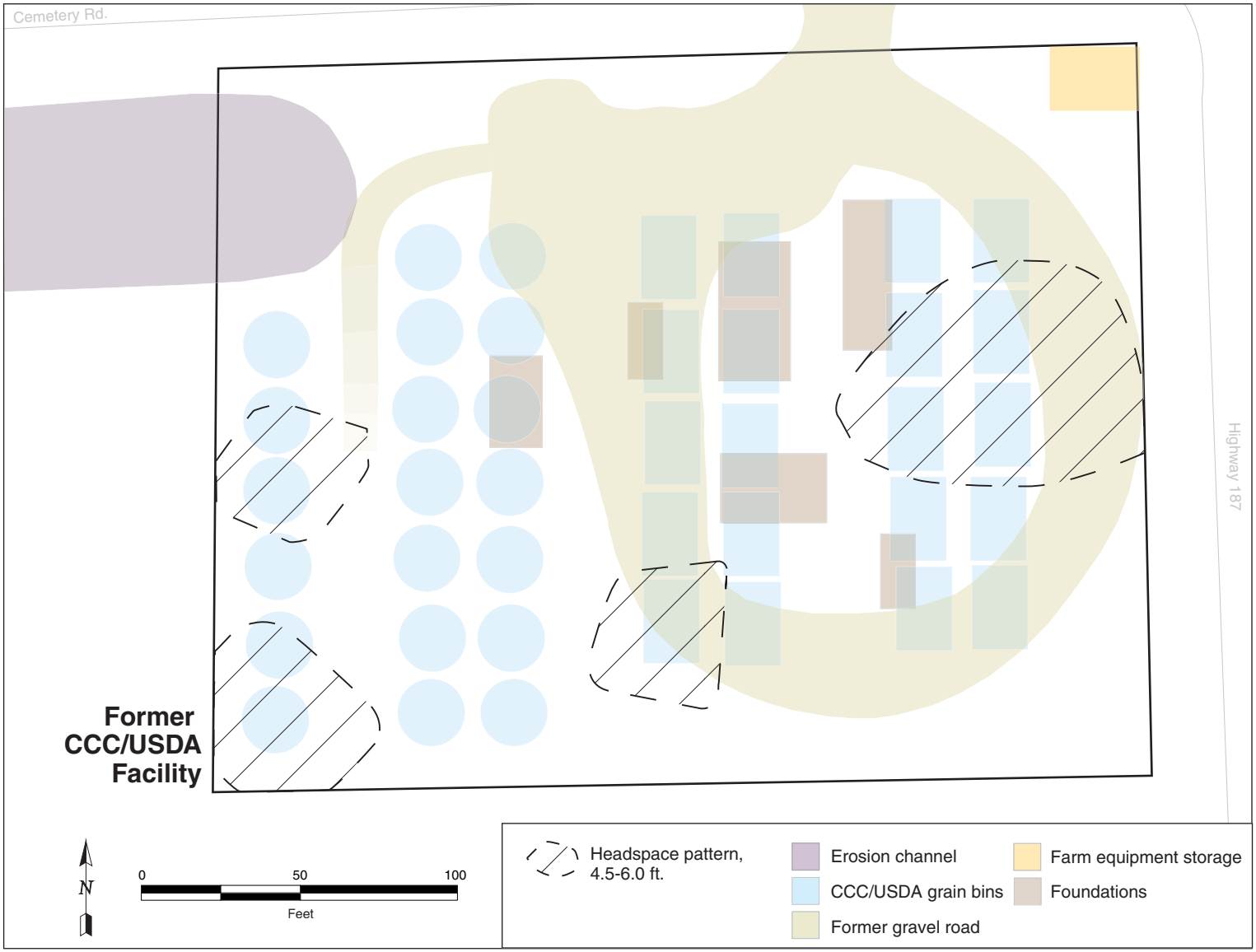

FIGURE 4.2 Present and historical cultural features at the former CCC/USDA facility at Centralia, Kansas, with interpreted pattern of carbon tetrachloride from headspace analyses of deeper near-surface soil samples.

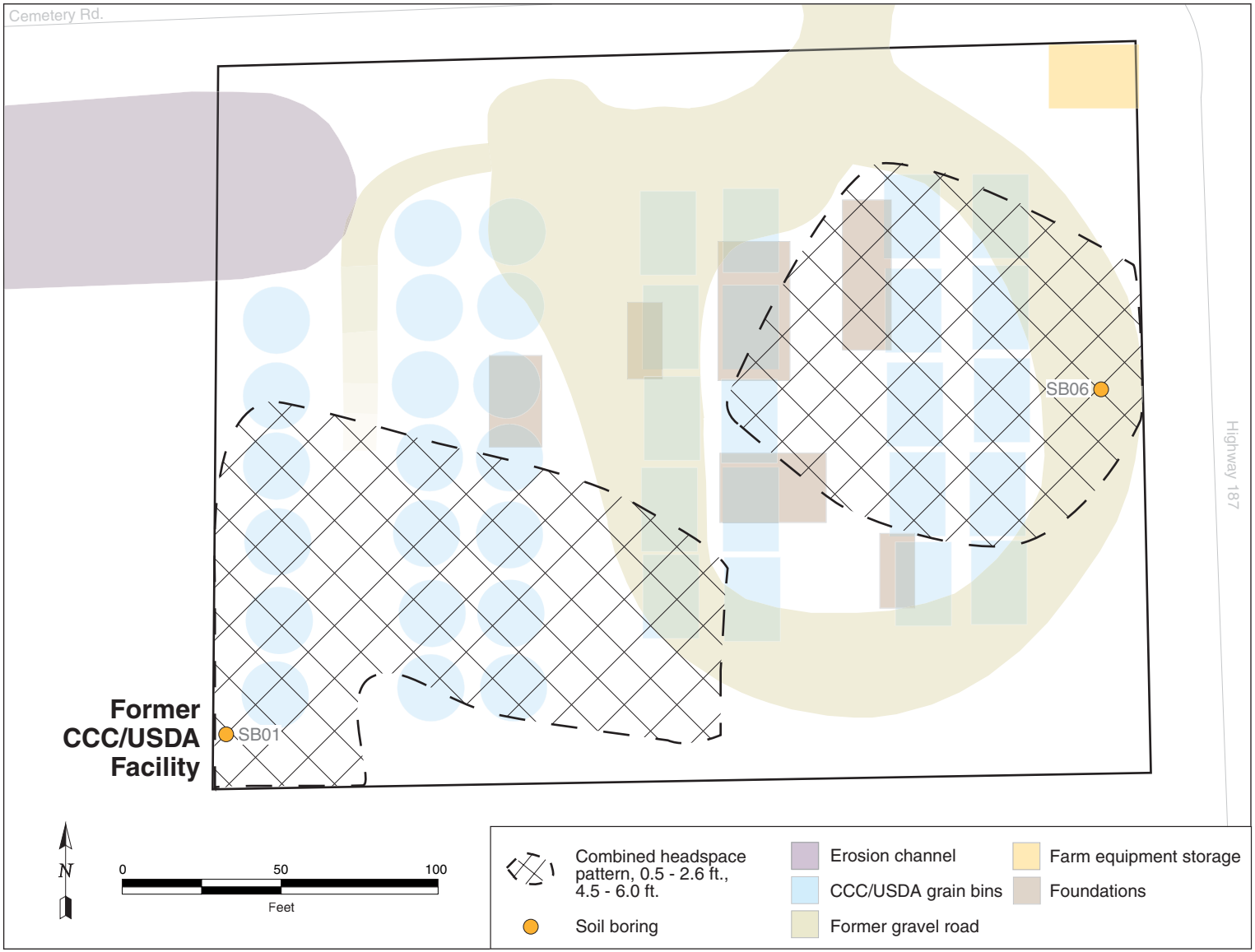

FIGURE 4.3 Present and historical cultural features at the former CCC/USDA facility at Centralia, Kansas, with interpreted pattern of carbon tetrachloride from headspace analyses of combined shallow and deeper near-surface soil samples.

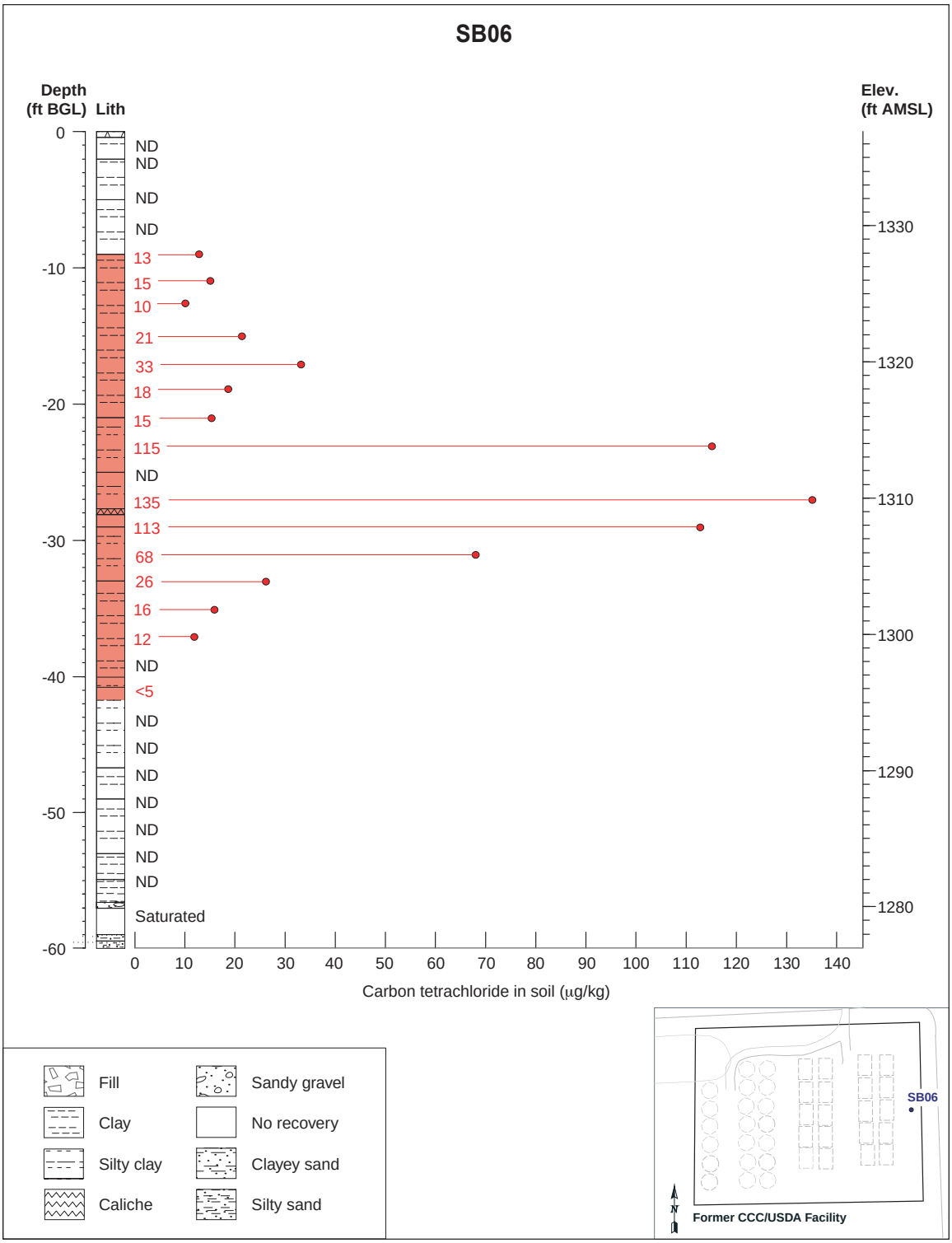

FIGURE 4.4 Subsurface soil profile in the unsaturated zone at SB06, with concentrations of carbon tetrachloride measured by the purge-and-trap technique (EPA Methods 5030B and 8260B).

Epoch	Formation	Stratigraphy	Hydrostratigraphy
Holocene	Topsoil		
Pleistocene	Upper Independence Formation (Till and glacio-fluvial outwash)		Leaky confining layer
			Shallow aquifer
	Atchison Formation (Glacio-lacustrine)		Confining layer
			Deeper aquifer
	Lower Independence Formation (Till)		No apparent water in till
Early Permian	Undifferentiated		Not investigated

FIGURE 4.5 Interpreted generalized local stratigraphy and the nature of the geologic units composing the shallow and deeper aquifers in the investigation area at Centralia, Kansas.

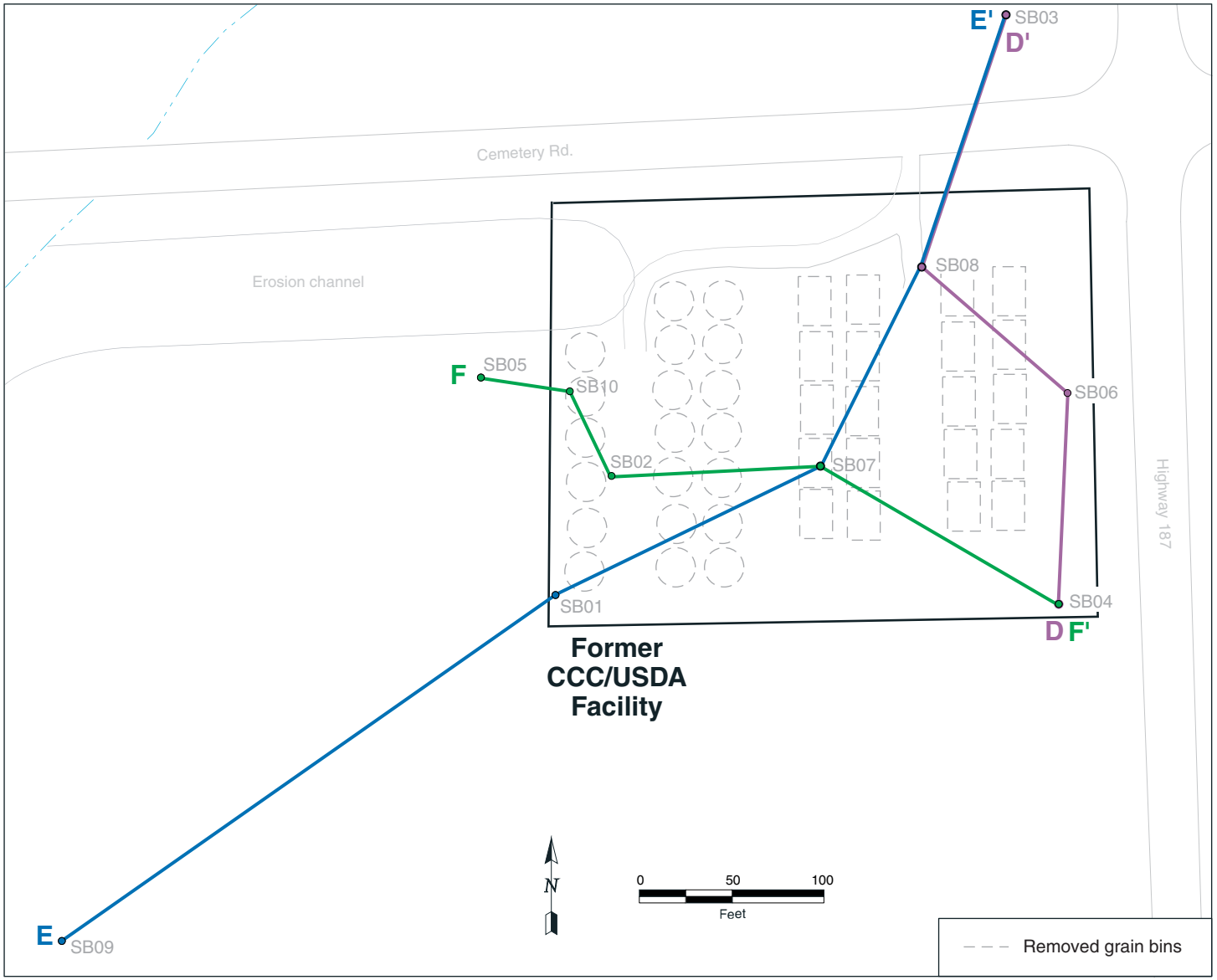

FIGURE 4.6 Locations of cross sections D-D´, E-E´, and F-F´ at Centralia, Kansas.

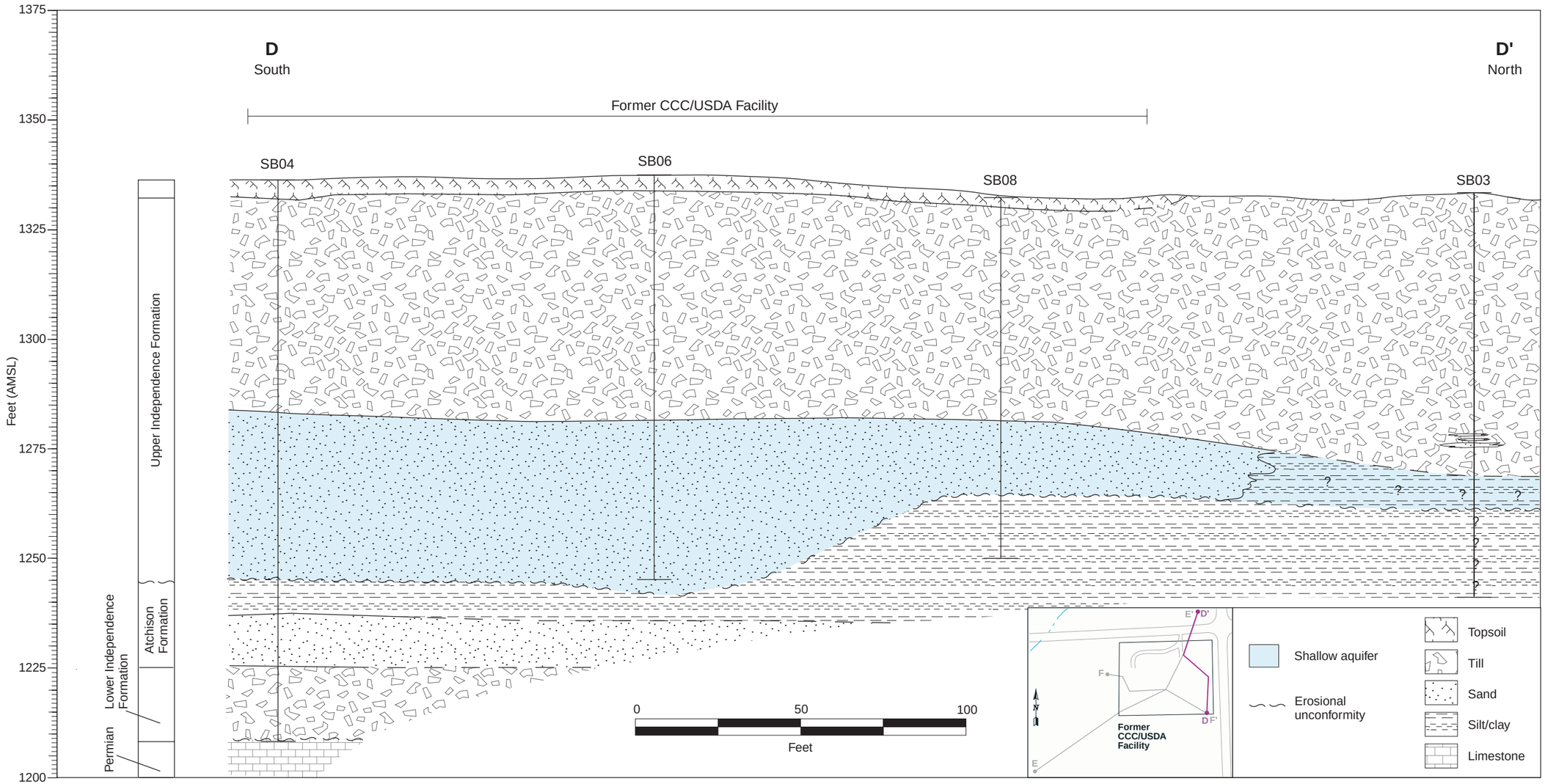

FIGURE 4.7 South-to-north geologic cross section D-D´, showing the shallow aquifer (in blue) and the associated nature and stratigraphy of the geologic units. (Figure is vertically exaggerated; location is shown in Figure 4.6.)

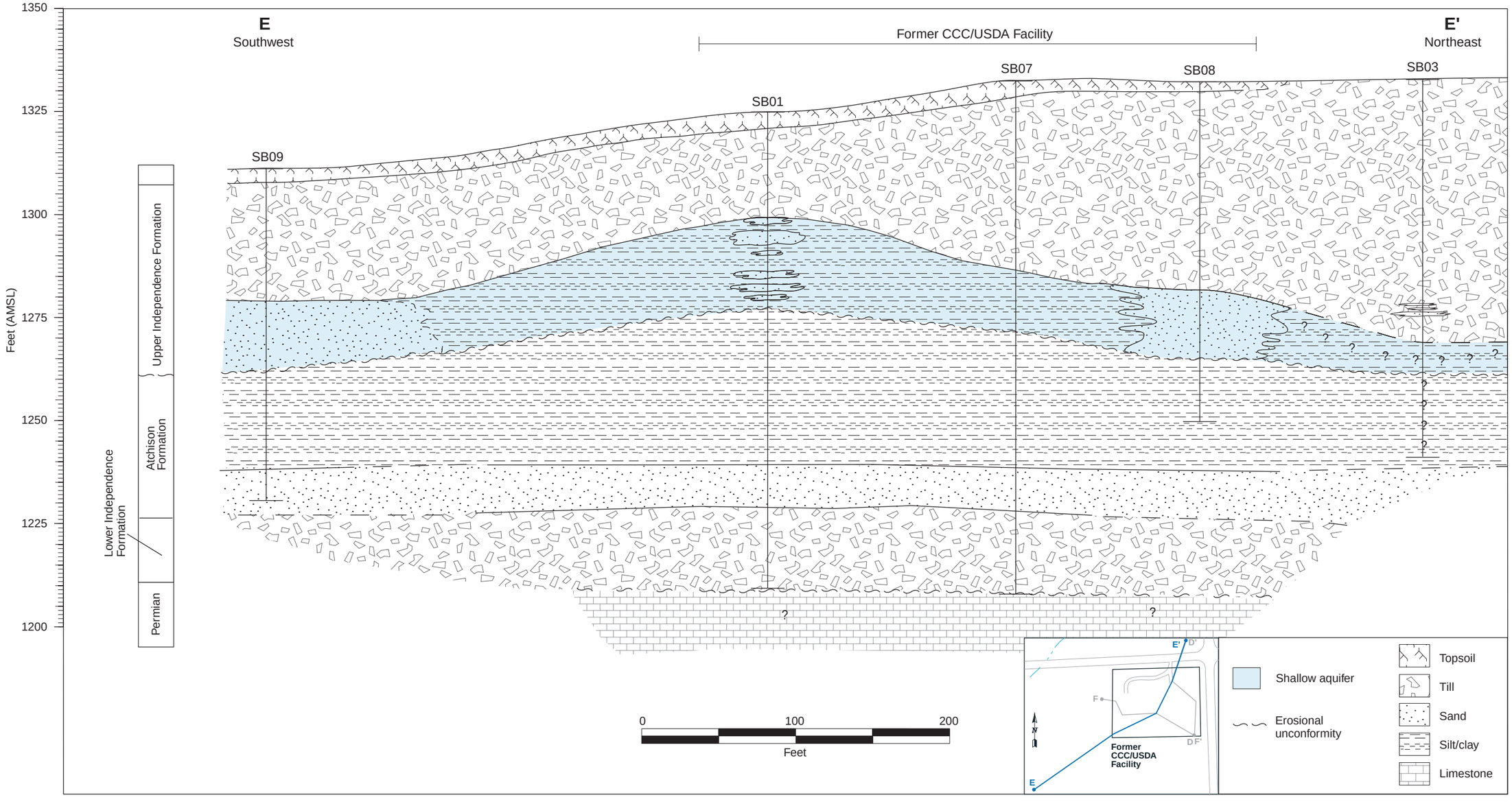

FIGURE 4.8 Southwest-to-northeast geologic cross section E-E´, showing the shallow aquifer (in blue) and the associated nature and stratigraphy of the geologic units. (Figure is vertically exaggerated; location is shown in Figure 4.6.)

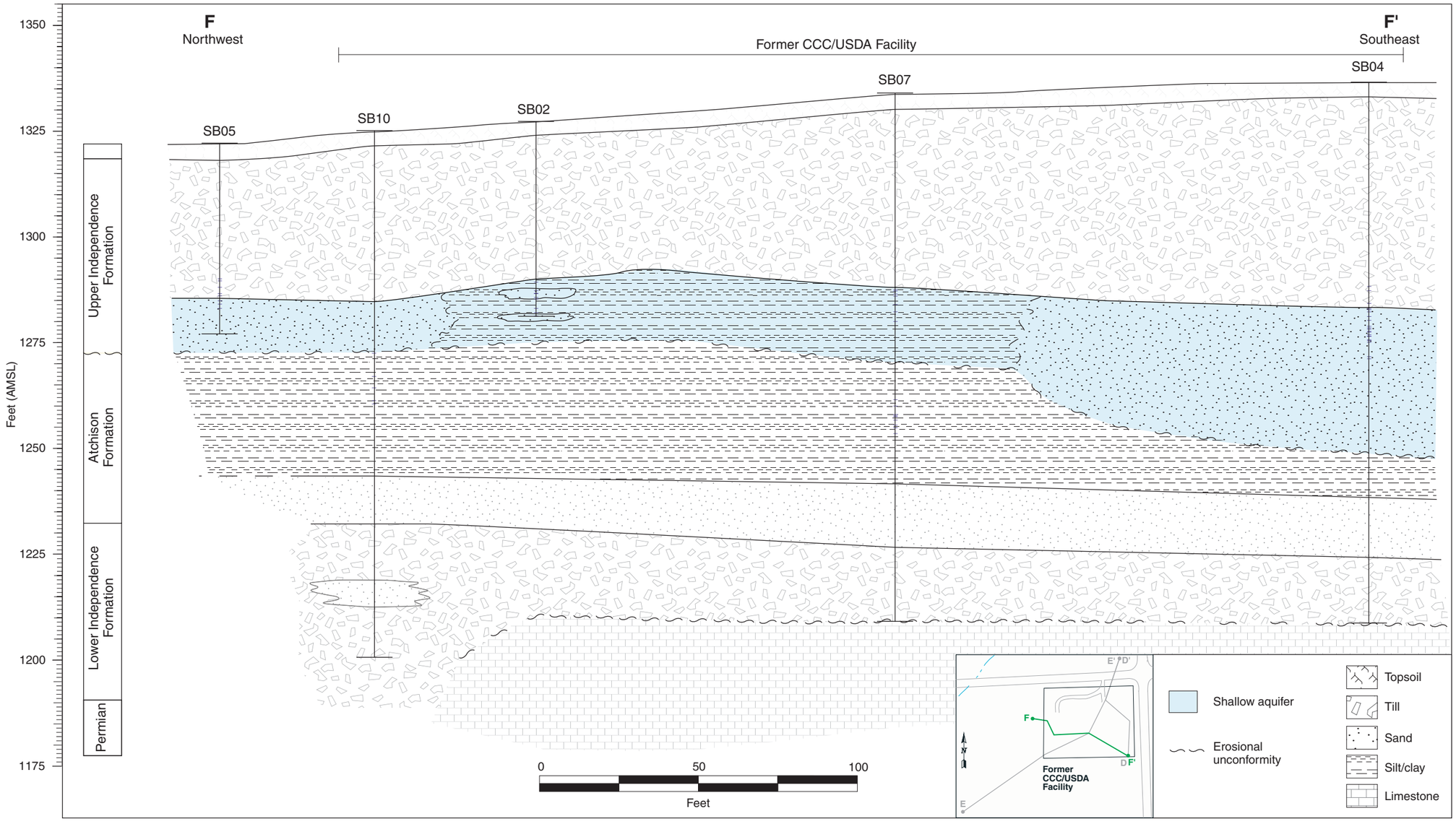

FIGURE 4.9 Northwest-to-southeast geologic cross section F-F´, showing the shallow aquifer (in blue) and the associated nature and stratigraphy of the geologic units. (Figure is vertically exaggerated; location is shown in Figure 4.6.)

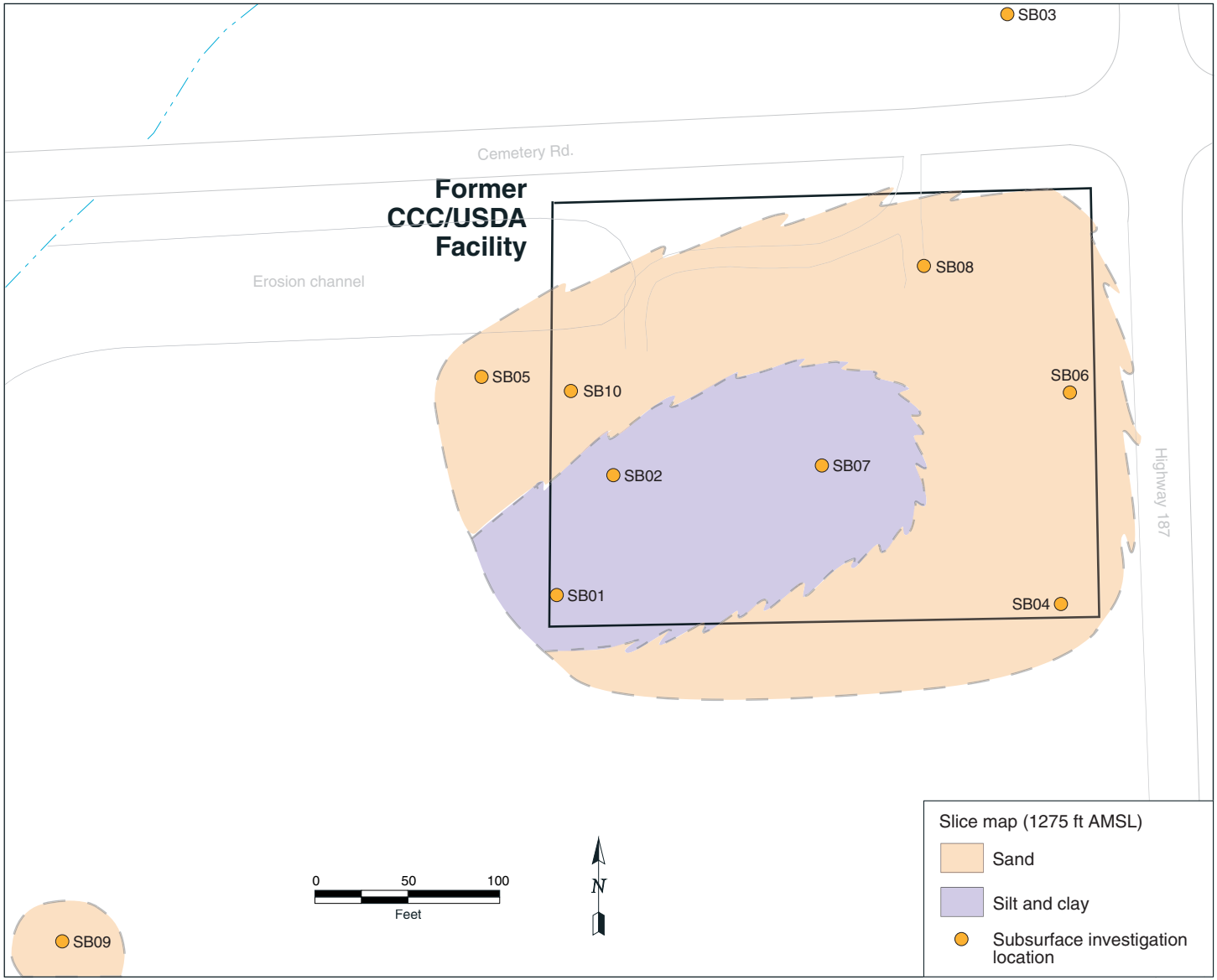

FIGURE 4.10 Distribution of the geologic material (sand versus silt and clay) through the shallow aquifer (elevation 1,275 ft AMSL) in the area of investigation.

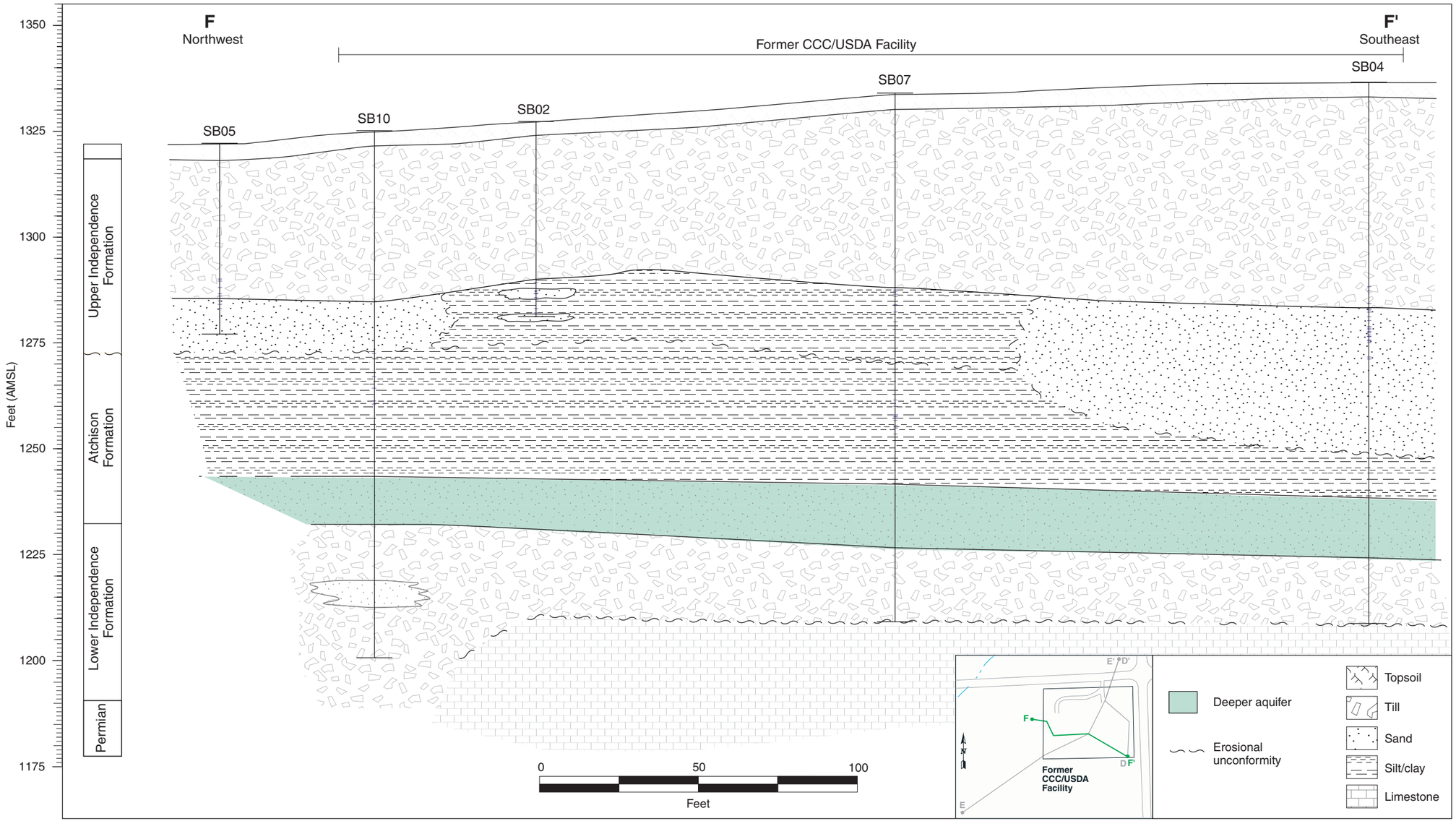

FIGURE 4.11 Northwest-to-southeast geologic cross section F-F´, showing the deeper aquifer (in green) and the associated nature and stratigraphy of the geologic units. (Figure is vertically exaggerated; location is shown in Figure 4.6.)

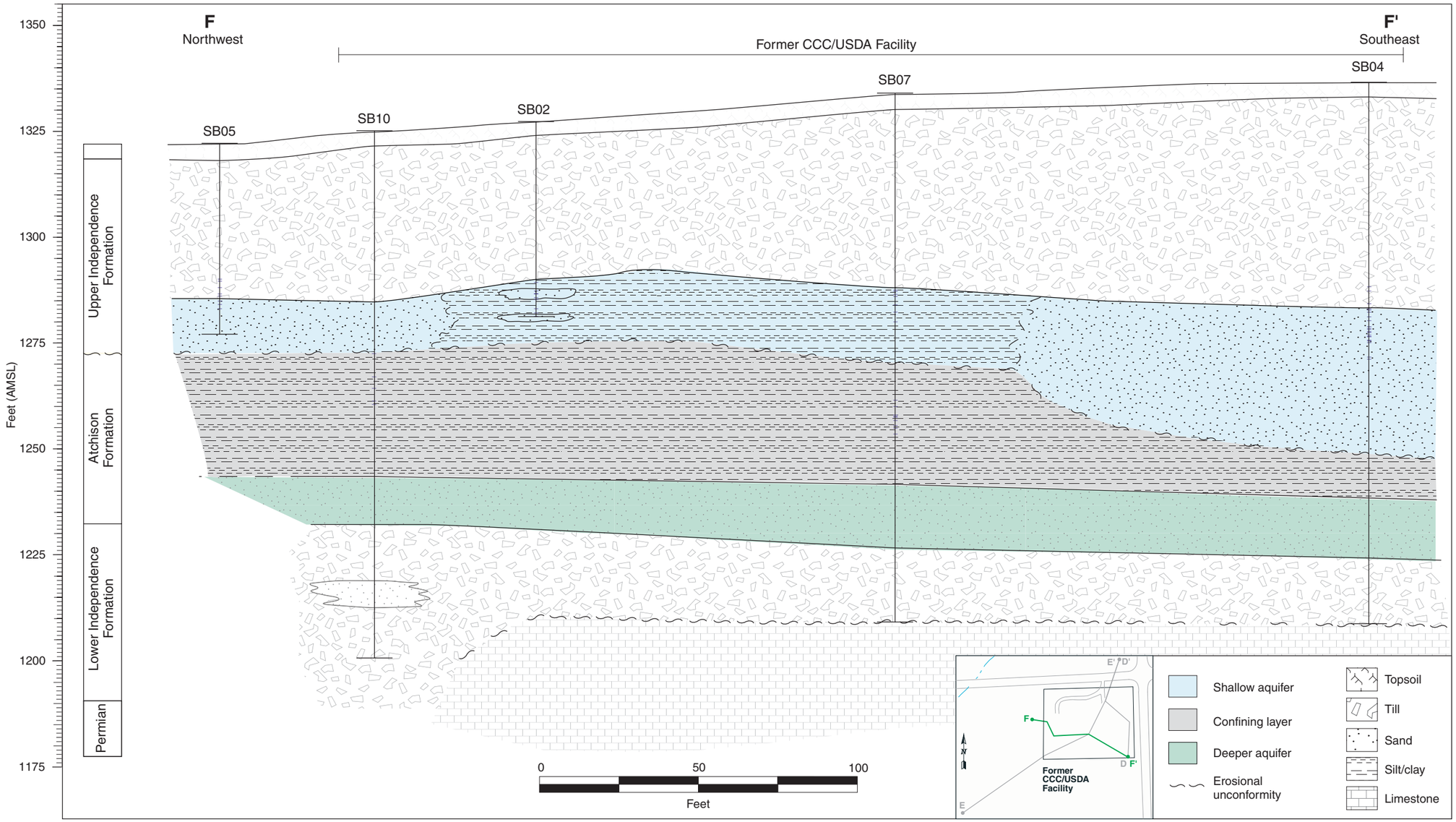

FIGURE 4.12 Northwest-to-southeast geologic cross section F-F´, showing the both the shallow and deeper aquifers and the fine grained layer of silt and clay (in gray) separating the two aquifers. (Figure is vertically exaggerated; location is shown in Figure 4.6.)

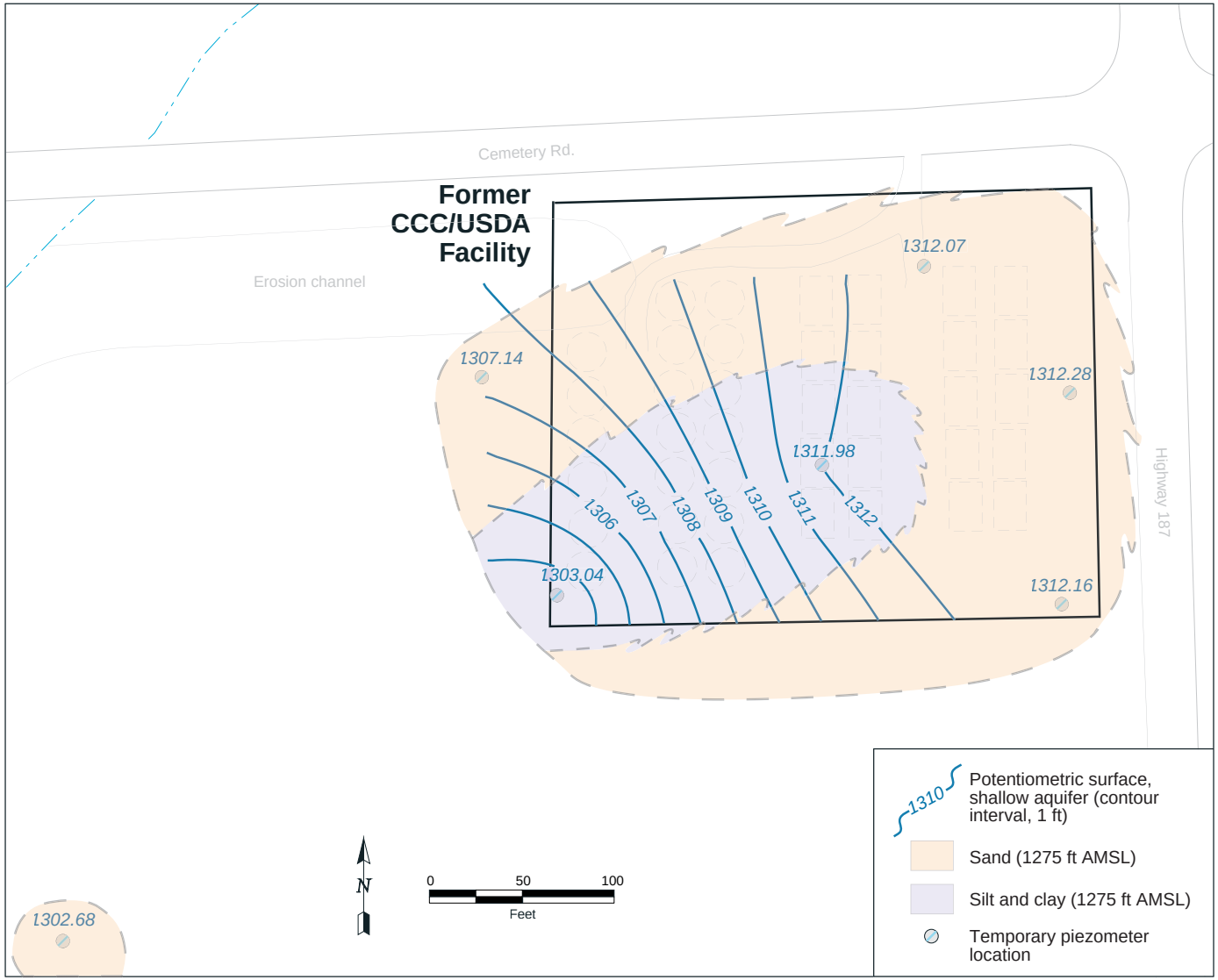

FIGURE 4.13 Groundwater elevation data measured in temporary piezometers in the shallow aquifer on April 12, 2002, with interpreted contours showing the gradient of the potentiometric surface, all superimposed on the map of the geology at 1,275 ft AMSL (Figure 4.10).

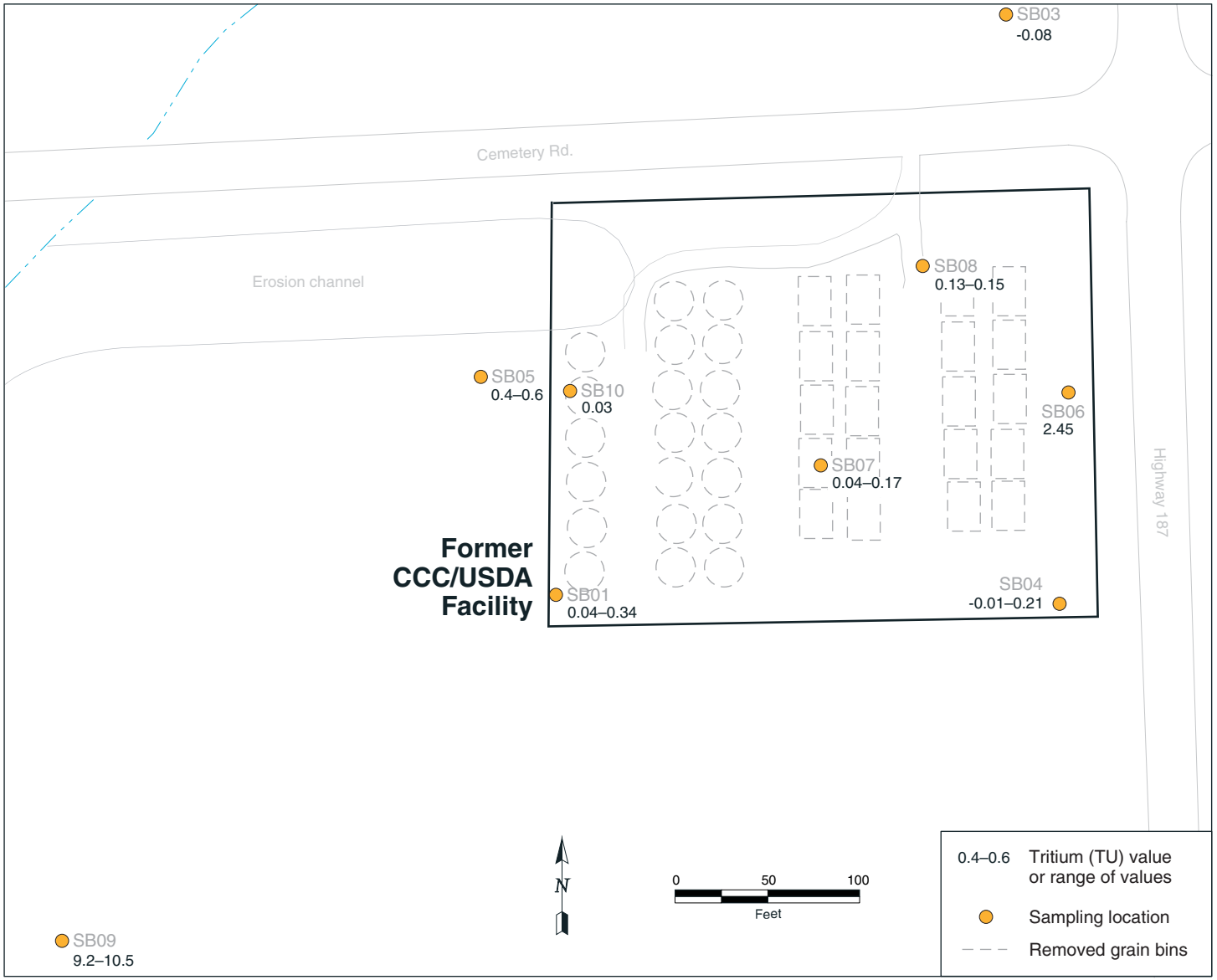

FIGURE 4.14 Range of the tritium concentrations measured in groundwater in the investigation area.

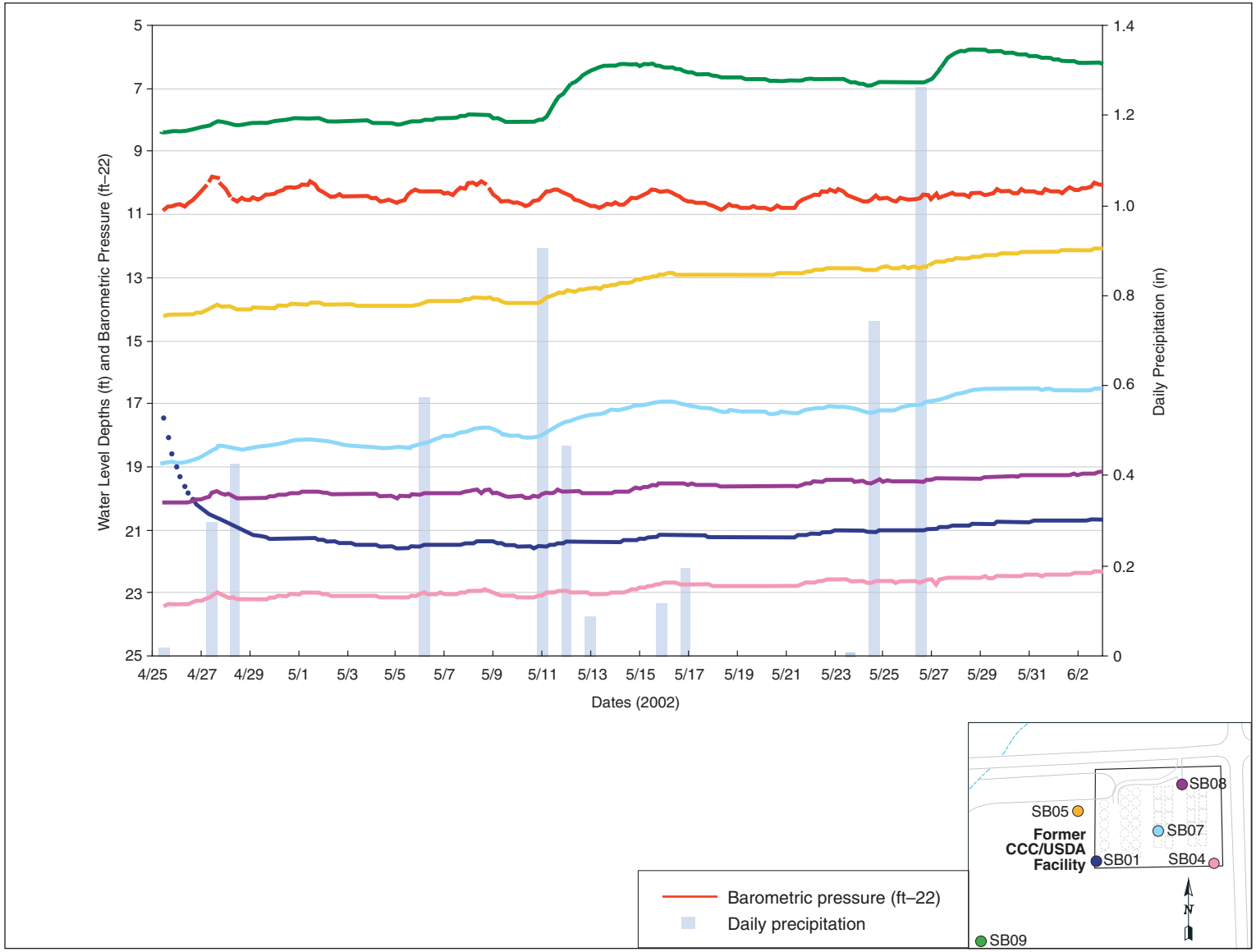

FIGURE 4.15 Water levels measured from April 25, 2002, to June 3, 2002, in the permanent piezometers, with barometric pressure and precipitation data.

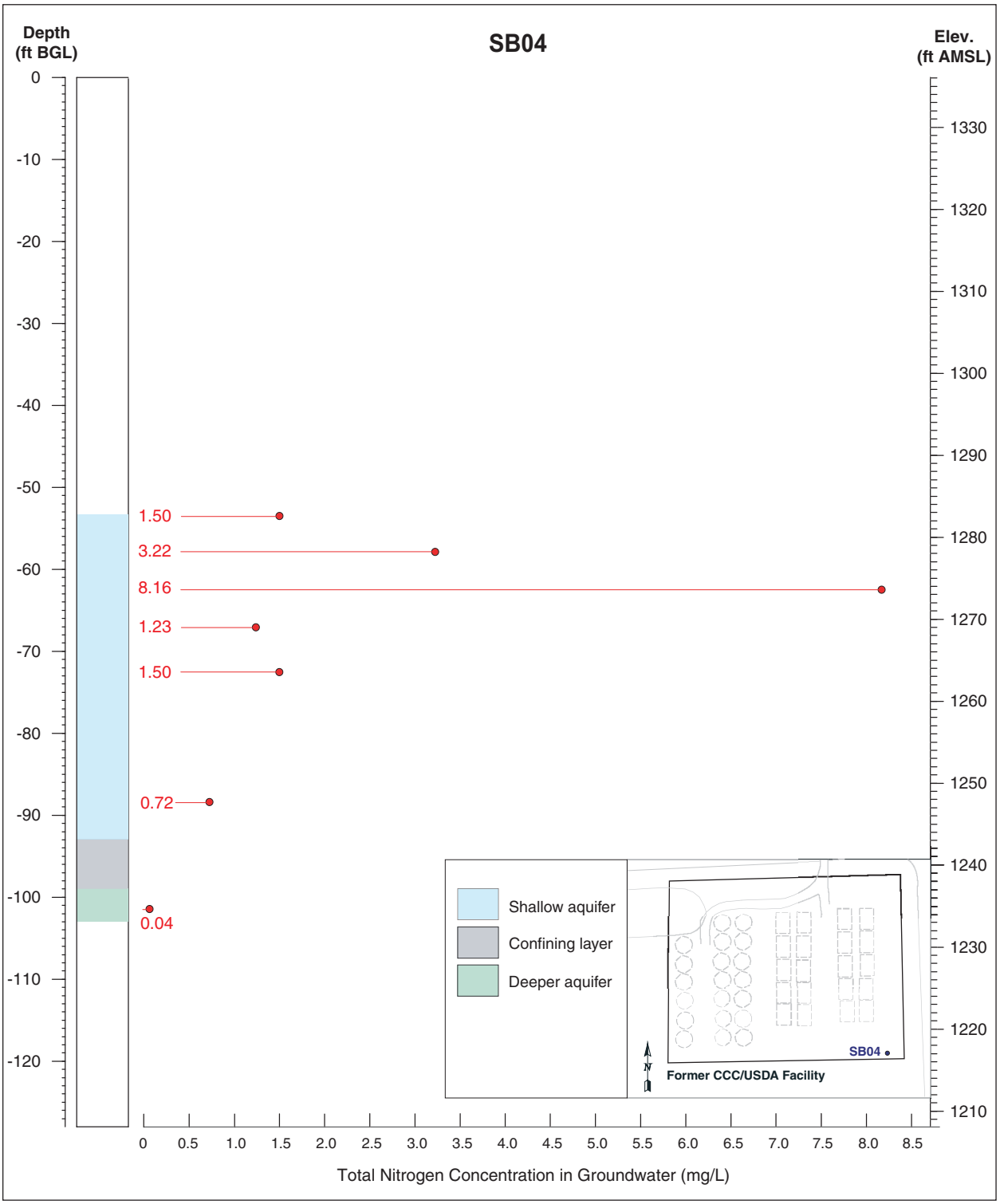

FIGURE 4.16 Total nitrogen data for SB04, showing total nitrogen concentrations in the shallow aquifer dropping to nearly zero in the deeper aquifer.

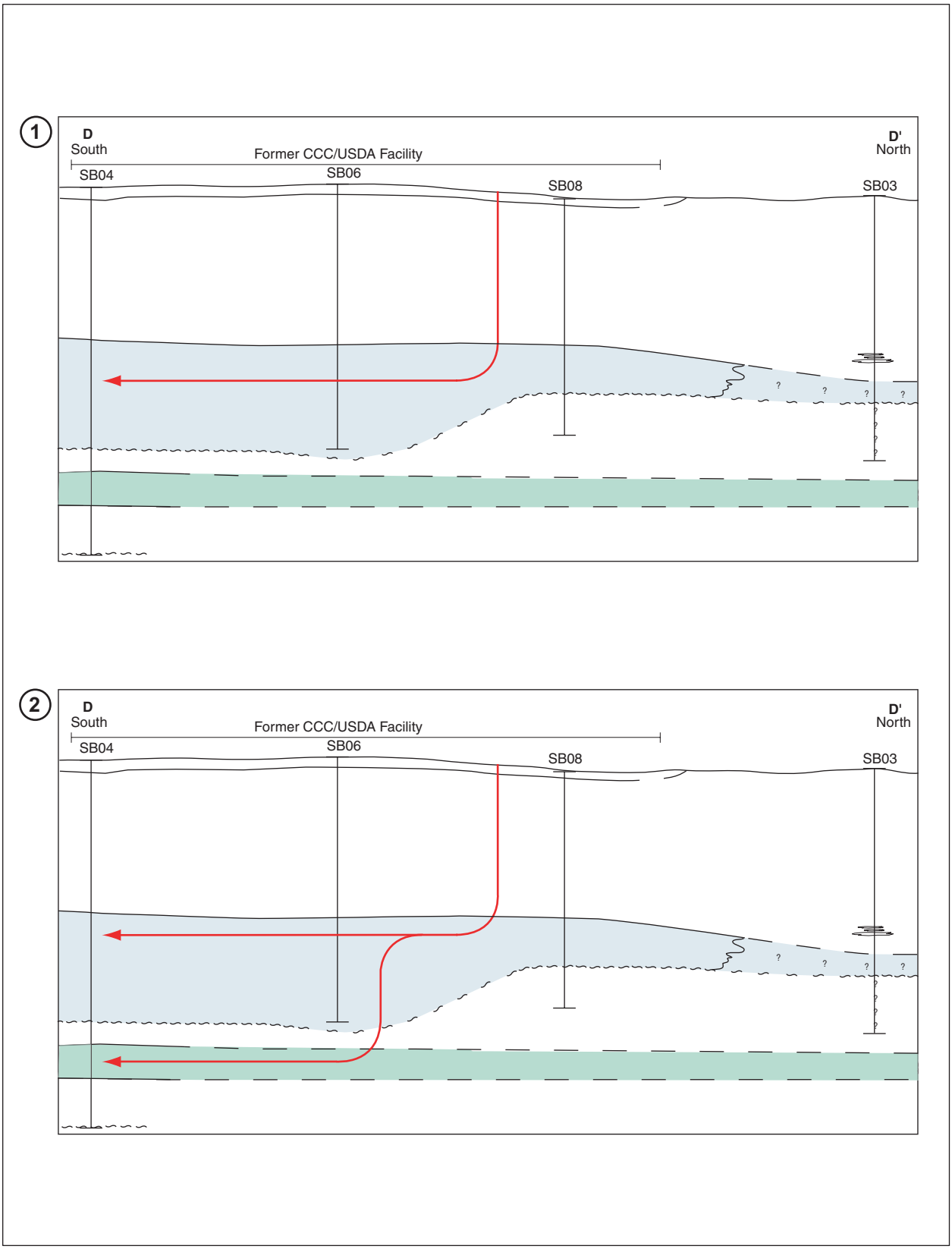

FIGURE 4.17 Two potential contaminant migration pathways considered in the Phase I investigation.

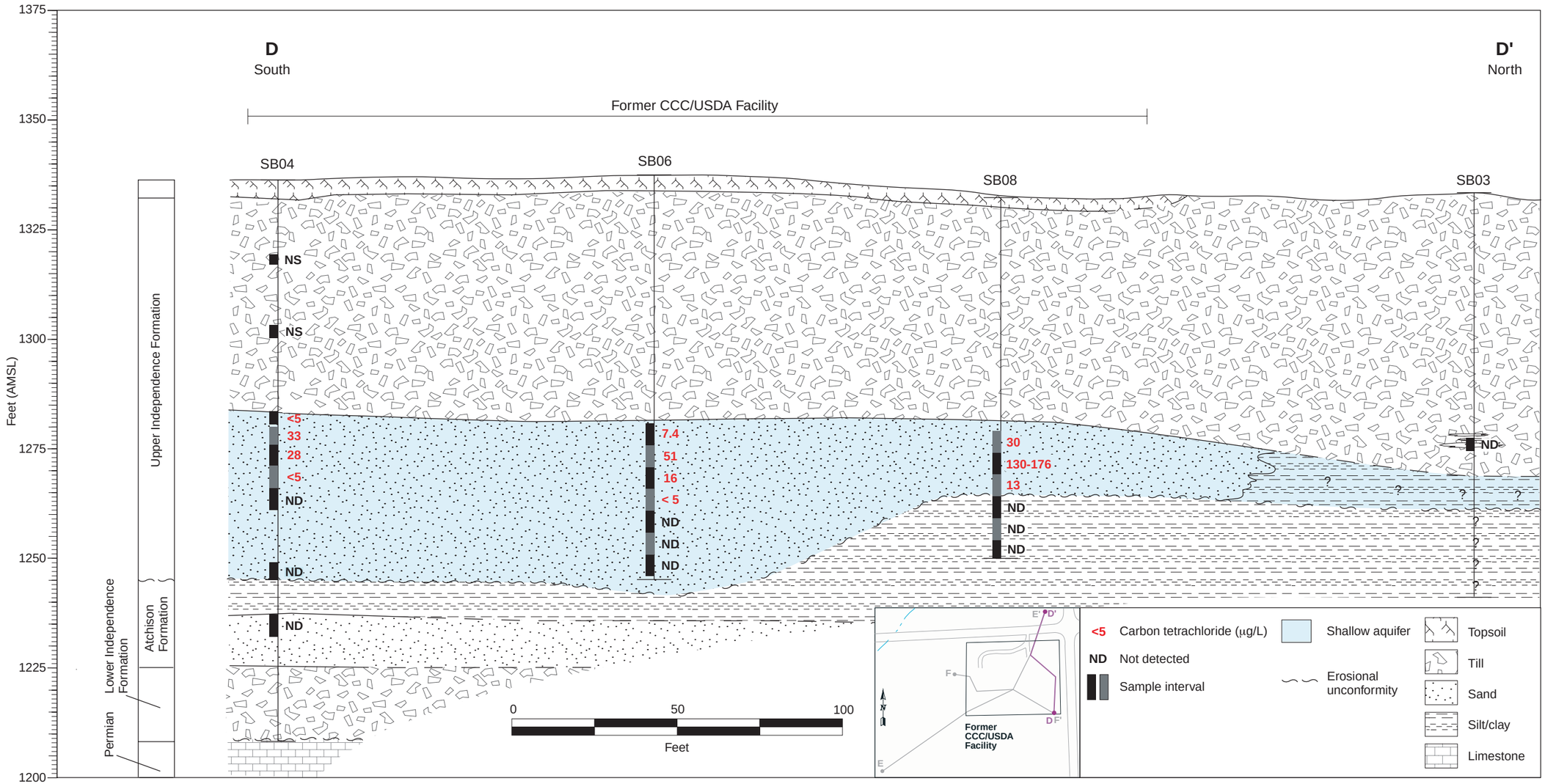

FIGURE 4.18 Cross section D-D´, showing the vertical and horizontal distribution of carbon tetrachloride in groundwater. (Figure is vertically exaggerated; location is shown in Figure 4.6.)

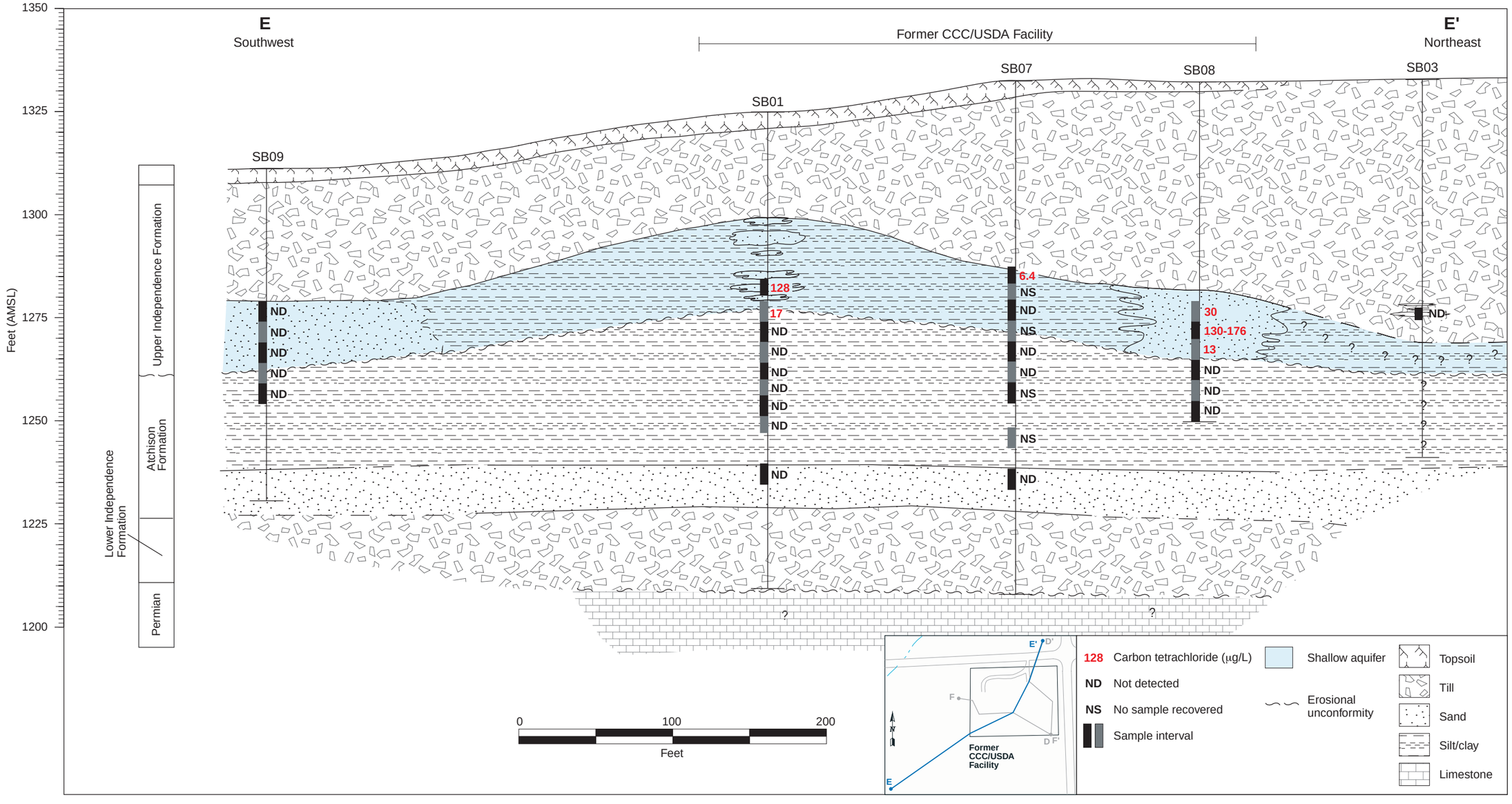

FIGURE 4.19 Cross section E-E´, showing the vertical and horizontal distribution of carbon tetrachloride in groundwater. (Figure is vertically exaggerated; location is shown in Figure 4.6.)

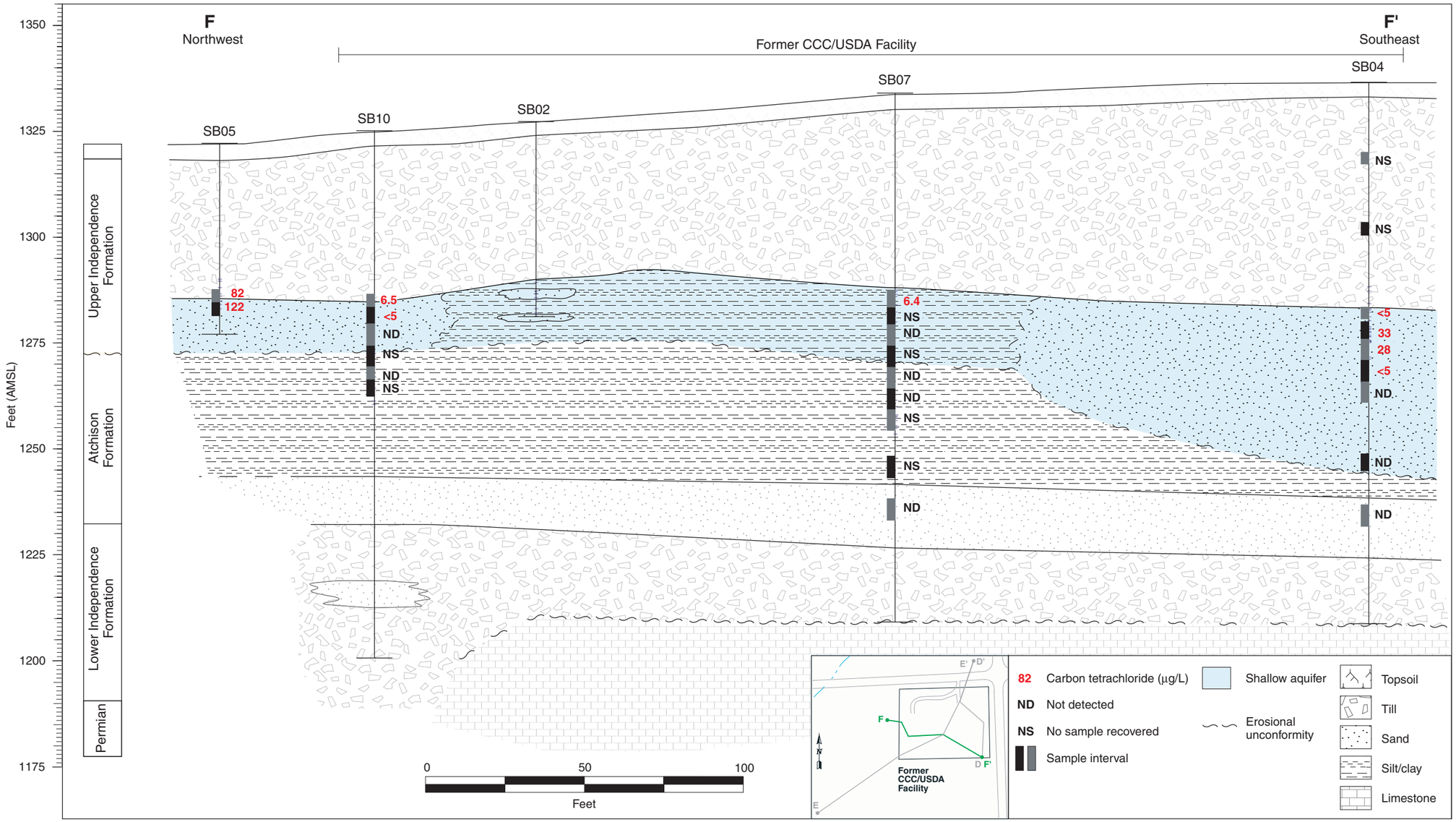

FIGURE 4.20 Cross section F-F´, showing the vertical and horizontal distribution of carbon tetrachloride in groundwater. (Figure is vertically exaggerated; location is shown in Figure 4.6.)

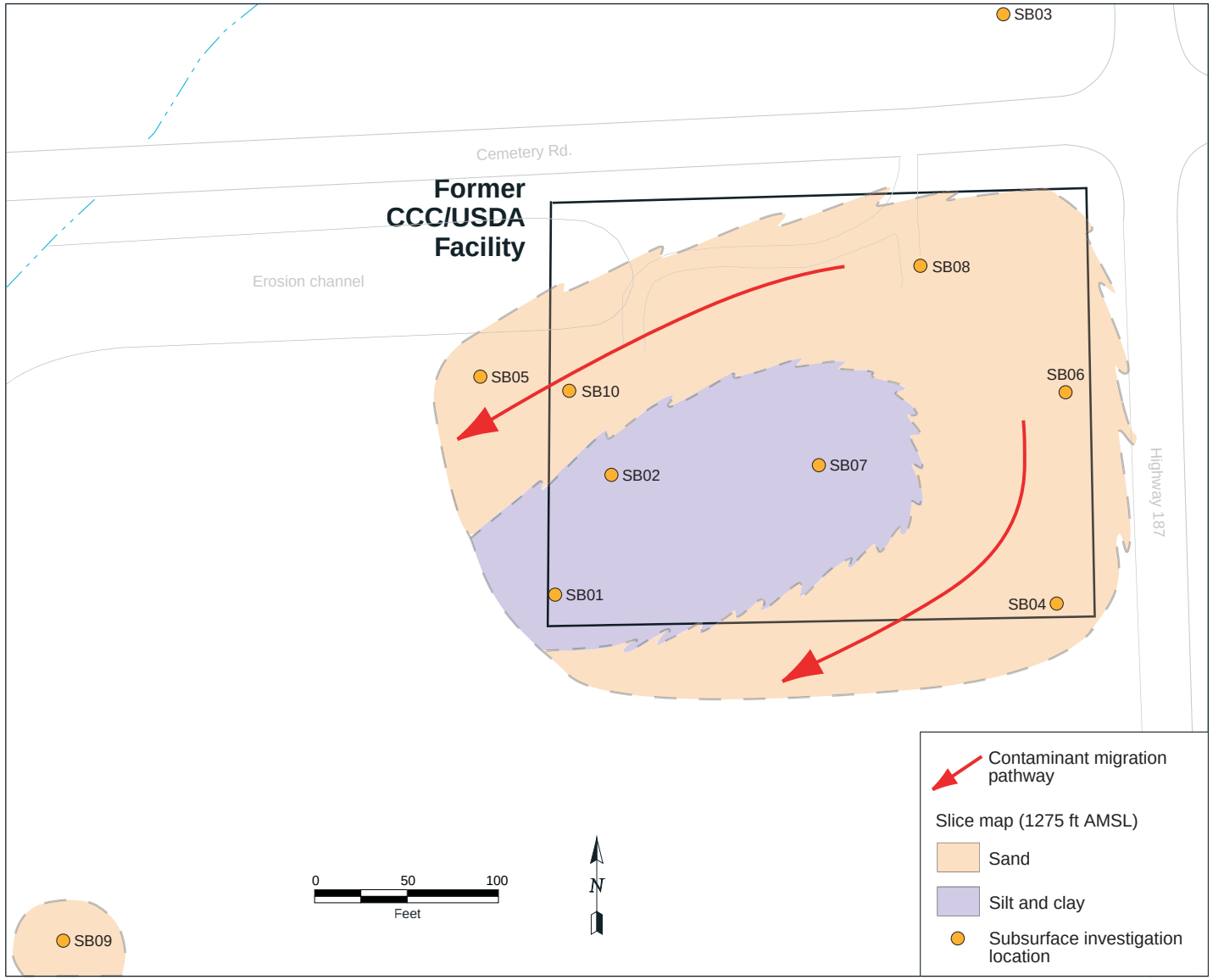

FIGURE 4.21 (pathway 1) Geology at 1,275 ft AMSL (Figure 4.10), with the most likely contaminant migration pathway shown by red arrows.

5 Conclusions and Recommendations

5.1 Conclusions

The conclusions for each of the four technical objectives for the Phase I investigation, as delineated in Section 1 and carried out during the field work, are as follows:

1. *Verify an association of carbon tetrachloride contamination with the former CCC/USDA facility.* An association of carbon tetrachloride contamination in the soil has been verified at the former CCC/USDA facility, both by interpretation of the headspace data for near-surface soils and by the elevated concentrations of carbon tetrachloride confirmed by purge-and-trap analysis of soil samples from the subsurface soil boring at SB06 (Section 4.1). There is no health risk from contaminated soil at the former facility.

2. *Characterize the nature and extent of the geologic units composing the aquifer or aquifers at and in the vicinity of the former Centralia CCC/USDA facility.* The nature and extent of the geologic units composing the shallow and deeper aquifers at the former CCC/USDA facility at Centralia have been characterized. The shallow aquifer is contained in the Pleistocene Upper Independence Formation, and the deeper aquifer is contained in the Atchison Formation.

   The nature of the shallow aquifer varies laterally, from coarser grained sand deposits to finer grained silt and clay material. The sand deposits are expected to be more permeable than the finer grained material. If groundwater flow occurs, preferential flow is expected through the more permeable sand material (Figure 4.21). The extent of the shallow aquifer toward the south, southwest, and northeast is still unknown.

   There is no evidence for vertical groundwater flow between the shallow aquifer and the deeper aquifer.

3. *Establish the direction(s) of groundwater flow at the former CCC/USDA facility*. The horizontal direction of groundwater flow within the shallow (contaminated) aquifer is toward the west-southwest at the former CCC/USDA facility.

4. *Identify the contaminant migration pathway(s) at the former CCC/USDA facility*. The identified pathway of contaminant migration at the former CCC/USDA facility involves vertical movement of the contaminant from a source on the property into the shallow aquifer and lateral migration in the sand deposits within this shallow aquifer (pathway 1, Figure 4.17).

5.2 Recommendations and Technical Objectives for Phase II

Section 5.4 of the Centralia *Work Plan* (Argonne 2002a) gives potential conditions in which Argonne would recommend further investigation. The first condition, verifying an association of carbon tetrachloride contamination with the former CCC/USDA facility, has been met by the Phase I investigation. Therefore, Argonne is recommending a QuickSite® Phase II investigation. The objectives of the Phase II investigation at Centralia will be to do the following:

1. Delineate carbon tetrachloride contamination in the subsurface soils at the former CCC/USDA facility.

2. Evaluate the vertical and lateral extent of the carbon tetrachloride and chloroform contamination in the groundwater associated with the former CCC/USDA facility.

The investigative activities selected to achieve these technical objectives are discussed below. The procedures governing the activities proposed to meet these objectives are described in the *Master Work Plan* (Argonne 2002b).

5.3 Technical Program for Phase II

The investigative program outlined below is based on the current understanding of the Centralia site — gained from the results discussed in Section 4 of this report — and on the conclusions in Section 5.1. The investigative tasks and locations discussed here are intended to address the specific technical objectives given in Section 5.2. As new data are acquired during the field program, tasks might be revised to reflect an improved understanding of the site. Modifications might include a reduction or expansion in the task activities or the elimination of specific activities judged to be unproductive in addressing objectives.

5.3.1 Delineate Carbon Tetrachloride Contamination in the Subsurface Soils at the Former CCC/USDA Facility

Figure 5.1 shows the two general areas on the former CCC/USDA facility where carbon tetrachloride concentrations in near-surface soil samples indicate potential subsurface soil contamination with carbon tetrachloride. Figure 5.1 also shows the two soil borings, SB01 and SB06, where subsurface soil was analyzed for contamination during the Phase I investigation. Subsurface soil contamination was verified at SB06.

To further delineate carbon tetrachloride contamination in the subsurface soils at the former CCC/USDA facility, five new soil borings, SB11-SB15, are proposed for the Phase II investigation (Figure 5.1). These borings will be advanced with the ECPT or the Geoprobe to the top of the saturated zone. Soil samples will be taken every 5 ft and/or at changes in lithology. Upon recovery, the soil samples will be placed in jars, sealed, preserved on dry ice in the field (Argonne 2002b), and shipped to the AGEM Laboratory for purge-and-trap analysis for carbon tetrachloride and chloroform by EPA Methods 5030B and 8260B (Argonne 2002b).

Selected core sample material may also be taken for measurement of soil properties, such as total organic carbon, for potential use in Phase III modeling.

5.3.2 Evaluate the Vertical and Lateral Extent of the Carbon Tetrachloride and Chloroform Contamination in the Groundwater Associated with the Former CCC/USDA Facility

As discussed in Section 4.4, pathway 1 (Figure 4.17) is the identified pathway for migration of carbon tetrachloride at the former CCC/USDA facility (objective 4, Section 5.1). The ECPT will be used throughout the area of investigation (1) to identify the shallow aquifer by electronic logging and confirm its identity by core sampling, (2) to sample groundwater within the aquifer for contamination (Argonne 2002b, Sections 6.1-6.3), and (3) to install piezometers (Argonne 2002b, Section 6.4) required to monitor groundwater levels for further confirmation of flow direction(s).

Argonne will use the minimum number of ECPT penetrations necessary to achieve these objectives. Groundwater samples will be collected vertically through the shallow aquifer. If contamination is found in the shallow aquifer, groundwater sampling of the deeper aquifer will be done at selected locations to confirm the absence or presence of contamination there. The proposed borings and their locations are presented below and shown in Figure 5.2.

The sampling locations shown in Figure 5.2 — SB16, SB17, SB18, SB19, SB20, SB21, SB22, SB23, and SB24 — address variables at the former facility and within the shallow aquifer that might affect contaminant migration at and away from the facility. These variables include (1) changes in lithologies within the aquifer across the former facility; (2) local changes in the direction of groundwater flow from west-southwest to south-southwest; (3) the steeper gradient to the groundwater flow in the southwest portion of the former facility, in contrast to the flat gradient along the eastern section; and (4) the topography of the area immediately surrounding the facility, which might cause changes in the flow direction and gradient not investigated in Phase I.

Sampling location SB16 is topographically upgradient and to the east of the former facility. Testing and sampling with the ECPT at SB16 will address the issue of whether the shallow aquifer at this location is hydraulically upgradient of the contamination.

Location SB18 is downgradient of SB01, where the shallow aquifer is very silty and where downgradient migration is considered to be potentially very limited. Sampling at this location will address the migration of contamination within the silty aquifer beyond the former facility to the southwest of SB01.

Locations SB19 and SB22 are to the west of the northern portion of former facility, where the shallow aquifer is in coarse sand. Contamination might have migrated at least to the local intermittent drainage at SB22. Sampling at these locations will address the migration of contamination to the west-southwest within the coarser sand-gravel aquifer potentially trending from SB08 through SB05 and into the intermittent drainage at location SB22.

Location SB20 is south of the eastern portion of the former facility, where the aquifer locally shows a very low, southerly gradient. At location SB20, there is potential for the aquifer flow to be directed to the southeast, into the valley southeast of the former facility. Such flow would direct the contamination to the southeast. Sampling at this location will address this issue.

Location SB21 is southwest of the eastern portion of the former facility, where the shallow aquifer is in coarse sand and gravel. Sampling at this location will address the potential continuity of the coarse aquifer material in the general southwesterly flow direction and the limits of contamination.

Location SB23 is just north of the western boundary of the former facility. Sampling here will confirm the presence or absence of the carbon tetrachloride reported at a level of 1.1 μg/L in previous KDHE investigations at the former facility (Argonne 2002a). This area is also being checked to ascertain whether there are additional sources of carbon tetrachloride outside the former facility and potentially upgradient from it.

Location SB24 is northeast of SB05 and KDHE location GW-6. Sampling at this location will confirm the presence or absence of an upgradient source of contamination in the vicinity of the two northernmost former grain bins, which were located just east of the erosion channel. Headspace analyses for carbon tetrachloride in near-surface soil samples recovered near these bins at the former CCC/USDA site indicated concentrations of 0.12-0.26 μg/kg.

Sampling at these initial locations may lead to the selection of additional sampling locations, depending on results of chemical analyses — as well as data from the extended groundwater flow monitoring network — that will enable the groundwater contaminant plume to be mapped both laterally and vertically.

Locations for the installation of permanent piezometers in Phase II will be based on the information found in the proposed borings. All permanent piezometers will be installed in

accordance with state of Kansas regulations and under the direction of a licensed water well contractor and registered with the KDHE. The procedures are outlined in the *Master Work Plan* (Argonne 2002b, Section 6.4.6 and Appendix E). Piezometer location coordinates will be determined by a state-licensed surveyor, and the groundwater elevation data will be plotted to further evaluate the flow direction.

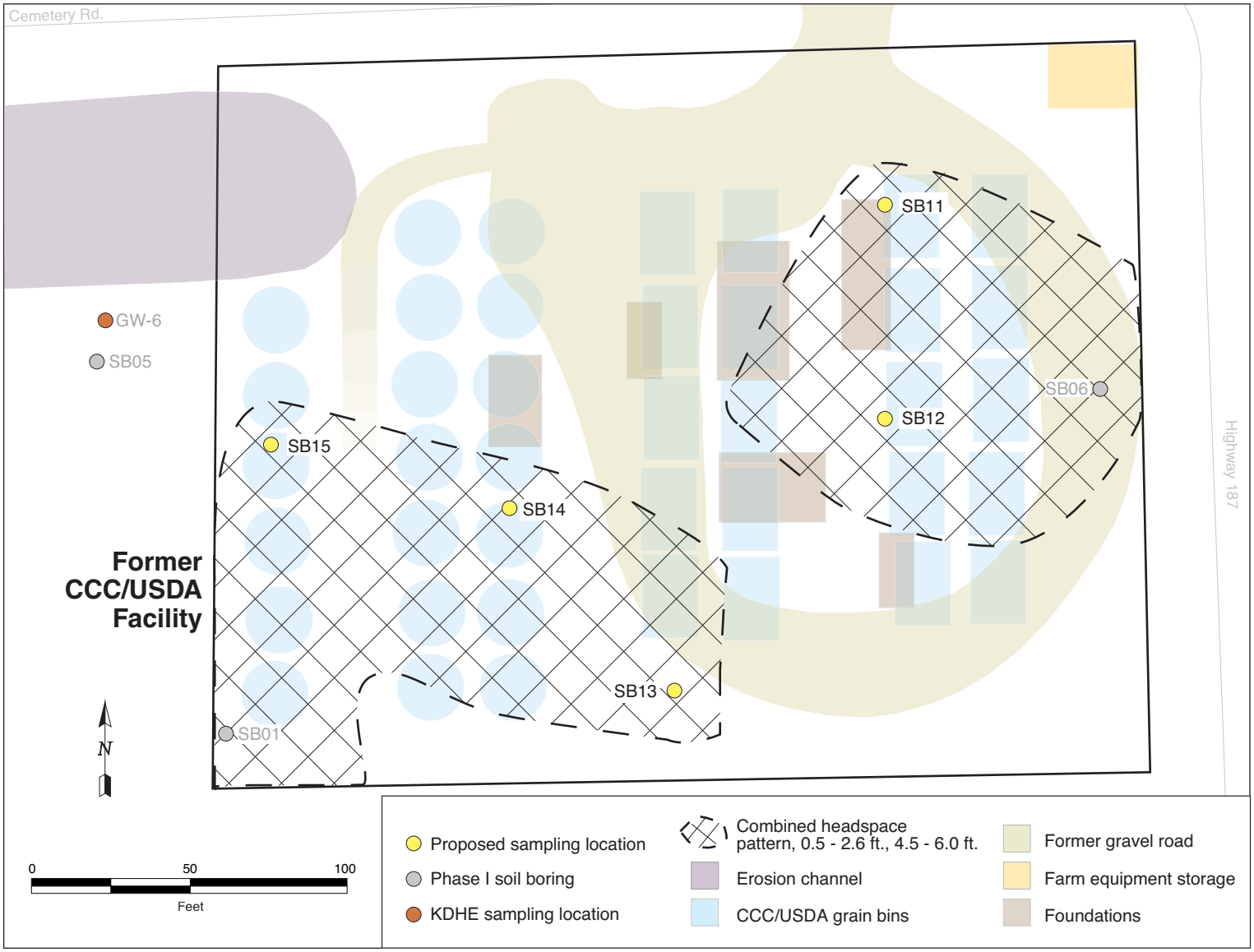

FIGURE 5.1 Proposed Phase II subsurface soil sampling locations at the former CCC/USDA facility.

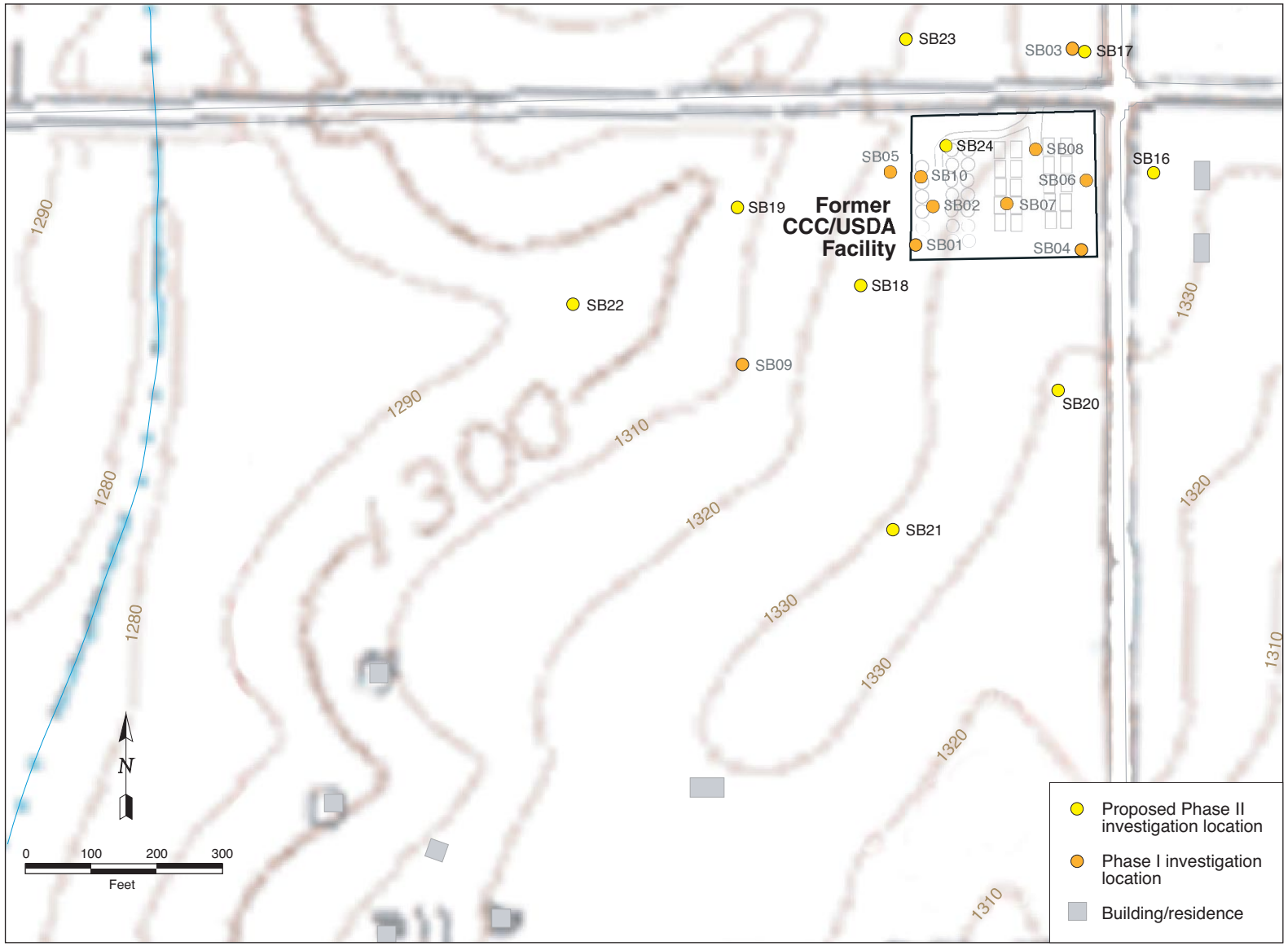

FIGURE 5.2 Additional proposed Phase II investigation locations in the study area at Centralia.

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Appendix A:

Geologic Logs and Electronic Cone Penetrometer Logs

Argonne National Laboratory

Well ID: **SB01**

Project **Centralia, KS** **Elevation:** 1325.3 ft **Log Date:** Mar 21-23, 2002 **Rig:** CPT - VdB
Geologist: L. LaFreniere/ Boulding **Total Depth:** 116 ft **Driller:** T. Hinz **Drilling Company:** ASW
Location: 1838925, 514989 **Core Description:** to 116 '

Depth (ft BGL)	% Rec	S.S. / W.S.	CCl_4	LITHOLOGY DESCRIPTION	Elev (ft AMSL)
0				Silty Clay: medium plasticity, moderately calcareous, no Fe/Mn, yellowish brown (10YR), moist.	1325
				Clay: high plasticity, non-calcareous, organic rich, very dark brown (10YR), moist.	
			ND	Clay: high plasticity, non-calcareous, high organic content, dark yellowish brown (10YR), moist.	
				Clay: trace sand, high plasticity, slightly calcareous, yellowish brown (10YR), moist.	
			ND	Silty Clay: occasional pebbles to 1cm in length, medium plasticity, scattered carbonate and Fe/Mn accumulations, yellowish brown (10YR) with strong brown (7.5YR) mottles, moist.	
-5					1320
			ND		
			ND		
			ND	Silty Clay: As above, trace pebbles to 1 inch.	
-10			ND		1315
			ND	Silty Clay: trace sand, moderate plasticity, strongly calcareous, extensive carbonate and Mn accumulations, yellowish brown (10YR), moist.	
			ND	Silty Clay: trace sand, moderate plasticity, strongly calcareous, numerous Mn accumulations, yellowish brown (10YR) and strong brown (7.5 YR) mottles, moist.	

Carbon tetrachloride in soil sample = μg/kg

SB01 Pg. 2

Depth	%	W.S. S.S.	LITHOLOGY	Elev
-15				1310
		ND	Silty Clay: trace pebbles to 1 inch, moderate plasticity, moderately calcareous, extensive carbonates at 20-20.5 feet. Occasional Fe/Mn accumulations throughout, yellowish brown (10YR) w/ occasional strong brown (7.5YR) mottles, moist.	
		ND		
-20		ND		1305
		ND		
		ND		
-25				1300
		ND	Clayey Sand: 65% medium to coarse sand, plastic, moderately calcareous, clay layers at 26.2 to 26.3 feet, some Mn accumulations, brownish yellow (10YR) with lt. gray (10YR) and strong brown (7.5YR), Fe accumulations, moist to wet.	
			Silty Clay: some sand, moderately plastic, slighly calcareous, few Mn accumulations, brownish yellow (10YR), w/ light gray (10YR) mottles, moist.	
			Clayey Sand: Same as 25.7-26.6, with more Mn accumulations.	
		ND	Silty Sand: 80% medium to coarse sand, well sorted, subrounded, non plastic, non calcareous, brownish yellow (10YR), wet.	
			Clayey Sand: 45% medium to coarse sand, 5% granules, 5% med - fine gravel, slightly calcareous, many Mn accumulations, pale brown (10YR), moist.	
-30			Clayey Sand: 55% medium to very coarse sand, 5% granules, 5% gravel, poorly sorted, sub angular, plastic, mod. calcareous, many Mn accumulations, yellowish brown (10YR) with light gray (10YR) and strong brown (7.5 YR) mottles, moist.	1295
			Clayey Sand: 85% med. to very coarse sand, poorly sorted, subrounded to subangular, plastic, calcareous, Mn accumulations throughout, yellowish brown (10YR), moist to wet.	

Carbon tetrachloride in soil sample = μg/kg

SB01 Pg. 3

Depth	%	W.S. S.S.		LITHOLOGY	Elev
				(Clayey sand)	
				Clay: 30% sand, <5% granules, very poorly sorted, high plasticity, calcareous, Mn accumulations, dark yellowish brown to yellowish brown (10YR).	
				Sand: very poorly sorted, < 5% clay, fine to medium grained, subrounded to subangular, Mn accumulations, highly calcareous, yellowish brown (10YR), wet.	
				Clayey Sand: as above, but clay increases to 20%	
				Sand: Fine to coarse grained, 10% clay, very poorly sorted, subrounded to subangular, calcareous, some Mn accumulations, yellowish brown (10YR).	
-35					1290
				Clay: 30% sand, 5% gravel, matrix is moderately calcareous, highly calcareous inclusions/clasts (white) rimmed with Mn. Laminated Mn accumulations, pale brown (10YR) with brownish yellow oxidized areas, oxidation decreases with depth. Increasing calcareous gravel with depth, up to 10%, and up to 1 inch in length.	
				Sand: Fine to coarse, poorly sorted, loose, highly calcareous, subangular, lt gray (10YR)	
-40				Clay: as described above (34.4' - 39.4').	
					1285
				No Recovery:	
				Sand: fine to coarse grained, highly calcareous, poorly sorted, subrounded with some Mn, very pale brown (10YR). Sandy clay, non-calcareous inclusions (rip-up clasts from under-lying unit), light brownish gray (10YR), up to 1 " in length, rimmed with Manganese, wet.	
			128	Clay: non calcareous, light brownish gray (10YR) (like inclusions above).	
				Silty Clay: medium plasticity, highly calcareous, damp, brownish yellow (10YR).	
				Silty Clay: slightly calcareous, Mn accumulations, brownish yellow (10YR), with very fine grained, highly calcareous, light gray (10YR) sand inclusions.	
				Clayey Sand: 55% sand calcareous, brownish yellow (10YR), with sand inclusions, gravel to 1", inclusions very fine grained sand, highly calcareous, light gray (10YR) .	
-45					1280
				Clayey Silt: highly calcareous, Mn accumulations, brownish yellow (10YR).	
				Silty Clay: same as 43.4' to 44.5'.	
				No recovery:	
			17	Silty Clay: medium plasticity, Mn accumulations, yellowish brown (10YR), calcareous, moist, with sand lens at 50.8 to 51.1', very fine grained, non plastic, mottled light brownish gray (10YR), moist, highly calcareous accumulations throughout.	

Carbon tetrachloride in water sample = μg/L

SB01 Pg. 4

Depth	%	W.S. S.S.	LITHOLOGY	Elev
-50				1275
		ND	Silty Clay: medium plasticity, yellowish brown (10YR), calcareous, moist, with sand filling in areas of bioturbation; very fine grained, non plastic, light brownish gray (10YR) moist, highly calcareous inclusions throughout.	
-55				1270
			No Recovery:	
		ND	Clayey Silt: <5% sand, no gravel, medium plasticity, yellowish brown (10YR), highly calcareous (increasing), moist to damp. Marked decrease in sand inclusions described above.	
-60			Slough:	1265
			Silty Clay: med. plasticity, highly calcareous, gray- brn (10YR), damp, some silt laminations	
			Clayey Silt: 5% sand and small gravel, low plasticity, very highly calcareous, dark gray (10YR), damp. Transitional Zone.	
			Silty Clay: medium plasticity, highly calcareous, grayish brown (10YR), damp, with very fine sand inclusions, brownish-gray (10YR), moist, slightly mottled.	
			Clay: high plasticity, highly calcareous, dark gray (10YR), moist, with minor silt inclusions, highly calcareous, mottled.	
		ND	Silty Clay: medium plasticity, highly calcareous, dark grayish brown (10YR), damp, with very fine grained sand mottles, highly calcareous, light brownish gray (10YR). Silty sand lens at 63.5-64 feet, finely laminated.	
-65			Silty Clay: medium plasticity, very highly calcareous, dark brown (10YR), moist, laminated.	1260
			Clay: high plasticity, highly calcareous, dark grayish brown (10YR), moist.	

Carbon tetrachloride in water sample = μg/L

SB01 Pg. 5

Depth	%	W.S. S.S.		LITHOLOGY	Elev
			ND	Clay: high plasticity, highly calcareous, dark grayish brown (10YR), moist.	
				Slough:	
-70			ND	Silty Clay: medium plasticity, highly calcareous, dark grayish brown (10YR), damp. Very fine laminations of light and darker silty clay.	1255
				Slough:	
				Clayey Silt: low plasticity, highly calcareous, dark brown (10YR), moist.	
				Clay: very slightly silty, medium plasticity, highly calcareous, very dark gray (10YR), damp.	
-75			ND	Clayey Silt: low plasticity, very highly calcareous, dark grayish brown (10YR), damp.	1250
				Clay: very slightly silty, medium plasticity, highly calcareous, very dark gray (10 YR), damp.	
				Clayey Silt: low plasticity, highly calcareous, dark grayish brown (10 YR), damp to dry.	
-80				Clay: very slightly silty, medium plasticity, highly calcareous, very dark gray (10YR), damp.	1245
				Clayey Silt: low plasticity, very highly calcareous, silt is very coarse grained, dark grayish brown (10YR).	

Carbon tetrachloride in water sample = μg/L

SB01 Pg. 6

Depth	%	W.S. S.S.		LITHOLOGY	Elev
				Clay: very slightly silty, medium plasticity, laminated, highly calcareous, very dark gray (10 YR), damp.	
-85				Clay: as described above, wet.	1240
				Silty Sand: 90% sand, 10% silt, very fine grained, well sorted, sub-rounded, calcareous, dark gray (10YR), wet to saturated.	
				Silty Sand: 85% Sand, 15% Silt, very fine grained, well sorted, calcareous, faintly laminated, subrounded, dark gray (10YR), wet.	
				Silt: non-plastic, highly calcareous, laminated, light gray (10YR), damp, with minute laminae of light gray (10YR) very fine sand, > 85% very fine grained, sub angular, calcareous, damp.	
			ND	Slough: saturated	
				Silty Sand: 85% sand, subrounded, non plastic, moderately calcareous, dark gray (10YR) wet to saturated.	
				Silt: non-plastic, laminated, moderately calcareous, dark gray (10YR), wet.	
-90				Silt: non-plastic, laminated, moderately calcareous, dark gray (10YR), damp. Thin laminae composed of very fine sand.	1235
				Slough: saturated	
				Clayey Sand: 70% sand, plastic, subrounded, moderately calcareous, dark gray (10YR), saturated.	
-95				Clay: calcareous, very dark gray (10 YR), damp. Calcareous gravel and sand increases with depth to 5%. Sand inclusion - very fine grained, very dark gray (10YR), 2" in length, increasingly calcareous with depth.	1230

Carbon tetrachloride in water sample = μg/L

SB01 Pg. 7

Depth	%	W.S. S.S.	LITHOLOGY	Elev
-100			Slough:	1225
			Clay: as above (96-100 ft).	
-105			Clay: as above, but much less calcareous, very dark gray (10YR), damp. A few sand inclusions at 104 to 105 ft.; fine grained, >90% sand, highly calcareous, dark gray (10YR).	1220
-110				1215
-115				1210

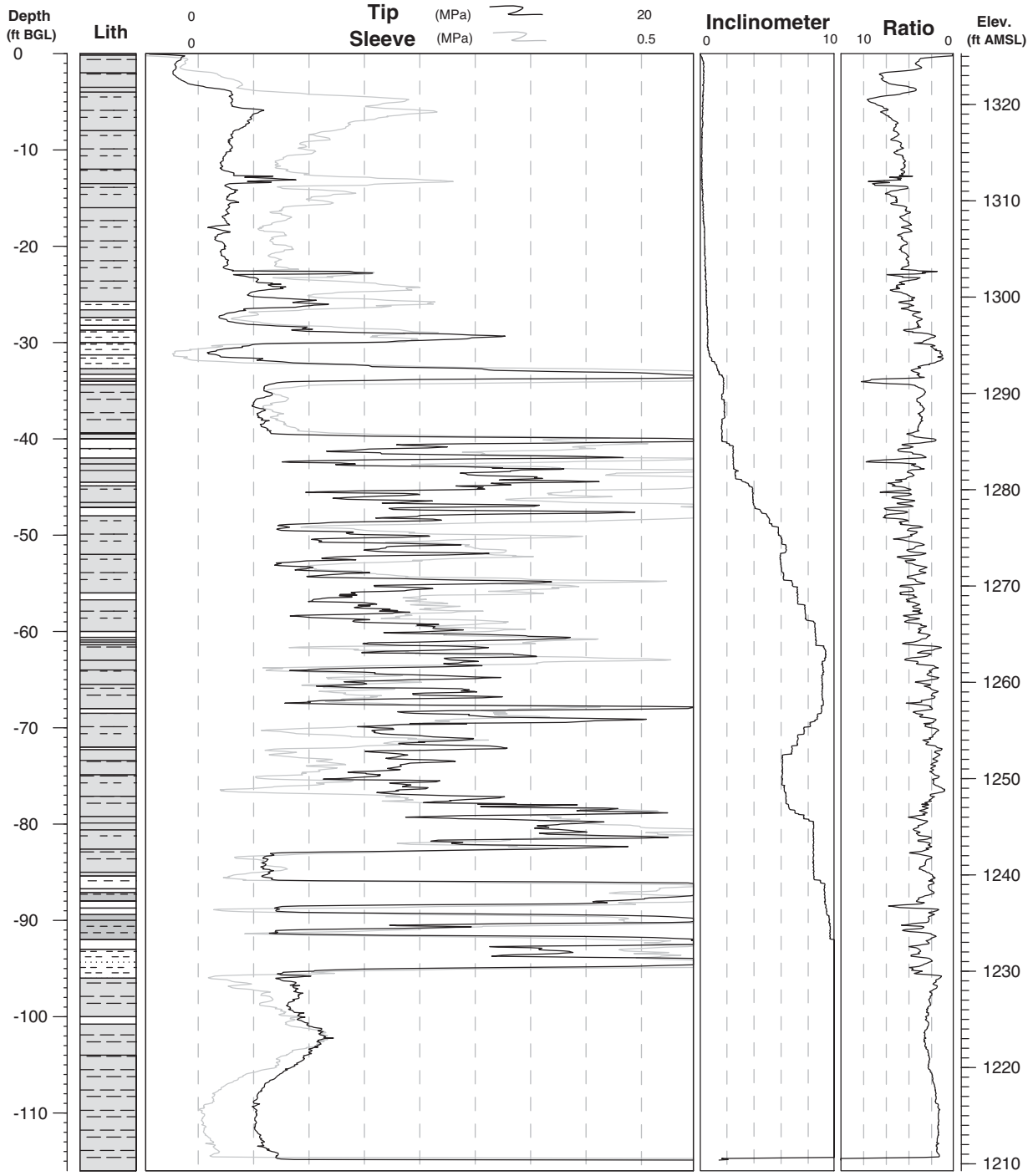
Argonne National Laboratory

Project: Centralia, KS **Boring ID:** SB01

Elevation: 1325.3 ft
Depth: 116 Feet
Geologist: L. LaFreniere/ Boulding
Location: 1838925, 514989

Log Date: Mar 21-23, 2002
Plot Date: Mar 23, 2002

Rig: CPT - VdB
Driller: T. Hinz
Company: ASW



Argonne National Laboratory **Well ID: SB02**

Project **Centralia, KS** **Elevation:** 1326.8 ft **Log Date:** Mar 21, 2002 **Rig:** CPT - 40T
Geologist: L. LaFreniere **Total Depth:** 46 ft **Driller:** R. Christensen **Drilling Company:** ASW
Location: 1838955, 515052 **Core Description:** from -38' to 46'

LITHOLOGY DESCRIPTION

Depth (ft BGL)	% Rec	S.S. / W.S.	CCl_4	Lithology description	Elev (ft AMSL)
-35				No Sample: Sampling begins at 38 ft.	1290
				No Recovery: (Mixed slough/sand)	
-40				Clay: <10% sand and granules, subangular, high plasticity, very slightly calcareous, light brownish gray (10YR), moist.	
				Clay: transitional zone, as above with slight oxidation.	
				Clayey Sand: 50-60% sand & granules, (<5 % granules & fine gravel); v. coarse to med. grained, poorly sorted, plastic,slightly calcareous, brownish yellow (10YR), with yellowish red (5YR) iron accumulations (5YR), and bleached lenses of light gray (10YR), moist.	1285
				Clayey Sand: 70-75%sand, <5% gravel, pebbles to 1" in length; calcareous, Mn coatings, medium to very coarse, poorly sorted, dark yellowish brown (10YR), moist.	
				No Recovery:	
				Sand: 90% medium to coarse sand, loose, coarsening upwards sequence; very calcareous; yellowish brown (10YR), wet.	
-45				Clayey Sand: 80% sand/ thin laminae of clay (<1 mm thick), predominantly medium grained, some fine grained, very calcareous, yellowish brown (10YR).	

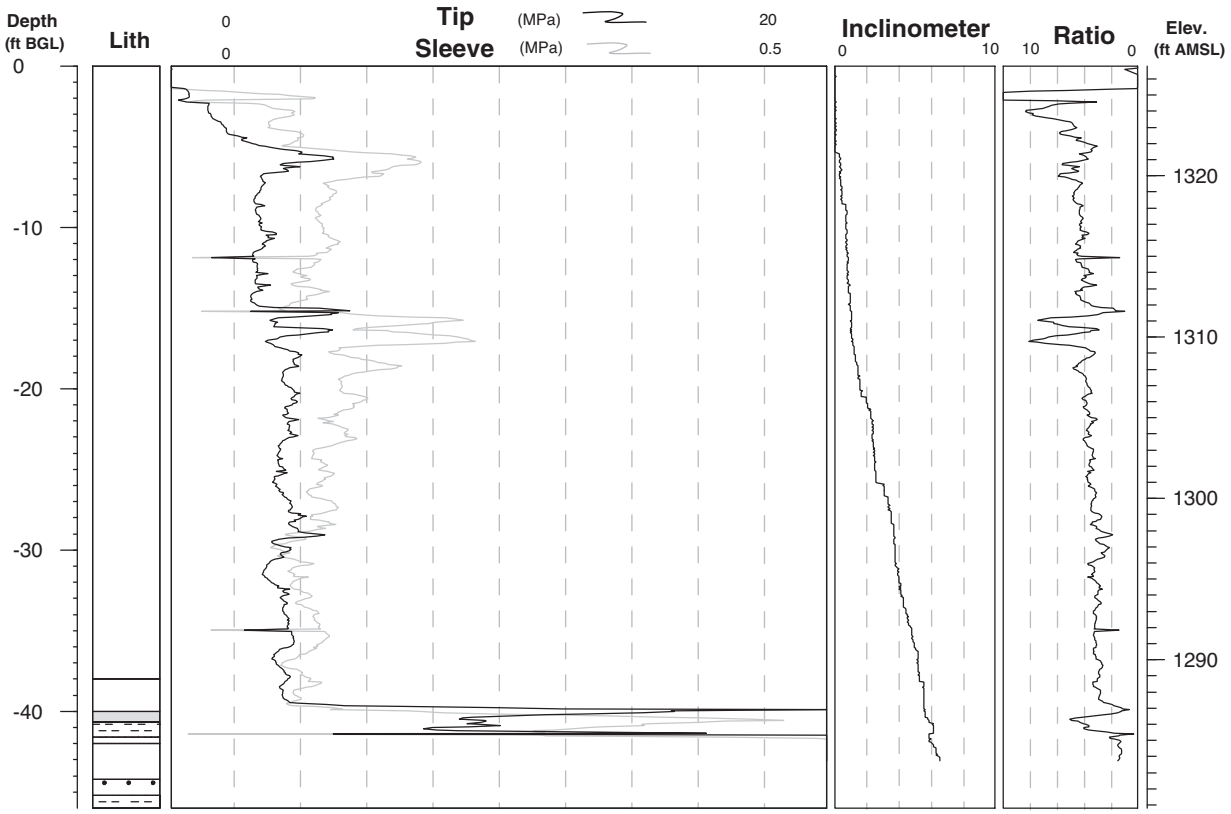
Argonne National Laboratory

Project: Centralia, KS **Boring ID:** SB02

Elevation: 1326.8 ft
Depth: 46 Feet
Geologist: L. LaFreniere
Location: 1838955, 515052

Log Date: Mar 21, 2002
Plot Date: Mar 21, 2002

Rig: CPT - 40T
Driller: R. Christensen
Company: ASW



Argonne National Laboratory **Well ID: SB03**

Project: Centralia, KS **Elevation:** 1333.11 ft **Log Date:** Mar 25, 2002 **Rig:** CPT- VdB
Geologist: L. LaFreniere **Total Depth:** 91.3 ft **Driller:** T. Hinz **Drilling Company:** ASW
Location: 1839171, 515299 **Core Description:** from 41.5' to 64.3'

Depth (ft BGL)	% Rec	S.S. / W.S.	CCl_4	LITHOLOGY DESCRIPTION	Elev (ft AMSL)
-40				No Sample: No sample from 0 to -41.5 ft	
				Clay: 25% sand, 15% small gravel, poorly sorted, high plasticity, moderately calcareous, small Fe inclusions associated with concentrations of sand, small limestone nodules scattered throughout, no obvious sedimentary structures, pale brown (10YR), damp. Gravel, well-rounded, to 2 cm in length; sandy till sequence.	1290
-45				No Sample:	

SB03 Pg. 2

Depth	%	W.S. S.S.	LITHOLOGY	Elev
				1285
-50				
				1280
			Silty Clay: 20% sand, fine to medium grained, calcareous, small weathered Fe nodules, medium plasticity, calcareous, yellowish brown (10YR), moist, with sand (90% very fine grained), non plastic, light brownish gray (10YR), moist, highly calcareous mottling. Till.	
			Clayey Sand: 70% sand, medium grained, plastic, moderately calcareous, oxidized, brownish yellow (10YR), wet. Till.	
-55			Silty Clay: as above (54-54.6')	
			Sand: 100% medium to coarse grained, subrounded to sub angular, highly calcareous, loose, brownish yellow (10YR), wet.	
			Silty Clay: 30% sand, fine to medium grained, calcareous, small weathered Fe and Mn nodules, medium plasticity, yellowish brown (10YR), moist, with very fine to medium grained sand inclusions, non-plastic, light brownish gray (10YR), highly calcareous. Till.	
		ND	Sand: 90 % sand, medium to very coarse grained, sub angular (quartz), loose, highly calcareous brownish yellow (10YR), wet.	

Carbon tetrachloride in water sample = μg/L

SB03 Pg. 3

Depth	%	W.S. S.S.		LITHOLOGY	Elev
		ND			
				Clayey Sand: 70% Sand, medium to coarse grained, subrounded (quartz), calcareous, brownish yellow (10YR), wet. Till.	
				No Sample:	1275
-60					
				Slough:	
				Silty Clay: 30% sand, fine to medium grained, calcareous, small Fe and Mn weathered nodules, medium plasticity, yellowish brown (10YR), moist, with very fine to medium grained sand inclusions, non plastic, light brownish gray (10YR), moist, highly calcareous. Till.	1270

Carbon tetrachloride in water sample = μg/L

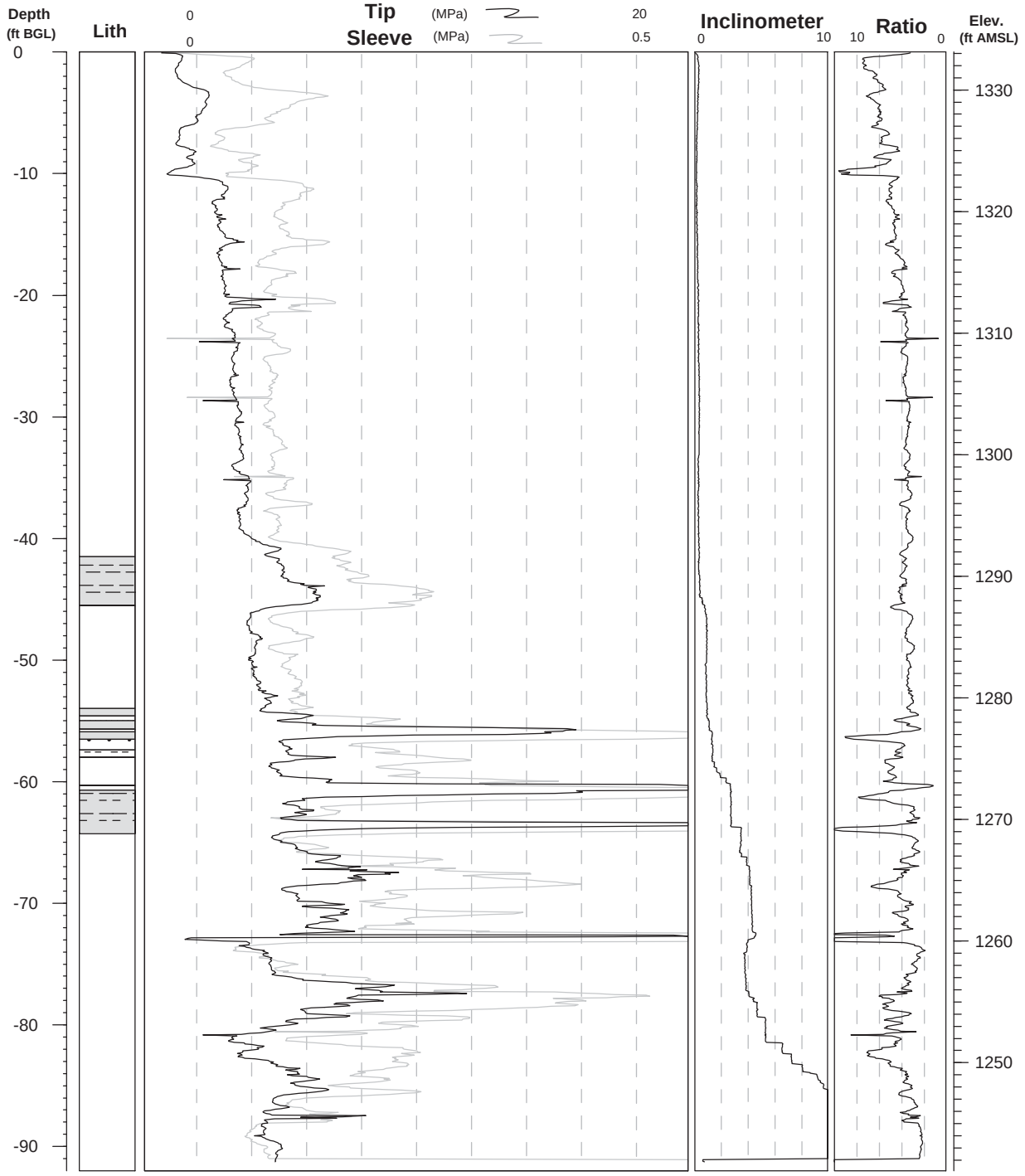
Argonne National Laboratory

Project: Centralia, KS **Boring ID:** SB03

Elevation: 1333.11 ft
Depth: 91.3 ft
Geologist: L. LaFreniere
Location: 1839171, 515299

Log Date: Mar 25, 2002
Plot Date: Mar 25, 2002

Rig: CPT- VdB
Driller: T. Hinz
Company: ASW



Argonne National Laboratory

Well ID: **SB04**

Project: **Centralia, KS** **Elevation:** 1336.08 ft **Log Date:** Mar 24, 2002 **Rig:** CPT - 40T
Geologist: L. LaFreniere **Total Depth:** 127.23 ft **Driller:** R. Christensen **Drilling Company:** ASW
Location: 1839195, 514978 **Core Description:** from -48.3' to -65.4'

Depth (ft BGL)	% Rec	S.S. / W.S.	CCl_4	LITHOLOGY DESCRIPTION	Elev (ft AMSL)
-45				No Sample: No Sample from 0 to -48.3 ft	
					1290
				Silty Clay: 40% sand, 5% gravel, medium plasticity, calcareous matrix, grayish brown (10YR), damp. Calcareous white weathering carbonate cemented inclusions (small) scattered throughout. Strong Mn present, large weathered calcareous nodule (possibly limestone) 2.5" in length, zones of porosity associated with sandier lenses.	
				Silty Clay: as described above with decrease in Mn. Gravel to 1.5" in length near base of interval. Fe oxide associated with large gravel clasts.	
-50					
					1285

Carbon tetrachloride in water sample = μg/L

SB04 Pg. 2

Depth	%	W.S. S.S.	LITHOLOGY	Elev
			Silty Clay: 30% sand, <5% gravel, fine to medium grained sand, subangular, fairly well sorted, moderately plastic, calcareous, Mn, grayish brown (10YR) becomes pale brown (10YR) at base of interval, damp.	
			Clayey Sand: 90% sand, <3% gravel, medium to very coarse grained, subrounded, poorly sorted, plastic, calcareous, FeOxide, weathered, yellowish brown (10YR), wet. Top transitional zone.	
		<5	Clayey Sand: 90% sand, <3% gravel, fine to coarse grained, subrounded, fairly well sorted, calcareous, FeOxide, yellowish brown, wet with silty clay clasts, medium plasticity, calcareous, light yellowish brown (10YR), moist. Transitional zone.	
-55			Silty Clay: 35% sand, <3% gravel, fine to medium sand, poorly sorted, subrounded, Mn staining throughout, light brownish gray (10YR) matrix clay/stained with Mn to yellowish brown (10YR), dry to damp. Transitional zone.	
			GRAVELLY SAND: 85% sand and granules, 10% gravel, medium to coarse grained sand, subrounded, very poorly sorted, very highly calcareous, with clay clasts, high plasticity, highly calcareous, wet. Gravel to 3/4 in. in length (pink quartzite).	1280
			Slough: Limited recovery, probably as described above.	
		33	Sand: 90% sand, medium to very coarse sand, very poorly sorted, subrounded grains, yellowish brown (10YR), calcareous, wet.	
			Clayey Sand: 85% sand and granules, fine to very coarse sand, subrounded, very poorly sorted, plastic, highly calcareous, yellowish brown (10YR), wet.	
			GRAVELLY SAND: 80% sand, 15% gravel and granules, very poorly sorted, loose, highly calcareous fine to coarse sand subrounded to subangular yellowish brown (10YR), wet. Glacio-fluvial sequence.	

Carbon tetrachloride in water sample = µg/L

SB04 Pg. 3

Depth	%	W.S. S.S.	LITHOLOGY	Elev
			(GRAVELLY SAND)	
			Silty Clay: 40% sand, subrounded, medium grained, medium plasticity, light brownish gray (10YR), damp.	
			GRAVELLY SAND: 75% sand, 15% granules and gravel, gravel to 1.5" in length, pink quartzite, highly calcareous, minor matrix clays, loose, yellowish brown (10YR), wet. Glacio-fluvial sequence.	
-60			Clayey Sand: 65% sand, 15% gravel, very poorly sorted - sub-angular to sub-rounded grave. Sand is sub-rounded, plastic; manganese rims on oxidized silt clasts (small), gravels sub-angular to 3/4 " in length, calcareous, wet. Glacio-fluvial sequence.	
			Organic material.	
			Clayey Sand: 60% sand, 15% gravel and granules, very poorly sorted, sub-angular; sand is medium to very coarse grained, very poorly sorted, subrounded quartz grains, basal gravel cobble 4 cm in length and width of fossiliferous limestone, yellowish brown (10YR), wet.	
			Clayey Silt: low plasticity, calcareous, brownish yellow (10YR), damp to moist.	1275
			No recovery:	
		28	Clayey Silt: plastic, calcareous, light yellowish brown (10YR), saturated.	
-65			Silty Sand: 85% sand, non plastic, highly calcareous, very fine grained, well sorted, subrounded, light yellowish brown (10YR), saturated.	

Carbon tetrachloride in water sample = μg/L

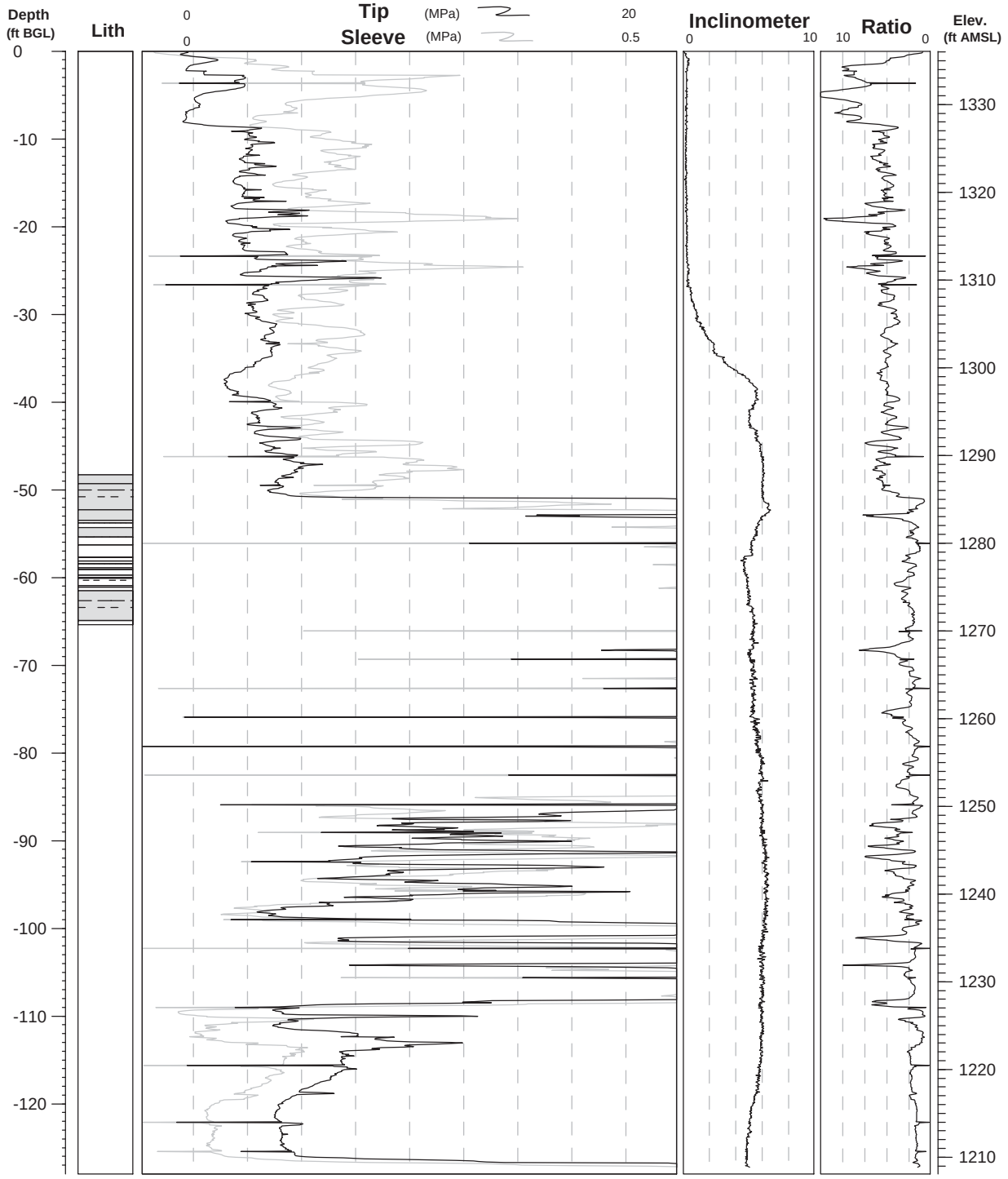
Argonne National Laboratory

Project: Centralia, KS **Boring ID:** SB04

Elevation: 1336.08 ft
Depth: 127.23 ft
Geologist: L. LaFreniere
Location: 1839195, 514978

Log Date: Mar 24, 2002
Plot Date: Mar 27, 2002

Rig: CPT - 40T
Driller: R. Christensen
Company: ASW



Argonne National Laboratory

Well ID: **SB05**

Project: **Centralia, KS** **Elevation:** 1321.6 ft **Log Date:** Mar 23, 2002 **Rig:** Geoprobe
Geologist: Boulding/Kulla/Yan **Total Depth:** 45.53 ft **Driller:** T. Hinz **Drilling Company:** ASW
Location: 1838885, 515105 **Core Description:** from -26' to -39'

Depth (ft BGL)	% Rec	S.S. / W.S.	CCl_4	LITHOLOGY DESCRIPTION	Elev (ft AMSL)
-25				No Sample: No Sample from 0 to -26 ft	
				Silty Clay: trace granules, pebbles up to 10mm, yellowish brown (10YR), medium plasticity, dry. Numerous Fe and Mn accumulations, moderately calcareous.	1295
				Clay: grayish brown (2.5YR), high plasticity, dry, scattered pebbles up to 5mm. Some Fe, Mn accumulation, slightly calcareous.	
-30				Clay: as above, grayish brown (10YR), scattered FeOxide, moist.	1290
				Silty Clay: minor (<10%) sand and rock fragments, some Fe and Mn inclusions, yellowish brown to pale gray (10YR), damp. Limited recovery.	
				No recovery:	

SB05 Pg. 2

Depth	%	W.S. S.S.	LITHOLOGY	Elev
-35		82	Silty Clay: increase in sand and rock fragments and granules from above (10%), angular to subrounded, light gray (10YR), moist to damp.	
			Silty Clay: as above, with increase in iron staining, medium yellowish brown (10YR), moist.	1285
			Silty Sand: very silty and clayey, 60 to 80% very fine to fine, increasing sand size at 38 feet, medium brown (10YR), wet at 37.4 ft.	
		122	Sand: 85% coarse to very coarse sand, 5% granules, well sorted, rounded to sub-rounded, slightly to moderately calcareous, yellowish brown (10YR), wet.	

Carbon tetrachloride in water sample = μg/L

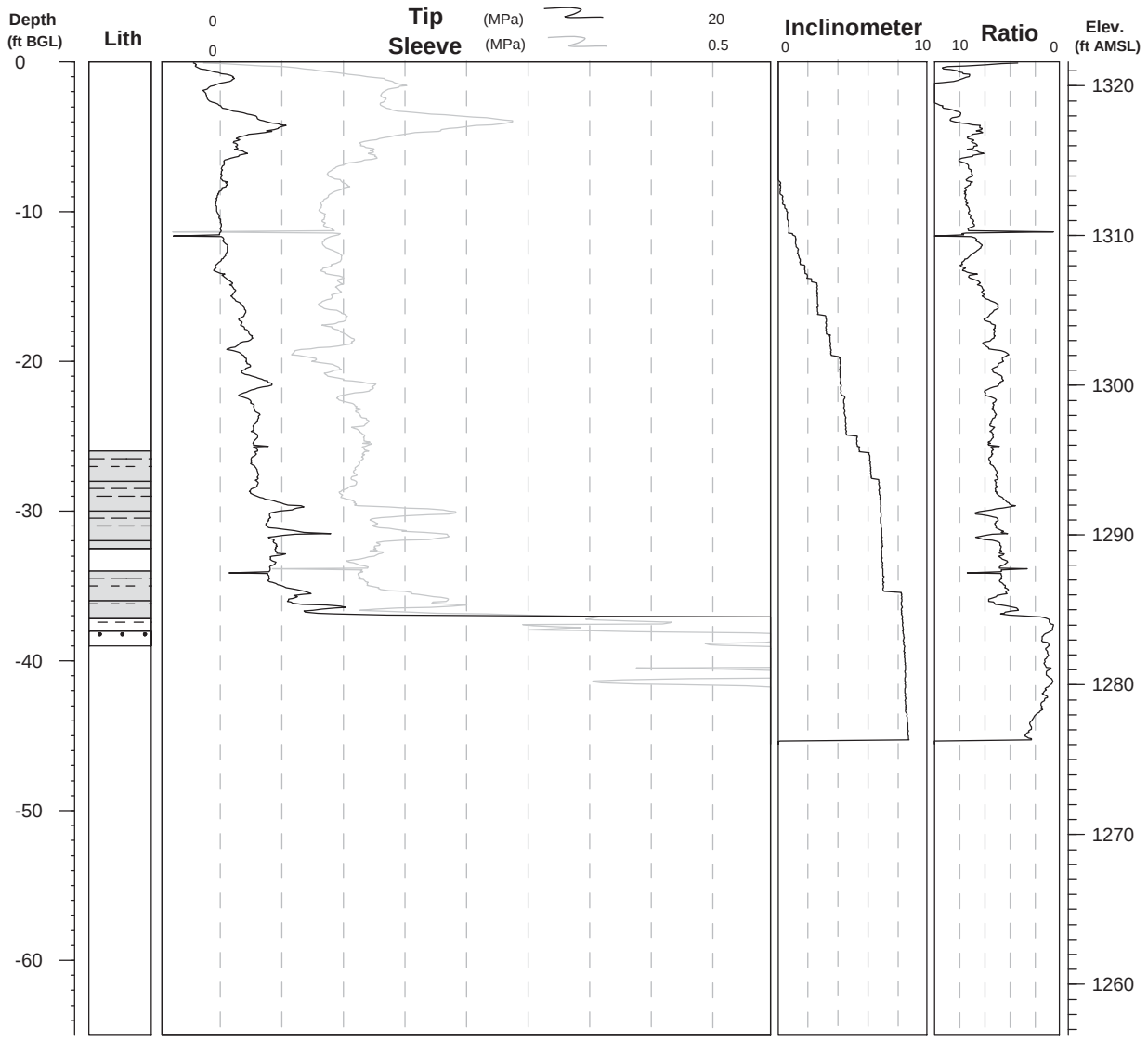
Argonne National Laboratory

Project: Centralia, KS **Boring ID:** SB05

Elevation: 1321.6 ft
Depth: 45.53 ft
Geologist: Boulding/Kulla/Yan
Location: 1838885, 515105

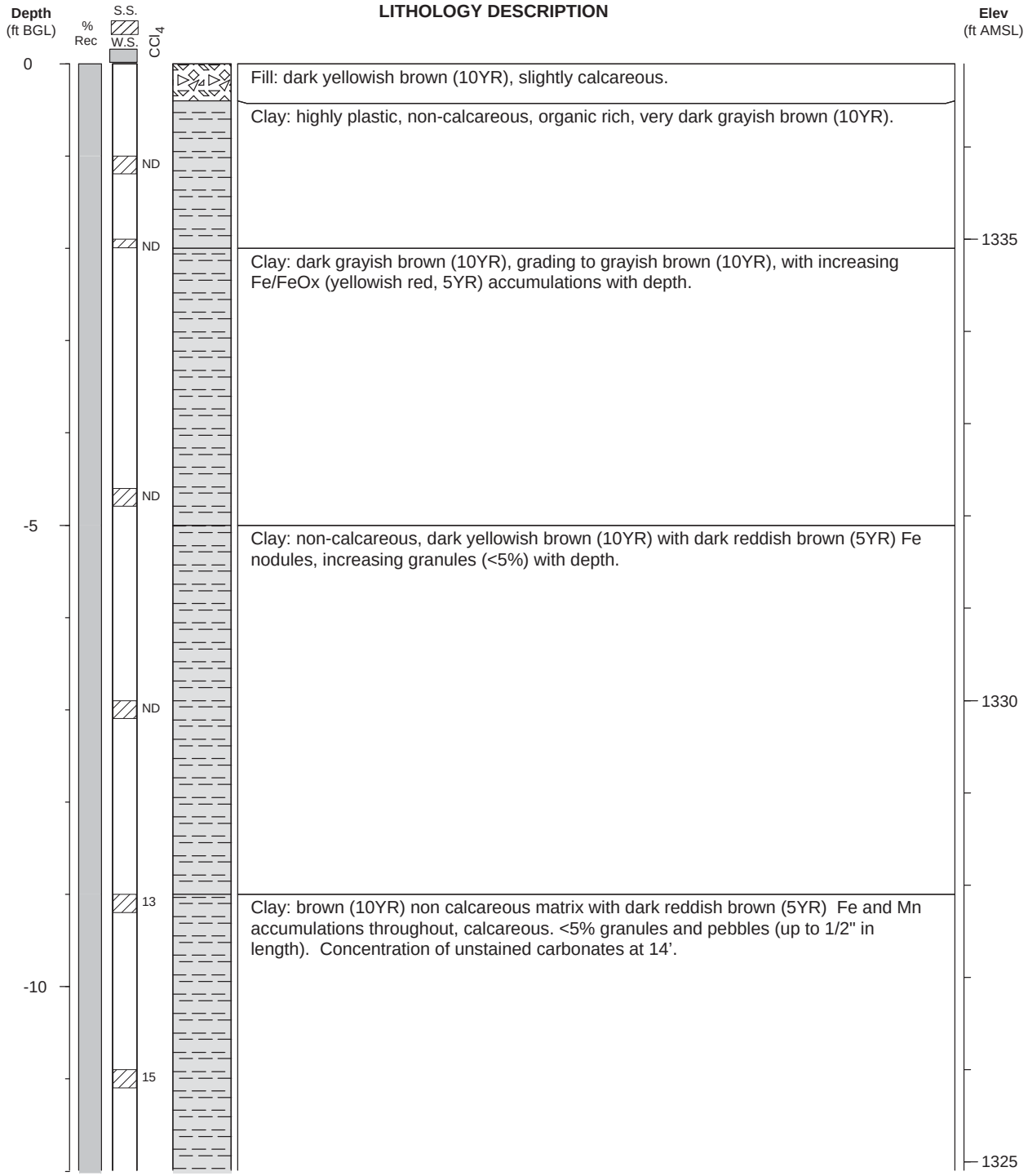
Log Date: Mar 23, 2002
Plot Date: Mar 23, 2002

Rig: Geoprobe
Driller: T. Hinz
Company: ASW



Argonne National Laboratory **Well ID: SB06**

Project: Centralia, KS **Elevation:** 1336.9 ft **Log Date:** Apr 4, 2002 **Rig:** CPT- 40T
Geologist: Boulding/Becker **Total Depth:** 92 ft **Driller:** R. Christensen **Drilling Company:** ASW
Location: 1839202, 515093 **Core Description:** Cored to -92 ft



Carbon tetrachloride in soil sample = µg/kg

SB06 Pg. 2

Depth	%	W.S. S.S.	LITHOLOGY	Elev
		10		
-15		21		
		33		1320
		18		
-20		15	Silty Clay: <5% granules, matrix slightly calcareous, heavily Mn stained (very dark gray 10YR), some FeOx accumulations, carbonate nodules up to 1.5 in in length. Dark yellowish brown (10YR) matrix, light brownish gray (10YR) redox depletions.	1315
		115		
-25		ND	Silty Clay: 15% gravel and granules (up to 3/4 in), 5% very coarse sand, some weathered sandstone pebbles, calcareous, abundant Fe, Mn staining, grayish brown (10YR).	

Carbon tetrachloride in soil sample = μg/kg

SB06 Pg. 3

Depth	%	W.S. S.S.	LITHOLOGY	Elev
		135		1310
			Caliche: cemented, highly calcareous zone.	
			Silty Clay: as above (25-27.7 feet). 15-20% gravel, granules and very coarse sand, grayish brown (10YR).	
		113	Silty Clay: 10% gravel and granules. moderately to strongly calcareous, trace iron stains (much less than above), grayish brown (10YR).	
-30				
		68		1305
		26	Clay: 5% gravel and granules, numerous Mn, FeOx accumulations (strong brown 7.5 YR), moderately to strongly calcareous, dark brown (7.5 YR). Extensive carbonate accumulations at 38.2-38.3 and 39.6-40 feet.	
-35		16		
		12		1300
		ND		

Carbon tetrachloride in soil sample = μg/kg

SB06 Pg. 4

Depth	%	W.S. S.S.	LITHOLOGY	Elev
-40				
		<5	Silty Clay: 5-10% granules, moderately calcareous, occasional FeOx accumulations, light grayish brown (10YR), damp.	1295
		ND		
-45		ND		
		ND	Clay: < 5% granules, light grayish brown (10YR), slightly calcareous, trace Fe staining, moist.	1290
		ND	Clay: as above, with 15% gravel and granules, FeOx zone at 51.5-51.6 feet. Moist to wet.	
-50		ND		1285
		ND	Clay: as above, with heavy FeOx staining. Moist to wet.	

Carbon tetrachloride in soil sample = μg/kg

SB06 Pg. 5

Depth	%	W.S. S.S.	LITHOLOGY	Elev
			(Clay)	
-55		ND	Clay: as between 49 and 53 feet.	
			Sandy Gravel: 45% gravel, 40% sand, highly calcareous, poorly sorted, sub-angular to sub-rounded, yellowish brown (10YR).	1280
		7.4	No Recovery:	
			Clayey Sand: 70% sand and granules, coarse to very coarse, rounded to sub-rounded, calcareous, well sorted, yellowish brown, (10YR), wet.	
			Silty Sand: 80% very fine sand, very slightly calcareous, very fine laminations (<1 mm thick), some reduced, some oxidized laminations, yellowish brown (10YR).	
-60			Sand: 85% medium to coarse sand, trace gravel, well sorted, rounded to sub-rounded, slightly to moderately calcareous, yellowish brown (10YR), wet.	
			No Recovery:	1275
		51	Sand: as above (60-61 feet), except predominately medium sand. Silty clay layer at 63.9 to 64.2 feet, wet.	
			Silty Sand: 70% very fine sand, well sorted, rounded to subrounded, slightly to moderately calcareous, finely laminated, yellowish brown (10YR), wet.	
			Sand: as 60-61 above, except predominately medium sand, wet.	
-65			No Recovery:	1270

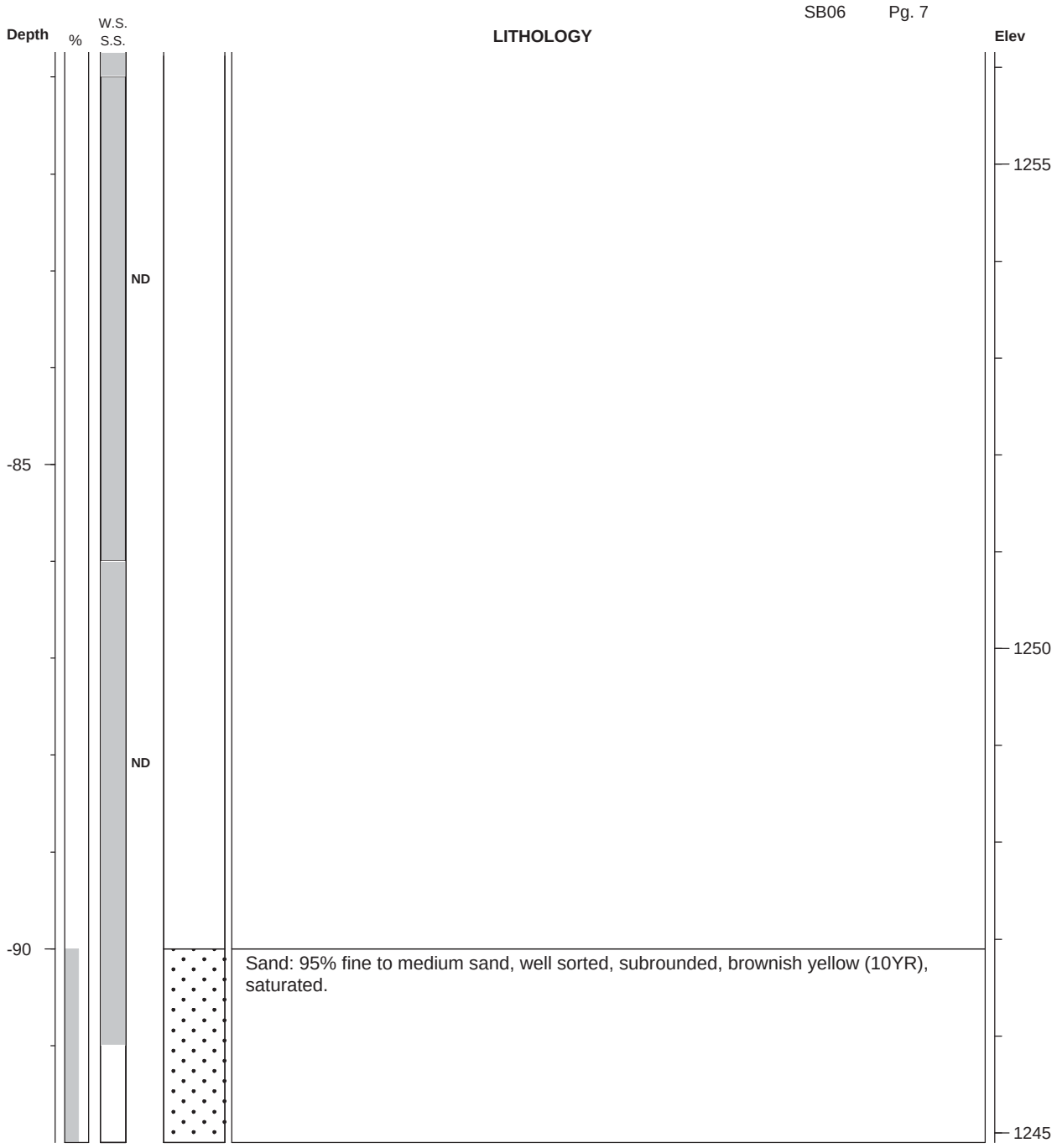
Carbon tetrachloride in soil sample = μg/kg
Carbon tetrachloride in water sample = μg/L

SB06 Pg. 6

Depth	%	W.S. S.S.	LITHOLOGY	Elev
		16	Sand: 85% medium to very coarse sand, < 5% granules, well sorted, rounded to subrounded, slightly to moderately calcareous, yellowish brown (10YR), wet.	
			Silty Sand: 80% fine to medium sand, well sorted, sub-rounded, strongly calcareous, dark brown (7.5 YR), wet. End of coring.	
-70			No Sample:	
				1265
		<5		
-75				
			Sand: 95% fine sand, well sorted, subrounded, calcareous, brownish yellow (10YR), wet.	
				1260
		ND	No Sample:	
-80				

Carbon tetrachloride in water sample = μg/L

SB06 Pg. 7



Carbon tetrachloride in water sample = μg/L

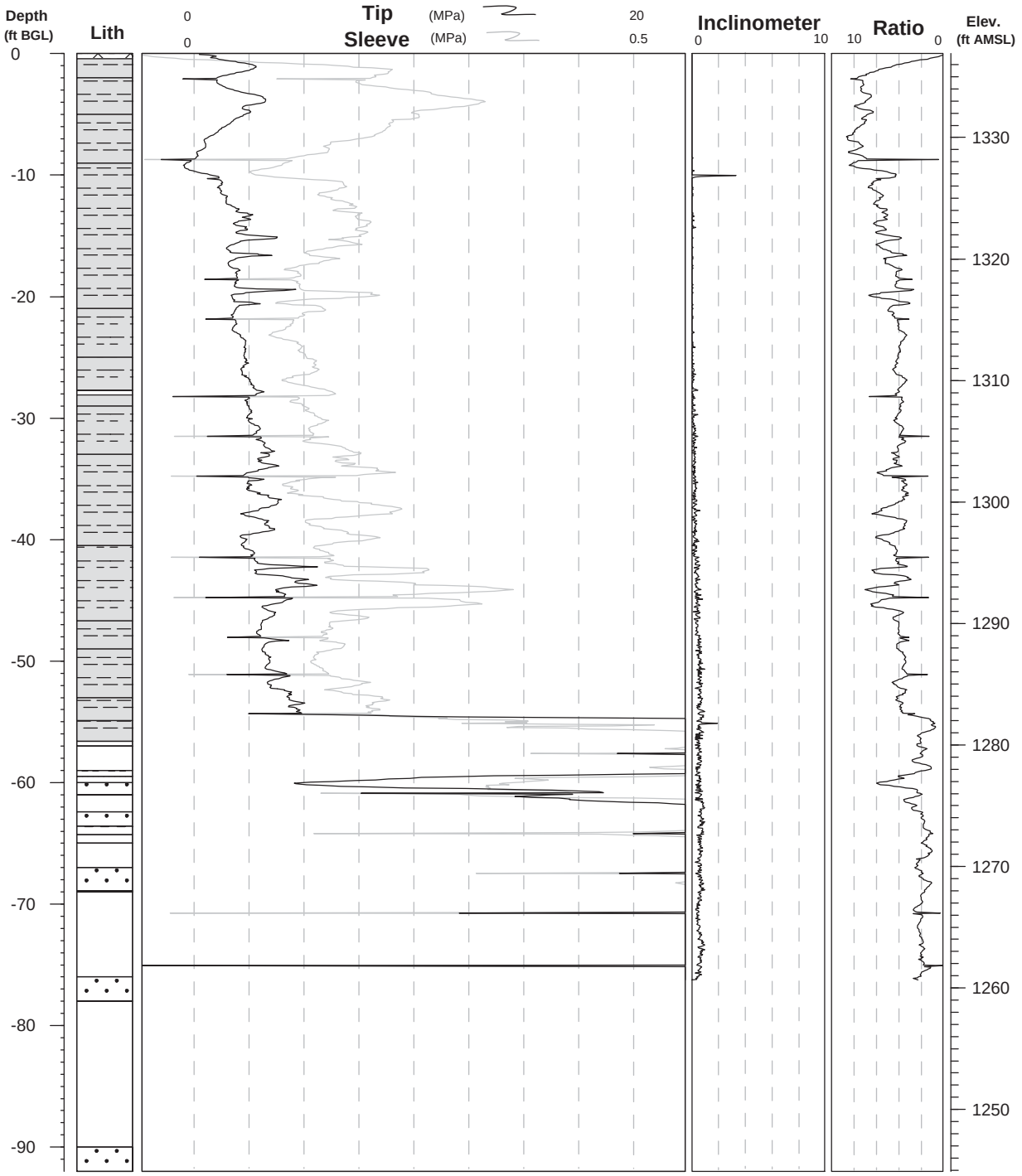
Argonne National Laboratory

Project: **Centralia, KS** **Boring ID:** **SB06**

Elevation: 1336.9 ft
Depth: 92 ft
Geologist: Boulding/Becker
Location: 1839202, 515093

Log Date: Apr 4, 2002
Plot Date: Apr 4, 2002

Rig: **CPT- 40T**
Driller: R. Christensen
Company: ASW



Argonne National Laboratory

Well ID: **SB07**

Project: **Centralia, KS** **Elevation:** 1333.5 ft **Log Date:** Apr 7, 2002 **Rig:** CPT - 40 Ton
Geologist: L. LaFreniere **Total Depth:** 124.80 ft **Driller:** R. Christensen **Drilling Company:** ASW
Location: 1839068, 515056 **Core Description:** from -46' to -80.5'

LITHOLOGY DESCRIPTION

Depth (ft BGL)	% Rec	S.S. / W.S.	CCl_4	Elev (ft AMSL)
-45				
				No Sample: No sample from 0 to -46.0 ft
				Silty Clay: 10% sand, 5% white calcareous granules, well sorted sand, sub-angular, fine to medium grained, medium plasticity, calcareous, grayish-brown (2.5 YR), damp.
				Silty Clay: 20% sand, 5% white calcareous granules, very coarse grained, sub-angular to sub-rounded, minor MN, highly calcareous, grayish-brown (2.5 YR), poorly sorted. (Increased sand content from above).
				Silty Clay: 15% sand, 5% gravel (well-rounded), medium grained, sub-angular, poorly sorted, medium plasticity, highly calcareous, dark yellowish brown (10 YR), (increase in silt content, oxidized) damp/dry with clayey sand, well sorted, v. fine to fine grained, well sorted, sub-angular-sub-rounded, very highly calcareous, no oxidation, light gray (10 YR), damp inclusions. (Basal contact zone <1/4 inch sand-highly oxidized).
			6.4	Silty Sand: 85% sand, no gravel, very fine grained (sucrosic), well sorted, sub-angular, non-plastic, highly calcareous, oxidized, brownish-yellow, damp.
				Clayey Silt: 10-15% sand, low plasticity, calcareous, FeO2, yellowish-brown (10 YR), damp. Sand is very, very fine grained, well-sorted, calcareous, yellowish-brown (10 YR) damp, with minor inclusion (small) of clayey sand. 85% sand, calcareous, well sorted, sub-angular, fine to medium grained, light gray, damp. (FeO2 throughout some appears as vertical microfracture fills.)
				1285
-50				
				Clayey Silt: 10% sand, very, very fine grained, well sorted, low plasticity, calcareous, Fe and MN, yellowish-brown (10YR) moist. (Possibly extremely fine sand).
			NS	Clayey Silt: 10% sand, 5% small granules, poorly sorted, sub-angular sand, low plasticity, calcareous, MN, yellowish-brown (10 YR), moist with small inclusions of sucrosic sand, light gray (10 YR), damp, well sorted, calcareous. Possible layering of sand, with alternating MN and clayey silt - slight increase in clay content with depth.
				1280

Carbon tetrachloride in water sample = μg/L

SB07 Pg. 2

Depth	%	W.S. S.S.	LITHOLOGY	Elev
			No Core Taken:	
-55		ND		
				1275
-60		NS		

Carbon tetrachloride in water sample = μg/L

SB07 Pg. 3

Depth	%	W.S. S.S.	LITHOLOGY	Elev
				1270
-65		ND		
				1265
-70		ND		
			Clayey Silt: Calcareous, low plasticity, Fe oxidation, yellowish-brown (10 YR), trace Mn, light gray (10 YR) depletions, moist.	

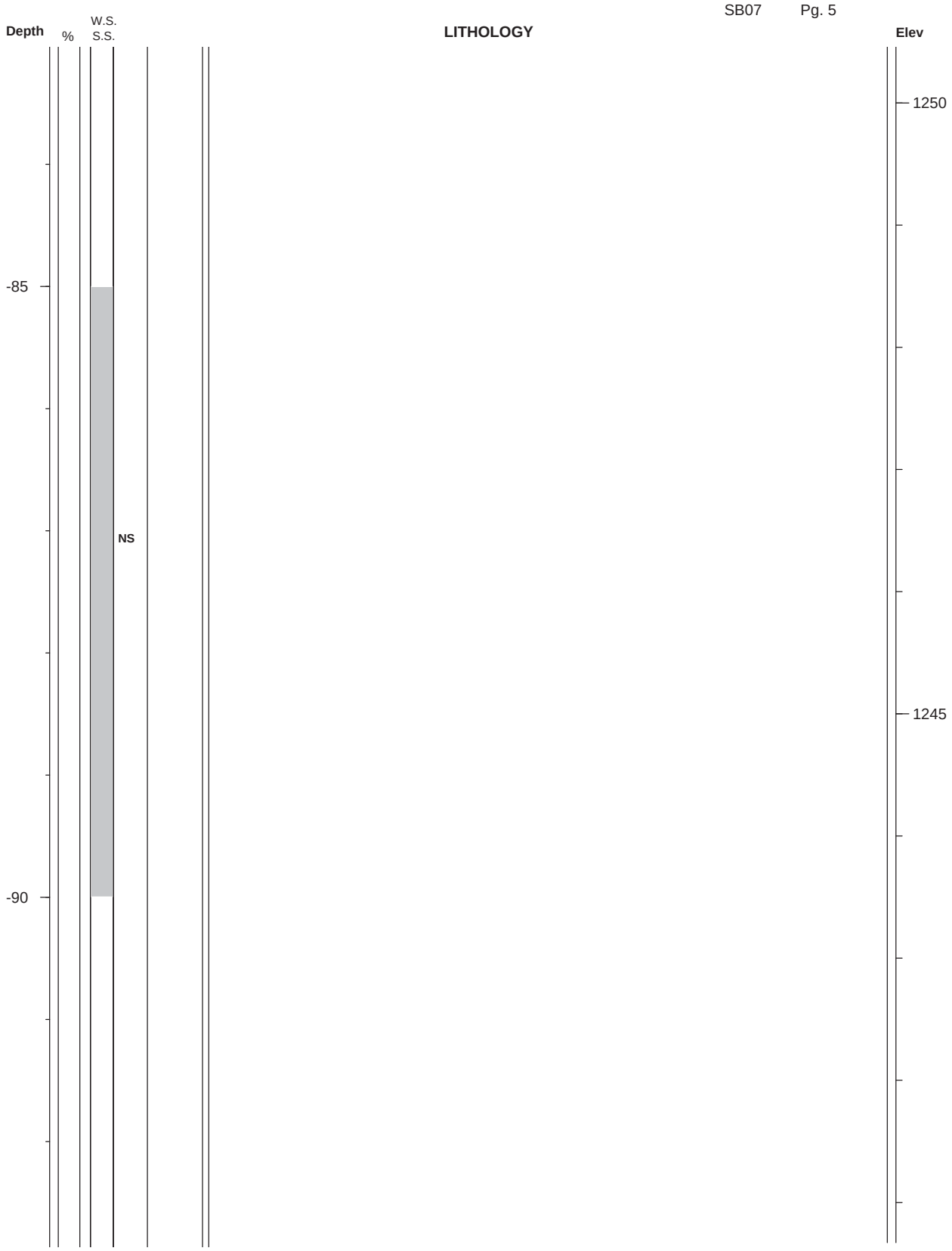
Carbon tetrachloride in water sample = µg/L

SB07 Pg. 4

Depth	%	W.S. S.S.		LITHOLOGY	Elev
					1260
				Clayey Silt: Low plasticity, calcareous, Fe oxide yellowish-brown (10 YR), with single large (2" long) rip-up clast, damp to dry. Clast very dark gray (10 YR) silty clay, calcareous with large areas of sucrosic sand (very fine), light gray, damp, well sorted. Coarse silt section has large areas of light gray (10 YR) sucrosic sand - possible "Bleached Area"- per Russ Boulding.)	
-75					
			NS	Silty Clay: Medium plasticity, calcareous, very dark gray (10 YR), dry, waxy appearance. (Waxy appearance possible horizontal microfracture-pushing artifact)	
				Sand: 85%, Highly calcareous, clay matrix, well sorted, sub-rounded, loose, pale brown (10 YR), damp.	
				Silty Clay: Medium plasticity, calcareous, gray (10 YR) damp with minor small "rip-up" clasts of silty clay (very dark gray (10 YR)), calcareous, dry. (Trace of small inclusions in dark gray clasts as described in section 76.0-76.3 ft).	
				Clayey Silt: Low plasticity. Highly calcareous, yellowish-brown (10 YR), moist with small clasts of silty clay, calcareous, very dark gray (10 YR) and dry, small, very dark gray (10 YR), calcareous, "rip-up" clasts with MN depletion rims. (Most prominent near upper contact interval).	
				Transitional zone: Between possible scour surface and overlying clayey silt as described above. Manganese depletion rims along contact with unit described below. Small "rip-up" clasts present indicative of erosion of underlying zone and incorporation into overlay clayey silt.	1255
				Silty Clay: Medium plasticity, calcareous, very dark gray, waxy appearance, crumbly in parts, damp/dry.	
-80					

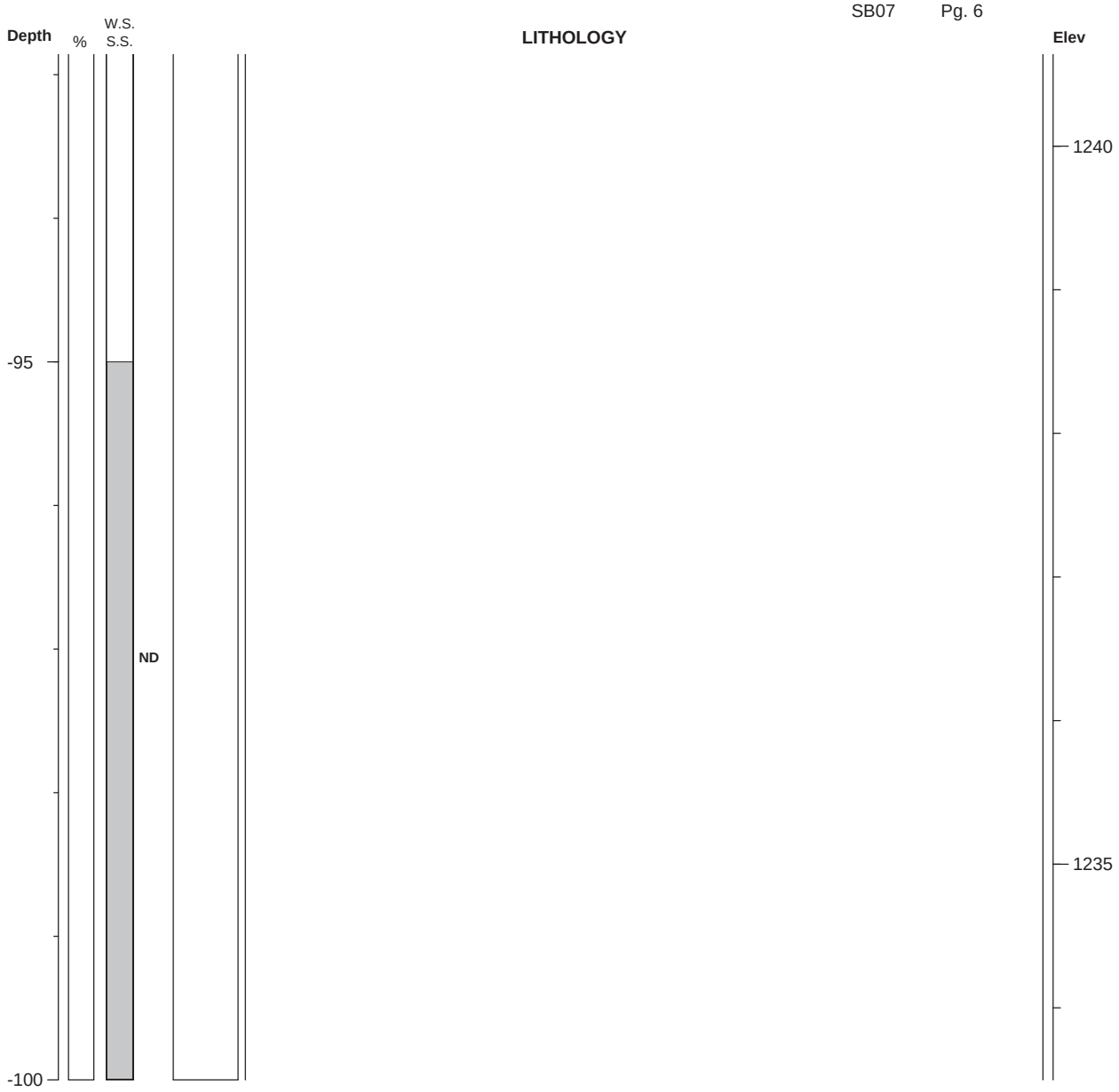
Carbon tetrachloride in water sample = μg/L

SB07 Pg. 5



Carbon tetrachloride in water sample = μg/L

SB07 Pg. 6



Carbon tetrachloride in water sample = μg/L

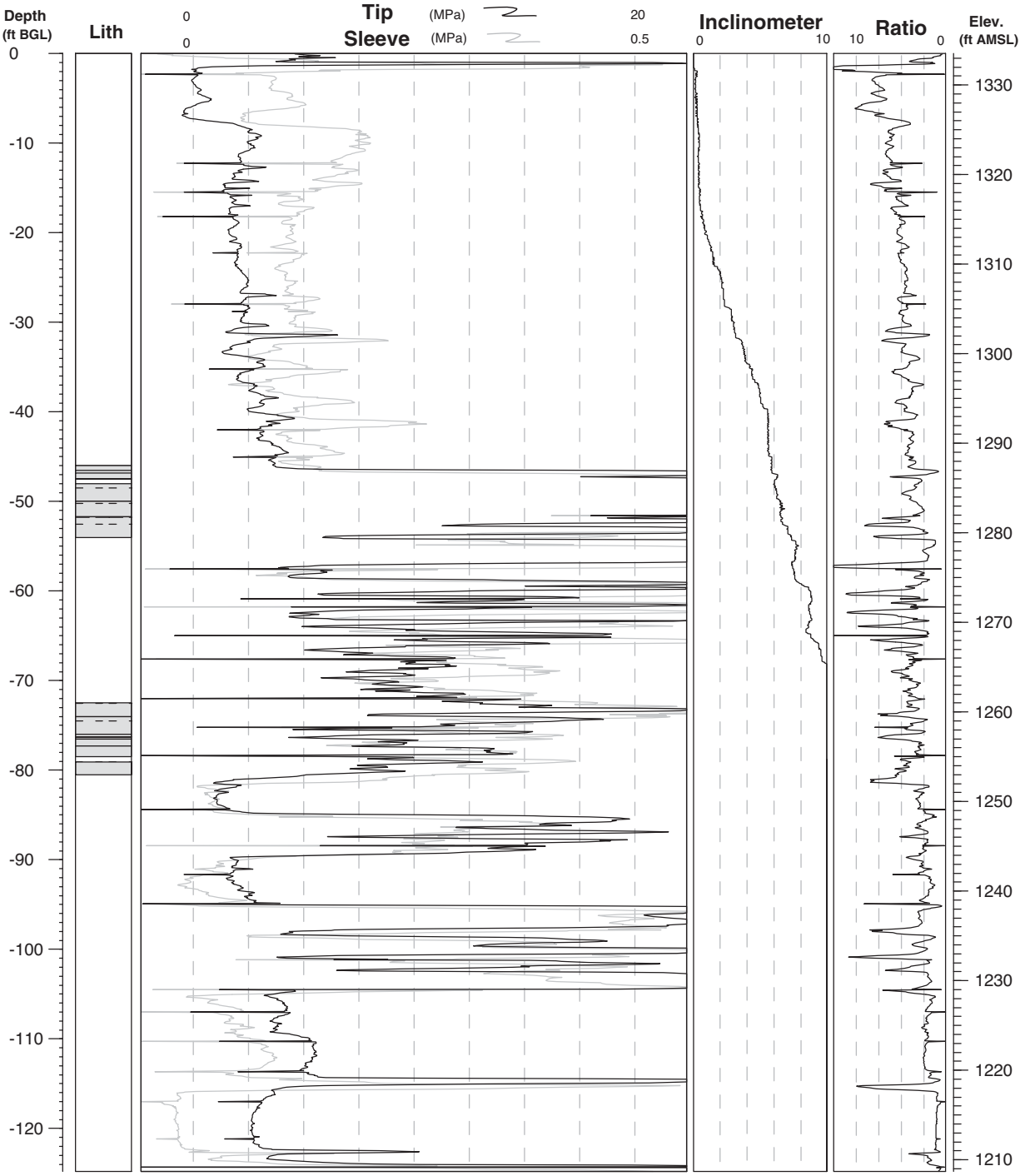
Argonne National Laboratory

Project: Centralia, KS **Boring ID:** SB07

Elevation: 1333.5 ft
Depth: 124.80 ft
Geologist: L. LaFreniere
Location: 1839068, 515056

Log Date: Apr 7, 2002
Plot Date: Apr 7, 2002

Rig: CPT - 40 Ton
Driller: R. Christensen
Company: ASW



Argonne National Laboratory

Well ID: **SB08**

Project: **Centralia, KS** **Elevation:** 1332 ft **Log Date:** Apr 8, 2002 **Rig:** CPT - VdB
Geologist: L. LaFreniere **Total Depth:** 82 ft **Driller:** T. Hinz **Drilling Company:** ASW
Location: 1839124, 515163 **Core Description:** from -50' to -70'

Depth (ft BGL)	% Rec	S.S. / W.S.	CCl_4	LITHOLOGY DESCRIPTION	Elev (ft AMSL)
-45				No Sample: No sample from 0 to -50 ft	
					1285
-50				Sand: (0.2 feet) >85%, medium to very coarse grained, subrounded, loose, calcareous, very poorly sorted, yellowish brown (10YR), saturated. (Probable loss of core due to loose sand, no recovery zone assumed to be sand).	
				Clayey Sand: 85% sand, medium to very coarse grained, calcareous, very poorly sorted, yellowish brown (10YR) with light gray (10YR) clay, saturated.	1280
				Sand: >85% medium to very coarse grained. Sub-rounded to sub-angular, loose, Fe oxide, calcareous, dk yellowish-brown (10YR), saturated, very poorly sorted. (Contact zone highly oxidated throughout).	

SB08 Pg. 2

Depth	%	W.S. S.S.	LITHOLOGY	Elev
			Gravelly Sand: Sand 90%, 5% gravel, medium to very coarse sand, small granular gravel, very poorly sorted, yellowish-brown (10YR), saturated, medium to very coarse grained. (Concentration of FeO2 at top and base of unit). (No sedimentary structures).	
			Sand: >85%, medium-coarse grained, oxidized, very poorly sorted, yellowish-brown (10YR), saturated, sub-rounded (No sedimentary structures).	
			Clayey Sand: 85% sand, fine to very coarse grained, very poorly sorted, oxidized, yellowish-brown (10YR), saturated, sub-rounded. Highly calcareous matrix clays.	
		130/ 30	No Recovery: (Probable sand) Saturated.	
-55			Sand: 90%, Medium to very coarse grained, sub-rounded, poorly sorted, calcareous, oxidized, yellowish-brown (10YR), saturated. (quartz sand).	
			Sand: 85%, 5% small granules, very poorly sorted, sub-rounded, calcareous, oxidized, yellow-brown (10YR), saturated. Med to v. coarse grained (Slight coarsening from above)	
			Sand: 90%, Fine to coarse grained, poorly sorted, sub-rounded, highly calcareous with slight clay matrix <10%. Yellowish-brown (10YR), saturated.	
			Sand: 90% medium grained, well sorted, sub-rounded, calcareous, Fe stained, yellowish-brown (10YR) saturated, loose.	1275
			Sand: 90% medium to coarse grained, poorly sorted, sub-rounded, calcareous, Fe stained, yellowish-brown (10YR), saturated loose (single gravel pebble of cemented fine sand).	
			Sand: As described above, 5% gravel, saturated.	
-60		176	Sand: Medium to very coarse sand, predominantly coarse and very coarse fraction, very poorly sorted, sub-rounded to some sub-angular (larger) grains, saturated. Gravel trace <2%, yellowish-brown (10YR).	

Carbon tetrachloride in water sample = µg/L

SB08 Pg. 3

Depth	%	W.S. S.S.	LITHOLOGY	Elev
				1270
			Sand: Well sorted, fine graine, calcareous, yellowish-brown (10YR).	
			Silty Sand: 85% sand, fine to medium grained, sub-rounded to sub-angular, highly calcareous, oxidized. (Medium gravel <10%).	
		13	No recovery: Incomplete recovery. Exact Depth Interval not positive (assume sand).	
-65				
			Sand: Medium grained, well sorted, sub-rounded, calcareous, FeO2, brownish yellow (10YR).	
			Clayey Silt: Core stuck partially in barrel - only parts recovered. Approx. depths only - transition zone. Mottled, brownish-yellow (10YR), low plasticity, highly calcareous with minor inclusions of light gray fine sand (10YR), Fe oxide.	
			Silty Clay: Medium plasticity, calcareous, damp, waxy in appearance, dark grayish brown (2.5YR).	1265
			Silty Clay: As described above with areas of very fine sand, light-gray (10YR) in appearance, calcareous, damp.	
			Clayey Silt: Low plasticity, calcareous, some evidence of manganese depletion, damp. Brownish yellow (10YR) mottles of very dark grayish brown (10YR).	
			Clayey Silt: Low plasicity, highly calcareous, brownish-yellow (10YR) with mottles of very dark grayish-brown (10YR), medium plasticity, calcareous, moist.	
		ND		
-70				

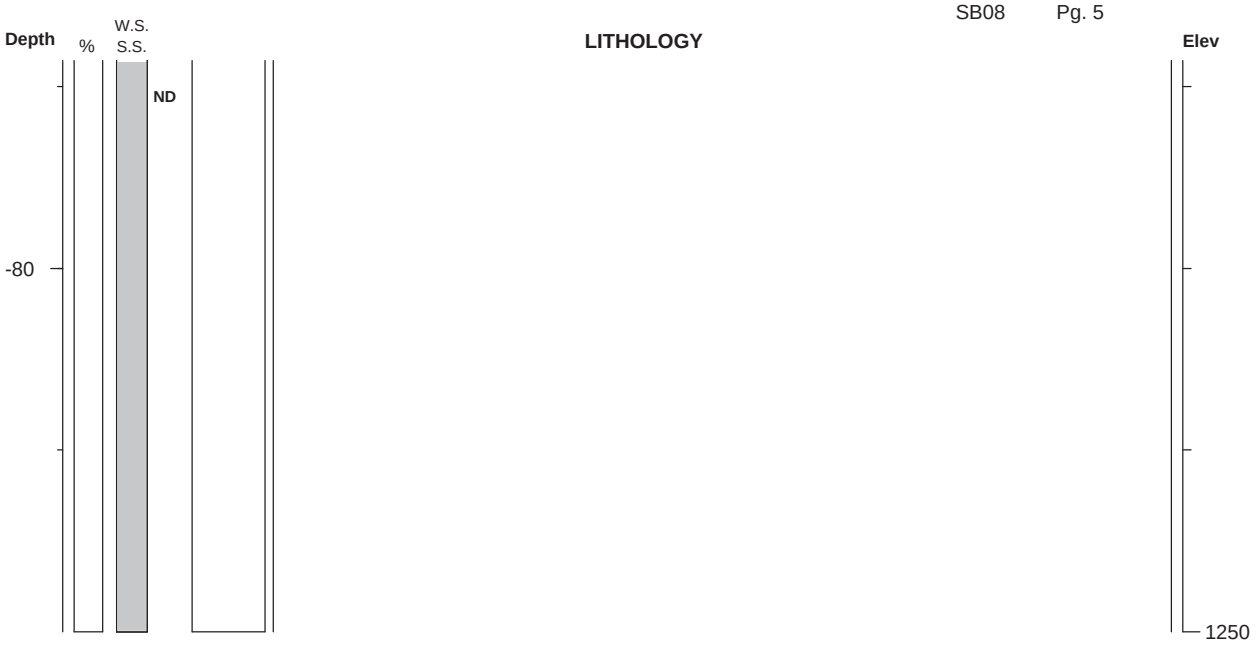
Carbon tetrachloride in water sample = μg/L

SB08 Pg. 4

Depth	%	W.S. S.S.		LITHOLOGY	Elev
					1260
			ND		
-75					
					1255

Carbon tetrachloride in water sample = μg/L

SB08 Pg. 5



Carbon tetrachloride in water sample = µg/L

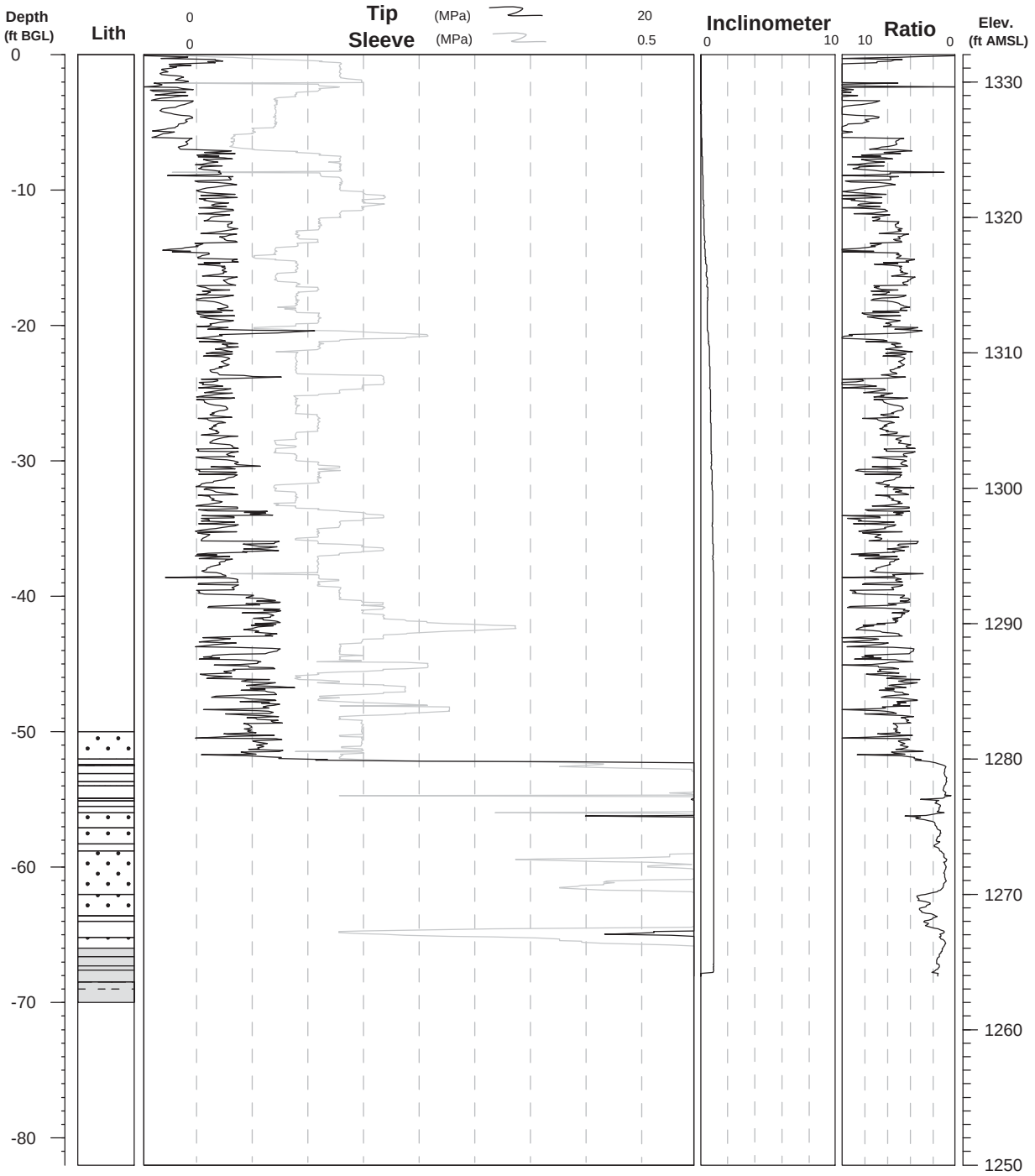
Argonne National Laboratory

Project: Centralia, KS **Boring ID:** SB08

Elevation: 1332 ft
Depth: 82 ft
Geologist: L. LaFreniere
Location: 1839124, 515163

Log Date: Apr 8, 2002
Plot Date: Apr 9, 2002

Rig: CPT - VdB
Driller: T. Hinz
Company: ASW



Argonne National Laboratory

Well ID: **SB09**

Project: **Centralia, KS** **Elevation:** 1311.33 ft **Log Date:** Apr 4, 2002 **Rig:** CPT- 40T
Geologist: Kulla/Becker/LaFreniere **Total Depth:** 75.9 ft **Driller:** R. Christensen **Drilling Company:** ASW
Location: 1838655, 514804 **Core Description:** to -71 ft

Depth (ft BGL)	% Rec	S.S. / W.S.	CCl_4	LITHOLOGY DESCRIPTION	Elev (ft AMSL)
0				Silty Clay: Organic rich, abundant grass roots, very dark brown (10YR), damp.	1310
				Silty Clay: Transitional color change with depth to very dark grayish brown (10YR) to dark grayish brown, increase in few pebbles, some fine sand <5%. (Till at 2 feet).	
-5				No Recovery:	1305
				Silty Clay: Gravel and coarse sand (10%), Fe accumulations, calcitic cementation (caliche), brown to yellowish brown (10YR), damp to moist.	
-10				Silty Clay: Same description as above, light yellowish brown, increasing carbonate cementation with depth, abundant iron and Mn inclusions at 12'. Damp to moist. (Paleosol at 12 ' mineralization).	

SB09 Pg. 2

Depth	%	W.S. S.S.	LITHOLOGY	Elev
				1300
			Silty Clay: Sand and gravel, (10%), vertical carbonate veins, very pale brown (10YR), to light yellowish brown (10YR), damp. (Till).	
-15				
			Silty Clay: Same description as above (12-16 feet) with gravel to 1.25 inch, occasional FeOx and carbonate accumulations, no carbonate veins.	1295
-20				
			Silty Clay: Same description as above (16-20 feet), gravel and sand increasing to 15%, less carbonate inclusions.	
				1290

SB09 Pg. 3

Depth	%	W.S. S.S.		LITHOLOGY	Elev
				Silty Clay: Same description as above (20-24 feet), increased oxidation zone at 27.5 to 28.0 feet.	
-25					1285
				Silty Clay: Same description as above (24-28 feet), with highly mineralized zone at 29.2 to 29.8 feet, Fe and Mn accumulations, carbonate veining. (Till).	
-30					1280
				Sand: 80% fine sand, 5% granules and gravel up to .5 inch, sorted, some silt laminae, yellowish brown (10YR), wet at 31.6 feet.	
			ND	Sand: 100% sand, very fine, yellowish brown, wet.	
-35					

Carbon tetrachloride in water sample = µg/L

SB09 Pg. 4

Depth	%	W.S. S.S.	LITHOLOGY	Elev
			Slough:	
			Sand: Fine to medium, 95% sand, rounded, well sorted, light yellowish brown (10YR), wet	1275
			Sand: Fine to coarse, 90% sand, pale brown (10YR), rounded, 5% gravel and granules. Very fine silty sand at 38.1 to 38.2 feet. Wet. (Fluvial?).	
		ND	Silty Sand: Very fine, well sorted, layered, 80-85% sand, light yellowish brown, wet. (Fining upward).	
-40			Sand: Very fine to coarse, 100% sand, subangular to subrounded, yellowish brown (10YR), fine to very fine at top of core, coarsens downward to medium-fine grained. Wet.	1270
		ND	Sand: Same description as above (40-44 feet).	
-45			Silty Sand: With very fine sand, layered, yellowish brown (10YR), wet, similar to 38.5 to 40 feet.	1265

Carbon tetrachloride in water sample = μg/L

SB09 Pg. 5

Depth	%	W.S. S.S.	LITHOLOGY	Elev
			No Sample:	
-50		ND		1260
-55		ND		
			Clayey Silt: low plasticity, calcareous, coarse silt, yellowish brown (10YR), with inclusions of light gray (10 YR), very fine grained sand, manganese depletions, dark gray silty clay rims, highly calcareous, moist. (Possible very fine sand overall)	1255
			Clayey Silt: low plasticity, calcareous, coarse silt, yellowish brown (10YR) with occasional light gray (10YR) fine sand inclusions, occasional rip up clasts of dark gray (10YR) silty clay, highly calcareous, overall moist to wet. Moisture content increases with depth.	

Carbon tetrachloride in water sample = μg/L

SB09 Pg. 6

Depth	%	W.S. S.S.	LITHOLOGY	Elev
-60			Clayey Silt: very coarse silt (possibly very fine sand), grayish brown (2.5 YR), with light gray (10YR) fine sand inclusions (increase from above), highly calcareous, moist to wet. No laminae present. Marked reduction in "rip up" clasts, low plasticity. (Could be described as very fine sand)	1250
			Clayey Silt: fine to coarse grained silt, generally finer grained than above, low plasticity, highly calcareous, grayish brown (2.5 YR), only minor light gray (10YR) sand inclusions.	
			Clayey Silt: Transitional zone with marked increase in dark gray (2.5YR) "rip up" clasts. Clayey silt, grayish brown (2.5 YR) medium to coarse silt, increase in sand inclusions (light gray 10YR), highly calcareous, moist.	
-65			No Sample:	1245
			Clayey Silt: dark gray (2.5 YR), with intercalated dark gray (10YR) clay "rip up" clasts, with trace light gray fine sand inclusions, highly calcareous, moist to wet.	
-70			Silty Clay: medium plasticity, highly calcareous, dark gray (10YR). (No obvious sed. structures)	
			Silt: loose, non plastic, very highly calcareous, light gray (10YR), fine grained.	

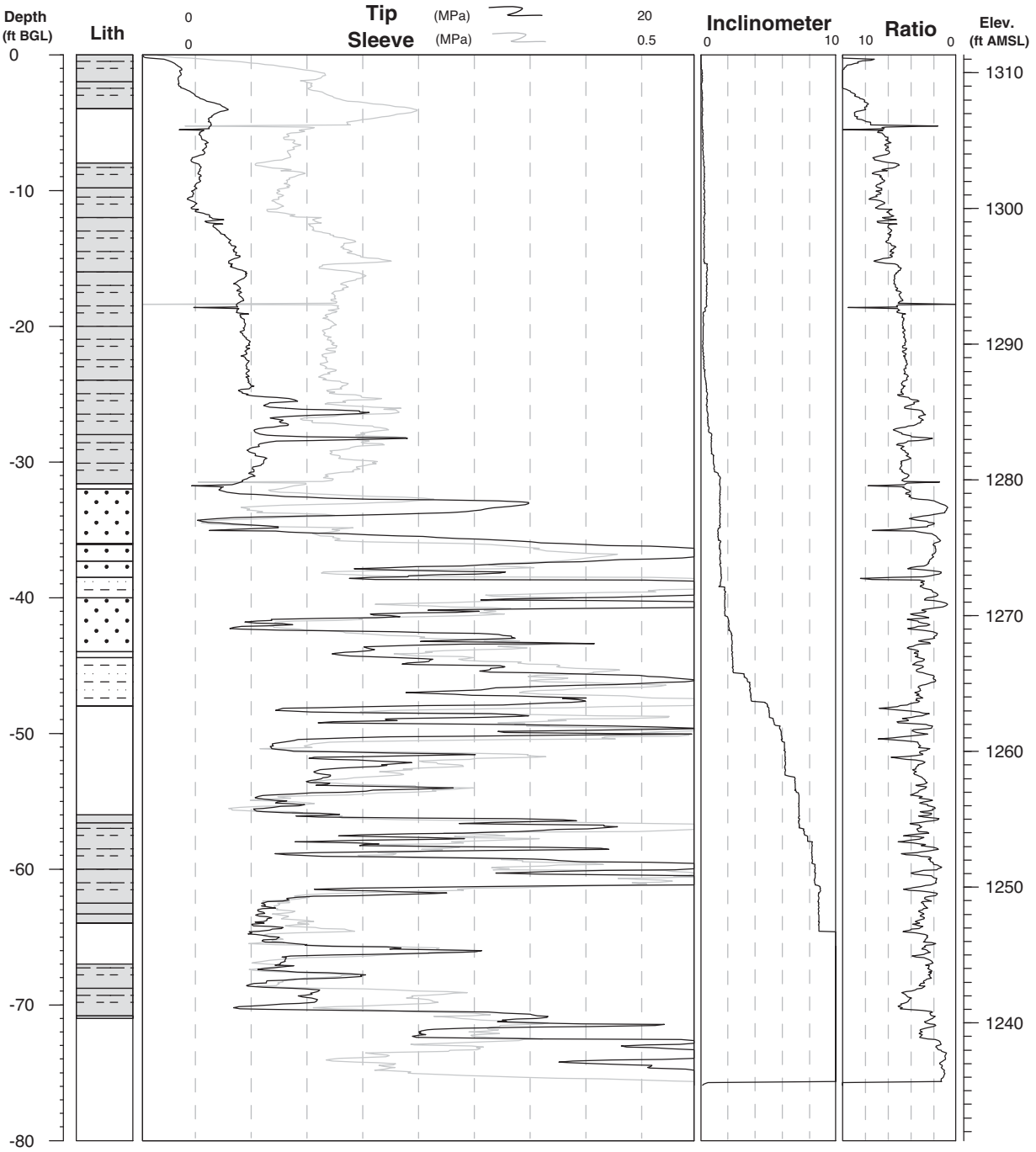
Argonne National Laboratory

Project: Centralia, KS **Boring ID:** SB09

Elevation: 1311.33 ft
Depth: 75.9 Feet
Geologist: Kulla/Becker/LaFreniere
Location: 1838655, 514804

Log Date: Apr 4, 2002
Plot Date: Apr 4, 2002

Rig: CPT- 40T
Driller: R. Christensen
Company: ASW



Argonne National Laboratory

Well ID: **SB10**

Project: **Centralia, KS** **Elevation:** 1324.5 ft **Log Date:** Apr 5, 2002 **Rig:** CPT - VDB
Geologist: L. LaFreniere **Total Depth:** 124.73 ft **Driller:** T. Hinz **Drilling Company:** ASW
Location: 1838933, 515098 **Core Description:** from - 52.5' to -64.5'

LITHOLOGY DESCRIPTION

Depth (ft BGL)	% Rec	S.S. / W.S.	CCl_4	Lithology description	Elev (ft AMSL)
-50				No Sample: No Sample from 0 to -52.5 ft	
			NS		
				Clayey silt: 60% silt, 10% very fine sand, non plastic, slightly to moderately calcareous, weakly laminated, scattered light gray (10YR) Fe depletions, yellowish brown (10YR), wet. 1" carbonate pebble at 55.5 '.	1270
-55					
			ND		
				Clayey Silt: low plasticity, slightly to moderately calcareous, yellowish brown (10YR), weakly laminated to 59.7', strongly laminated to 60.7', many strong brown (7.5 YR) Fe accumulations, and light gray (10YR) Fe depletions, moist. Very dark grayish brown (10YR) laminations at 59.7 to 60', wet slough 60.5 to 60.7'.	1265
-60			NS		
				Silty Clay: medium plasticity, slightly to moderately calcareous, strongly laminated, alternating yellowish brown (10YR), strong brown (7.5 YR), and light gray (10YR), moist.	
				Silty Clay: as above, except laminations are grayish brown (10YR), and light gray (10YR). End of Core.	1260

Carbon tetrachloride in water sample = μg/L

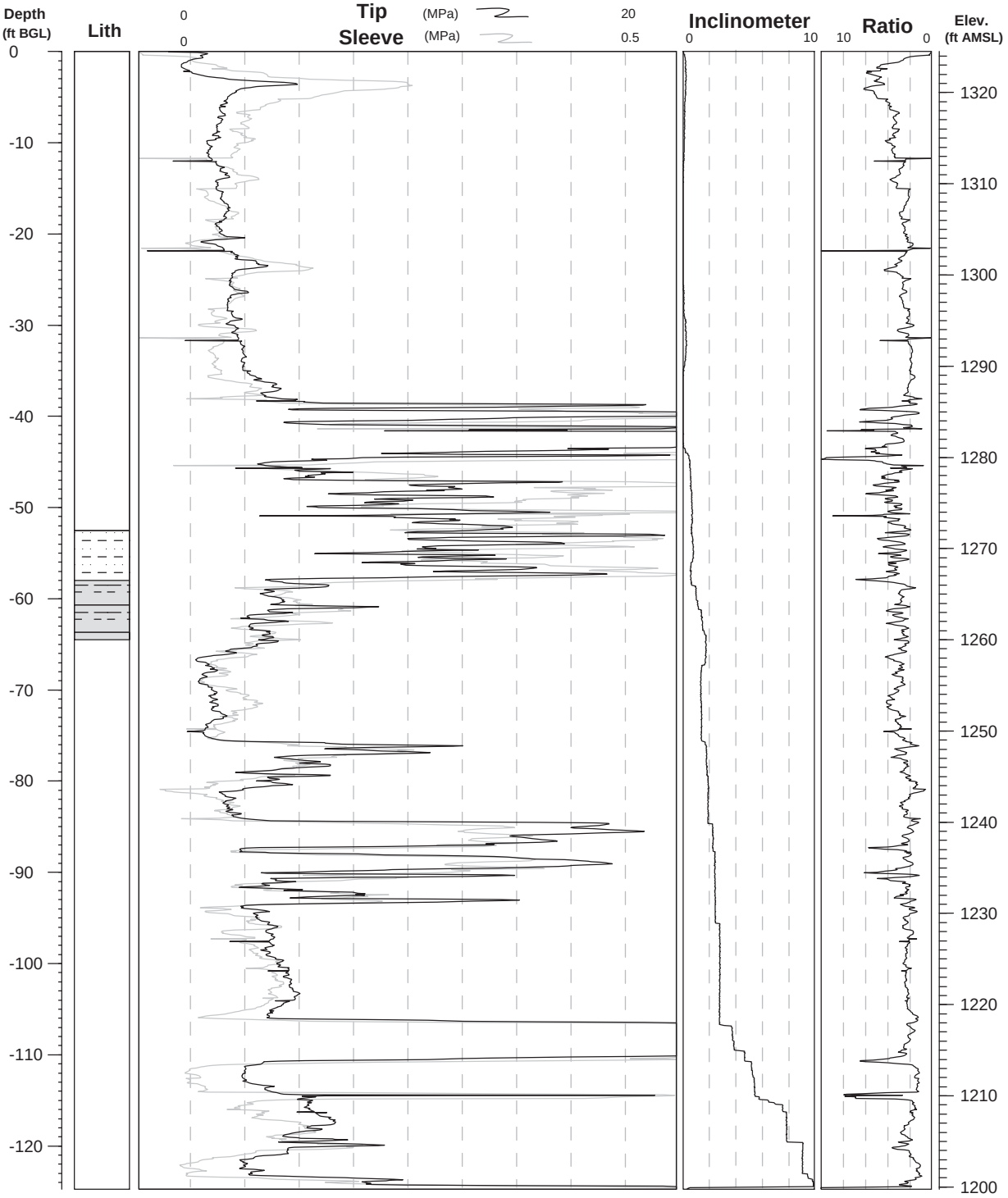
Argonne National Laboratory

Project: Centralia, KS **Boring ID:** SB10

Elevation: 1324.5 ft
Depth: 124.73 ft
Geologist: L. LaFreniere
Location: 1838933, 515098

Log Date: Apr 5, 2002
Plot Date: Apr 5, 2002

Rig: CPT - VDB
Driller: T. Hinz
Company: ASW



Appendix B:

Piezometer Construction Diagrams

Piezometer SB01: Centralia, KS

NE ¼ of NE ¼ of SE ¼, Section 1, Twp. 4 South, Rge. 11 East
Nemaha County, State of Kansas.

Ground elevation: 1325.60 ft AMSL

Date: 05/08 /02

WELL HEAD PROTECTION

12" Morrison Brothers, Co. Model 418XA Flush mount cover. Top of casing fitted with a (J-Plug) Morrison Brothers, Co. Model 678XA and a screened vent with a locking pipe plug and pad lock.

CONCRETE PAD

Must be a minimum of 8" thick and extend at least 8" larger than the Flush Mount (28" minimum). Sloped to prevent pooling of water, vegetation around well and allow for placement of a surveyor pin.

IMPERVIOUS GROUT

The well must be grouted with impervious grout and must be tremied as required, mixed with clean fresh water to have a minimum density of 9.4 lbs. per gallon.

WELL CASING

Well casing shall terminate as high as possible inside the Flush Mount and be capped with a (J-Plug) Morrison Brothers, Co. Model 678XA locking plug and pad lock.

1" PVC 160 psi (SDR) 26, or thicker threaded casing and Mill Slot (0.10") well screen.

HOLE SIZE

The hole must be at lease 4" in diameter for the top 20' and grouted to the base of the Flush Mount.

GRAVEL / SAND PACK

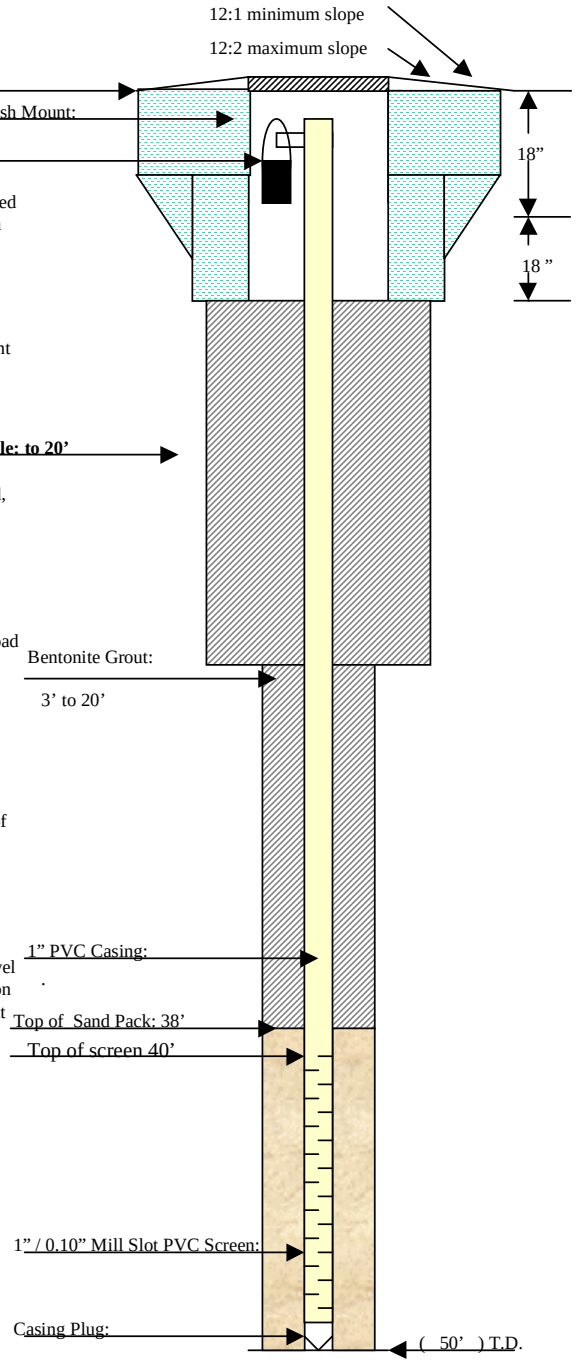
Gravel / Sand Pack screen size and gradation shall be determined based upon the grain size and gradation of portion or portions of the aquifer to be screened. Gravel Pack shall be designed to stabilize the aquifer material and permit the fine fraction to move into the well during development. Gravel pack shall extend to a length at least 2' above screen.

CONTRACTOR LICENSING

All wells must be constructed under the direction of a licensed water well contractor as specified under, Kansas Department of Health and Environment Regulation.

REGISTRATION

All wells must be registered with the Kansas Department of Health and Environment on form WWC-5 provided by that Department.



(NOT TO SCALE)

D. Surgnier for ANL

Piezometer SB04: Centralia, KS

NE ¼ of NE ¼ of SE ¼, Section 1, Twp. 4 South, Rge. 11 East
Nemaha County, State of Kansas.

Ground elevation: 1336.20 ft AMSL

Date: 05/08 /02

WELL HEAD PROTECTION

12" Morrison Brothers, Co. Model 418XA Flush mount cover. Top of casing fitted with a (J-Plug) Morrison Brothers, Co. Model 678XA and a screened vent with a locking pipe plug and pad lock.

CONCRETE PAD

Must be a minimum of 8" thick and extend at least 8" larger than the Flush Mount (28" minimum). Sloped to prevent pooling of water, vegetation around well and allow for placement of a surveyor pin.

IMPERVIOUS GROUT

The well must be grouted with impervious grout and must be tremied as required, mixed with clean fresh water to have a minimum density of 9.4 lbs. per gallon.

WELL CASING

Well casing shall terminate as high as possible inside the Flush Mount and be capped with a (J-Plug) Morrison Brothers, Co. Model 678XA locking plug and pad lock.

1" PVC 160 psi (SDR) 26, or thicker threaded casing and Mill Slot (0.10") well screen.

HOLE SIZE

The hole must be at lease 4" in diameter for the top 20' and grouted to the base of the Flush Mount.

GRAVEL / SAND PACK

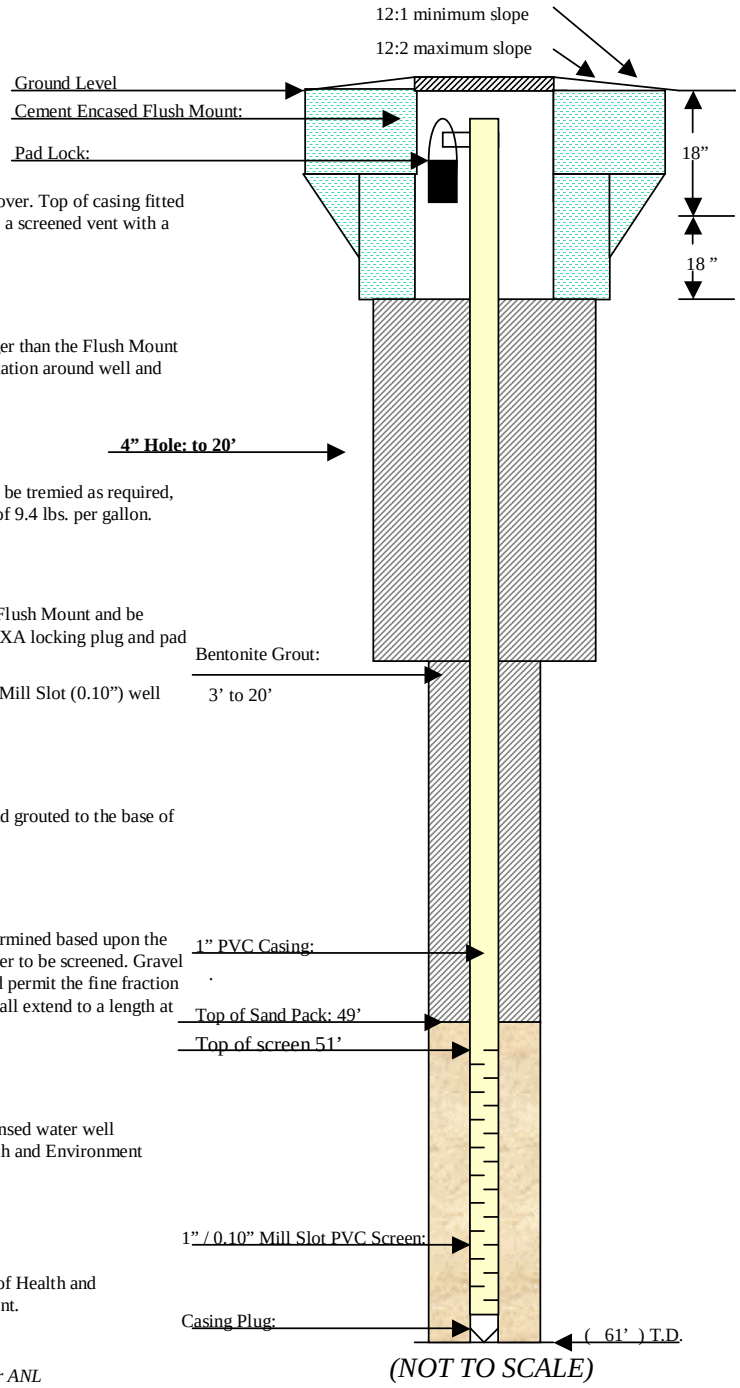
Gravel / Sand Pack screen size and gradation shall be determined based upon the grain size and gradation of portion or portions of the aquifer to be screened. Gravel Pack shall be designed to stabilize the aquifer material and permit the fine fraction to move into the well during development. Gravel pack shall extend to a length at least 2' above screen.

CONTRACTOR LICENSING

All wells must be constructed under the direction of a licensed water well contractor as specified under, Kansas Department of Health and Environment Regulation.

REGISTRATION

All wells must be registered with the Kansas Department of Health and Environment on form WWC-5 provided by that Department.



(NOT TO SCALE)

D. Surgnier for ANL

Piezometer SB05: Centralia, KS

NW ¼ of NE ¼ of SE ¼, Section 1, Twp. 4 South, Rge. 11 East
Nemaha County, State of Kansas.

Ground elevation: 1321.60 ft AMSL

Date: 05/08 /02

WELL HEAD PROTECTION

12" Morrison Brothers, Co. Model 418XA Flush mount cover. Top of casing fitted with a (J-Plug) Morrison Brothers, Co. Model 678XA and a screened vent with a locking pipe plug and pad lock.

CONCRETE PAD

Must be a minimum of 8" thick and extend at least 8" larger than the Flush Mount (28" minimum). Sloped to prevent pooling of water, vegetation around well and allow for placement of a surveyor pin.

IMPERVIOUS GROUT

The well must be grouted with impervious grout and must be tremied as required, mixed with clean fresh water to have a minimum density of 9.4 lbs. per gallon.

WELL CASING

Well casing shall terminate as high as possible inside the Flush Mount and be capped with a (J-Plug) Morrison Brothers, Co. Model 678XA locking plug and pad lock.

1" PVC 160 psi (SDR) 26, or thicker threaded casing and Mill Slot (0.10") well screen.

HOLE SIZE

The hole must be at lease 4" in diameter for the top 20' and grouted to the base of the Flush Mount.

GRAVEL / SAND PACK

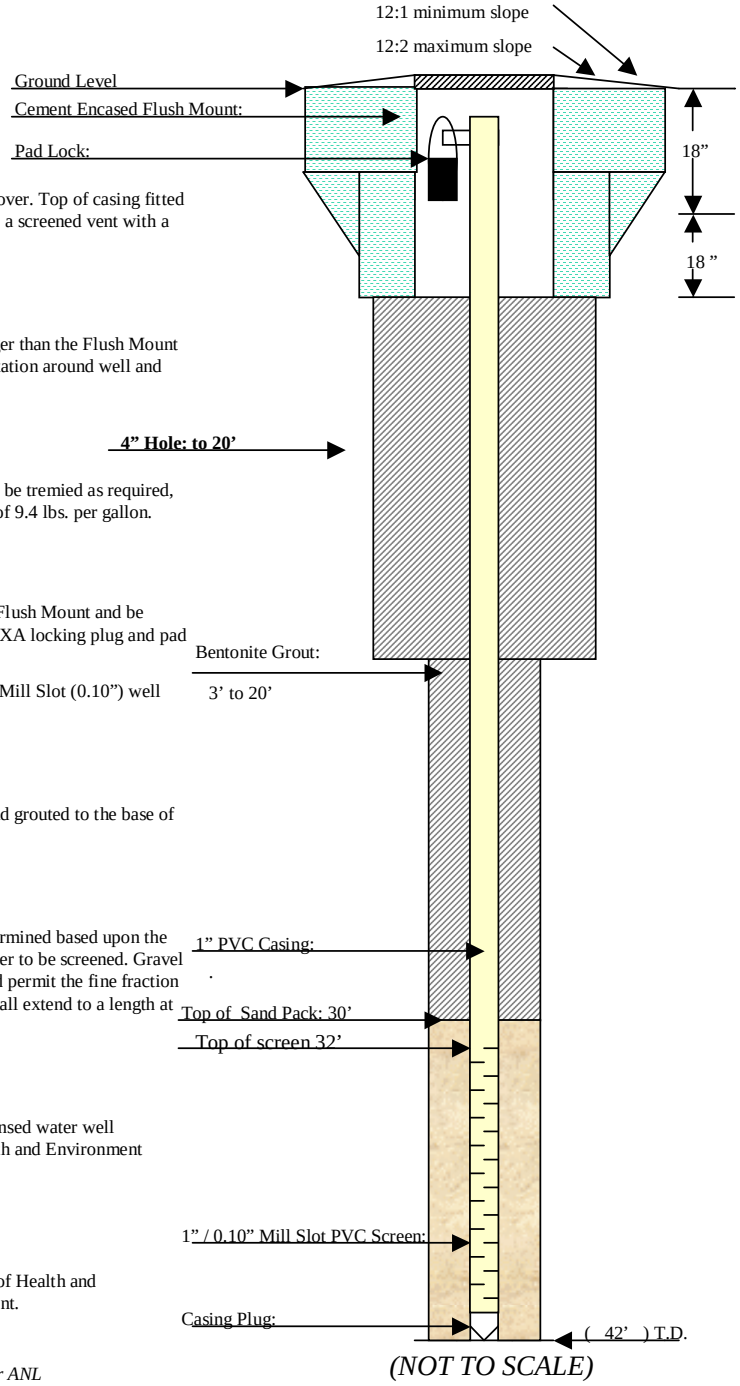
Gravel / Sand Pack screen size and gradation shall be determined based upon the grain size and gradation of portion or portions of the aquifer to be screened. Gravel Pack shall be designed to stabilize the aquifer material and permit the fine fraction to move into the well during development. Gravel pack shall extend to a length at least 2' above screen.

CONTRACTOR LICENSING

All wells must be constructed under the direction of a licensed water well contractor as specified under, Kansas Department of Health and Environment Regulation.

REGISTRATION

All wells must be registered with the Kansas Department of Health and Environment on form WWC-5 provided by that Department.



(NOT TO SCALE)

D. Surgnier for ANL

Piezometer SB07: Centralia, KS

NE ¼ of NE ¼ of SE ¼, Section 1, Twp. 4 South, Rge. 11 East
Nemaha County, State of Kansas.

Ground elevation: 1332.40 ft AMSL

Date: 05/08 /02

WELL HEAD PROTECTION

12" Morrison Brothers, Co. Model 418XA Flush mount cover. Top of casing fitted with a (J-Plug) Morrison Brothers, Co. Model 678XA and a screened vent with a locking pipe plug and pad lock.

CONCRETE PAD

Must be a minimum of 8" thick and extend at least 8" larger than the Flush Mount (28" minimum). Sloped to prevent pooling of water, vegetation around well and allow for placement of a surveyor pin.

IMPERVIOUS GROUT

The well must be grouted with impervious grout and must be tremied as required, mixed with clean fresh water to have a minimum density of 9.4 lbs. per gallon.

WELL CASING

Well casing shall terminate as high as possible inside the Flush Mount and be capped with a (J-Plug) Morrison Brothers, Co. Model 678XA locking plug and pad lock.

1" PVC 160 psi (SDR) 26, or thicker threaded casing and Mill Slot (0.10") well screen.

HOLE SIZE

The hole must be at lease 4" in diameter for the top 20' and grouted to the base of the Flush Mount.

GRAVEL / SAND PACK

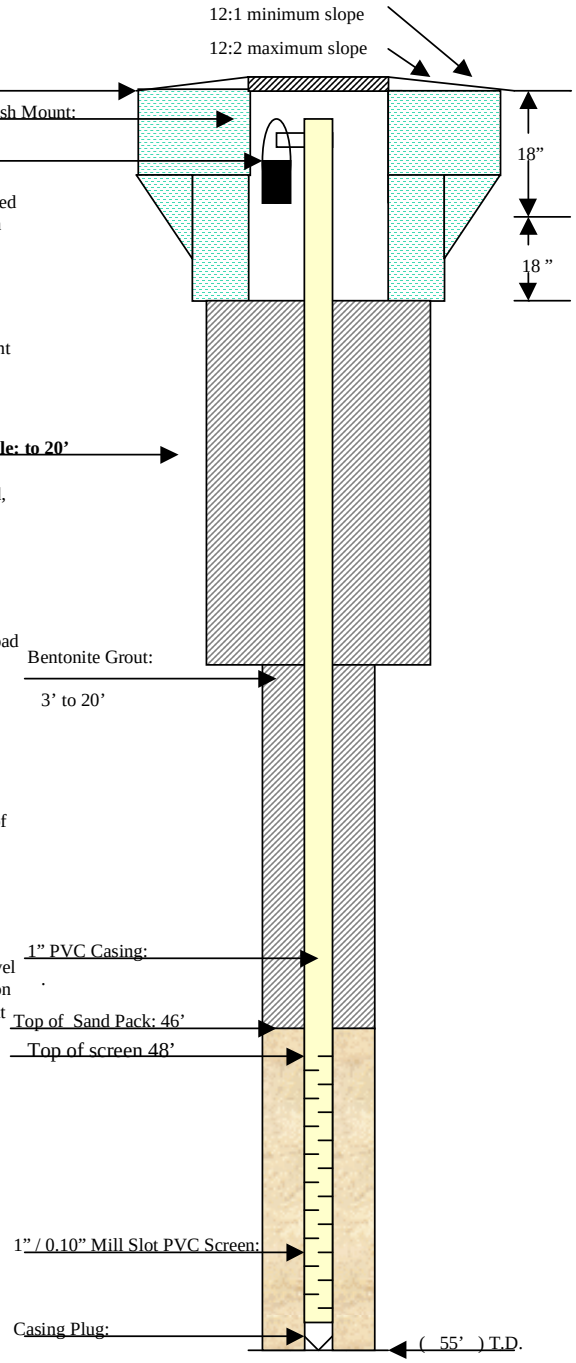
Gravel / Sand Pack screen size and gradation shall be determined based upon the grain size and gradation of portion or portions of the aquifer to be screened. Gravel Pack shall be designed to stabilize the aquifer material and permit the fine fraction to move into the well during development. Gravel pack shall extend to a length at least 2' above screen.

CONTRACTOR LICENSING

All wells must be constructed under the direction of a licensed water well contractor as specified under, Kansas Department of Health and Environment Regulation.

REGISTRATION

All wells must be registered with the Kansas Department of Health and Environment on form WWC-5 provided by that Department.



(NOT TO SCALE)

D. Surgnier for ANL

Piezometer SB08: Centralia, KS

NE ¼ of NE ¼ of SE ¼, Section 1, Twp. 4 South, Rge. 11 East
Nemaha County, State of Kansas.

Ground elevation: 1333.00 ft AMSL

Date: 05/08 /02

WELL HEAD PROTECTION

12" Morrison Brothers, Co. Model 418XA Flush mount cover. Top of casing fitted with a (J-Plug) Morrison Brothers, Co. Model 678XA and a screened vent with a locking pipe plug and pad lock.

CONCRETE PAD

Must be a minimum of 8" thick and extend at least 8" larger than the Flush Mount (28" minimum). Sloped to prevent pooling of water, vegetation around well and allow for placement of a surveyor pin.

IMPERVIOUS GROUT

The well must be grouted with impervious grout and must be tremied as required, mixed with clean fresh water to have a minimum density of 9.4 lbs. per gallon.

WELL CASING

Well casing shall terminate as high as possible inside the Flush Mount and be capped with a (J-Plug) Morrison Brothers, Co. Model 678XA locking plug and pad lock.

1" PVC 160 psi (SDR) 26, or thicker threaded casing and Mill Slot (0.10") well screen.

HOLE SIZE

The hole must be at lease 4" in diameter for the top 20' and grouted to the base of the Flush Mount.

GRAVEL / SAND PACK

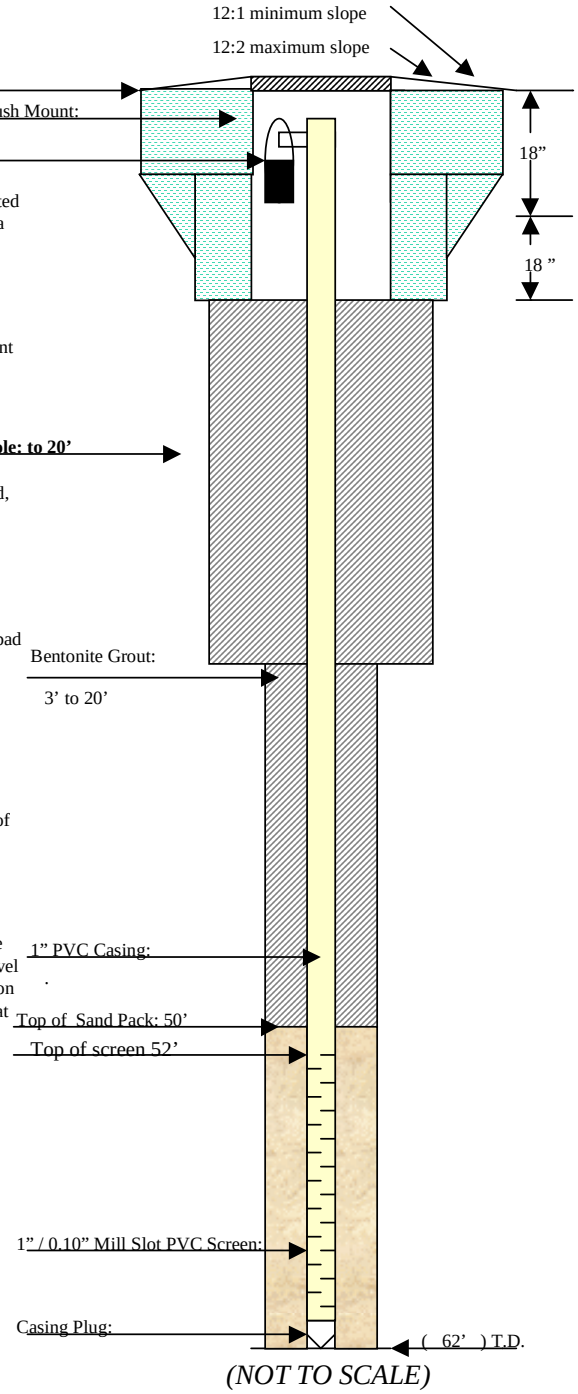
Gravel / Sand Pack screen size and gradation shall be determined based upon the grain size and gradation of portion or portions of the aquifer to be screened. Gravel Pack shall be designed to stabilize the aquifer material and permit the fine fraction to move into the well during development. Gravel pack shall extend to a length at least 2' above screen.

CONTRACTOR LICENSING

All wells must be constructed under the direction of a licensed water well contractor as specified under, Kansas Department of Health and Environment Regulation.

REGISTRATION

All wells must be registered with the Kansas Department of Health and Environment on form WWC-5 provided by that Department.



(NOT TO SCALE)

D. Surgnier for ANL

Piezometer SB09: Centralia, KS

SW ¼ of NE ¼ of SE ¼, Section 1, Twp. 4 South, Rge. 11 East
Nemaha County, State of Kansas.

Ground elevation: 1311.50 ft AMSL

Date: 05/08 /02

WELL HEAD PROTECTION

12" Morrison Brothers, Co. Model 418XA Flush mount cover. Top of casing fitted with a (J-Plug) Morrison Brothers, Co. Model 678XA and a screened vent with a locking pipe plug and pad lock.

CONCRETE PAD

Must be a minimum of 8" thick and extend at least 8" larger than the Flush Mount (28" minimum). Sloped to prevent pooling of water, vegetation around well and allow for placement of a surveyor pin.

IMPERVIOUS GROUT

The well must be grouted with impervious grout and must be tremied as required, mixed with clean fresh water to have a minimum density of 9.4 lbs. per gallon.

WELL CASING

Well casing shall terminate as high as possible inside the Flush Mount and be capped with a (J-Plug) Morrison Brothers, Co. Model 678XA locking plug and pad lock.

1" PVC 160 psi (SDR) 26, or thicker threaded casing and Mill Slot (0.10") well screen.

HOLE SIZE

The hole must be at lease 4" in diameter for the top 20' and grouted to the base of the Flush Mount.

GRAVEL / SAND PACK

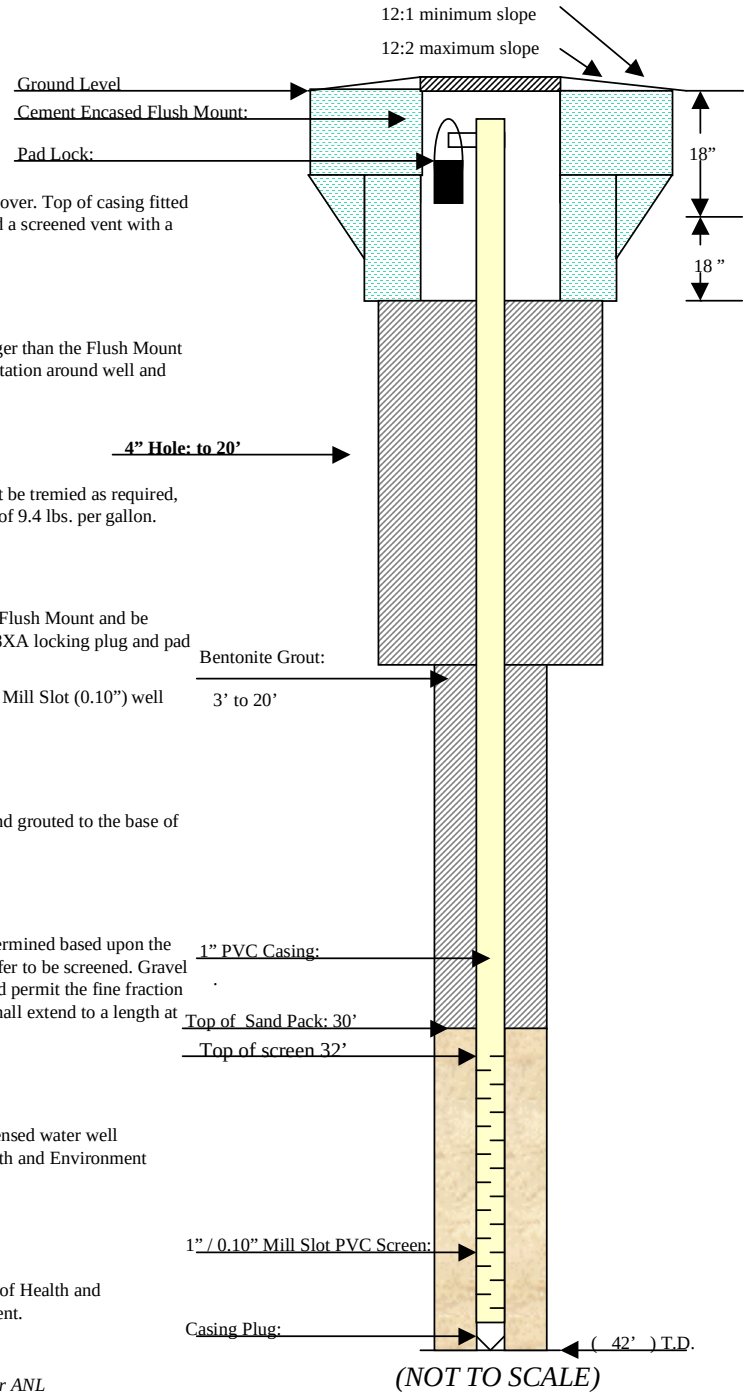
Gravel / Sand Pack screen size and gradation shall be determined based upon the grain size and gradation of portion or portions of the aquifer to be screened. Gravel Pack shall be designed to stabilize the aquifer material and permit the fine fraction to move into the well during development. Gravel pack shall extend to a length at least 2' above screen.

CONTRACTOR LICENSING

All wells must be constructed under the direction of a licensed water well contractor as specified under, Kansas Department of Health and Environment Regulation.

REGISTRATION

All wells must be registered with the Kansas Department of Health and Environment on form WWC-5 provided by that Department.



(NOT TO SCALE)

D. Surgnier for ANL

Appendix C:

Coordinates Survey Data

TABLE C.1 Coordinates survey data for Phase I sampling locations at Centralia.

	Horizontal Location[a] (ft)		Elevation[b] (ft AMSL)	
Location	Northing	Easting	Representative Ground Surface	Reference[c]
Temporary piezometers				
SB01t	514987.95	1838924.73	1325.30	1325.30
SB03t	515298.68	1839171.00	1333.11	1333.11
SB04t	514977.79	1839195.45	1336.08	1336.08
SB05t	515105.32	1838885.31	1321.59	1321.59
SB06t	515093.94	1839202.48	1336.90	1336.90
SB07t	515055.80	1839067.76	1331.84	1331.84
SB08t	515162.62	1839123.55	1333.02	1333.02
SB09t	514804.11	1838655.11	1311.33	1311.33
Permanent piezometers				
SB01	514987.31	1838927.09	1325.60	1325.16
SB04	514979.88	1839195.59	1336.20	1335.73
SB05	515105.24	1838883.36	1321.60	1321.28
SB07	515059.50	1839066.82	1332.40	1331.94
SB08	515167.10	1839120.47	1333.00	1332.56
SB09	514805.65	1838653.42	1311.50	1311.04
ECPT locations				
SB02	515052.32	1838955.30	1326.80	-[d]
SB10	515098.14	1838933.03	1325.08	-

[a] Horizontal coordinates are target location centers. Northings and eastings are Kansas State Plane Coordinates. Horizontal datum is North American Datum (NAD) 83.

[b] Vertical datum is National Geodetic Vertical Datum (NGVD) 88.

[c] Location for measurement of water level.

[d] No water level.

Appendix D:

Soil Sample Data

TABLE D.1 Soil samples collected during the Phase I field investigation at Centralia, Kansas.

Location	Sample	Sample Depth (ft BGL)	Sample Date	Sample Description
Near-surface soil samples				
QC	CNQCBG-S-15326	0.8-1	4/3/02	Background soil sample collected with hand auger from road right-of-way 30 ft west of eighth power pole along Rt. 187.
SU01	CNSU01-S-15096	0.9-1	3/20/02	First in the series of paired near-surface soil samples collected with the Geoprobe GT66 unit. Organic-rich dark brown clay.
SU01	CNSU01-S-15097	4.7-4.9	3/20/02	Yellowish brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.
SU02	CNSU02-S-15098	1-1.2	3/20/02	Organic-rich dark brown clay.
SU02	CNSU02-S-15099	5.8-6	3/20/02	Yellowish brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.
SU03	CNSU03-S-15100	0.8-1	3/20/02	Organic-rich dark brown clay.
SU03	CNSU03-S-15101	4.8-5	3/20/02	Yellowish brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.
SU04	CNSU04-S-15102	0.9-1	3/20/02	Organic-rich dark brown clay.
SU04	CNSU04-S-15103	4.8-5	3/20/02	Yellowish brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.
SU05	CNSU05-S-15104	1-1.2	3/20/02	Organic-rich dark brown clay.
SU05	CNSU05-S-15105	4.8-5	3/20/02	Yellowish brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.
SU06	CNSU06-S-15106	0.5-0.8	3/23/02	Organic-rich dark brown clay.
SU06	CNSU06-S-15107	5-5.8	3/23/02	Grayish brown silty clay with some iron and manganese inclusions.
SU07	CNSU07-S-15108	0.7-0.9	3/23/02	Organic-rich dark brown clay.
SU07	CNSU07-S-15109	4.8-5	3/23/02	Grayish brown silty clay with some iron and manganese inclusions.
SU08	CNSU08-S-15110	2.4-2.6	3/23/02	Organic-rich dark brown clay.
SU08	CNSU08-S-15111	4.8-5	3/23/02	Grayish brown silty clay with some iron and manganese inclusions.
SU09	CNSU09-S-15112	1.4-1.6	3/23/02	Dark yellowish brown clay with humic staining.
SU09	CNSU09-S-15113	4.35-4.55	3/23/02	Grayish brown silty clay with some iron and manganese inclusions.
SU10	CNSU10-S-15114	0.6-0.8	3/23/02	Organic-rich dark brown clay.
SU10	CNSU10-S-15116	4.7-4.9	3/23/02	Yellowish-brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.
SU11	CNSU11-S-15117	0.5-0.7	3/23/02	Organic-rich dark brown clay.

TABLE D.1 (Cont.)

Location	Sample	Sample Depth (ft BGL)	Sample Date	Sample Description
Near-surface soil samples (Cont.)				
SU11	CNSU11-S-15118	4.5-4.7	3/23/02	Yellowish brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.
SU12	CNSU12-S-15119	0.5-0.7	3/23/02	Organic-rich dark brown clay.
SU12	CNSU12-S-15120	4.6-4.8	3/23/02	Grayish brown silty clay with some iron and manganese inclusions.
SU13	CNSU13-S-15121	1.5-1.7	3/23/02	Organic-rich dark brown clay.
SU13	CNSU13-S-15122	4.7-4.9	3/23/02	Grayish brown silty clay with some iron and manganese inclusions.
SU14	CNSU14-S-15124	1-1.2	3/23/02	Organic-rich very dark brown clay. (Humus present. Iron oxide in small root molds near surface.)
SU14	CNSU14-S-15123	4.3-4.5	3/23/02	Grayish brown silty clay with abundant finely disseminated iron and manganese inclusions. Moderately abundant calcareous inclusions; few granules.
SU15	CNSU15-S-15135	1-1.2	3/23/02	Organic-rich dark brown clay.
SU15	CNSU15-S-15136	4.5-4.7	3/23/02	Grayish brown silty clay with some iron and manganese inclusions.
SU16	CNSU16-S-15279	1-1.2	3/25/02	Organic-rich dark brown clay. (High humus content. Friable.)
SU16	CNSU16-S-15280	4.5-4.7	3/25/02	Grayish brown silty clay with some iron and manganese inclusions.
SU17	CNSU17-S-15281	0.6-0.8	3/25/02	Organic-rich very dark brown clay. Iron oxide in small root molds near surface.
SU17	CNSU17-S-15282	3.8-4	3/25/02	Grayish-brown silty clay with abundant finely disseminated iron and manganese inclusions. Moderately abundant calcareous inclusions; few granules.
SU18	CNSU18-S-15283	0.8-1.1	3/25/02	Organic-rich dark brown clay.
SU18	CNSU18-S-15284	4.5-4.8	3/25/02	Yellowish brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.
SU19	CNSU19-S-15285	0.8-1	3/25/02	Organic-rich dark brown clay.
SU19	CNSU19-S-15286	4.6-4.8	3/25/02	Yellowish brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.
SU20	CNSU20-S-15287	0.6-0.8	3/25/02	Organic-rich very dark brown clay. (Humus present. Iron oxide in small root molds near surface.)
SU20	CNSU20-S-15288	4.6-4.8	3/25/02	Grayish brown silty clay with abundant finely disseminated iron and manganese inclusions. Moderately abundant calcareous inclusions; few granules.
SU21	CNSU21-S-15289	0.8-1	3/25/02	Organic-rich dark brown clay.
SU21	CNSU21-S-15290	4.6-4.8	3/25/02	Grayish brown silty clay with some iron and manganese inclusions.

TABLE D.1 (Cont.)

Location	Sample	Sample Depth (ft BGL)	Sample Date	Sample Description
Near-surface soil samples (Cont.)				
SU22	CNSU22-S-15291	0.6-0.8	3/25/02	Organic-rich dark brown clay.
SU22	CNSU22-S-15292	4.5-4.7	3/25/02	Grayish brown silty clay with some iron and manganese inclusions.
SU23	CNSU23-S-15293	0.9-1.1	3/25/02	Organic-rich very dark brown clay. (Iron oxide in small root molds near surface.)
SU23	CNSU23-S-15294	4.5-5	3/25/02	Grayish brown silty clay with abundant finely disseminated iron and manganese inclusions. Moderately abundant calcareous inclusions; few granules.
SU24	CNSU24-S-15295	1-1.2	3/25/02	Organic-rich dark brown clay.
SU24	CNSU24-S-15296	4.6-4.8	3/25/02	Grayish brown silty clay with some iron and manganese inclusions.
SU25	CNSU25-S-15297	0.6-0.8	3/25/02	Organic-rich dark brown clay.
SU25	CNSU25-S-15298	4.6-4.8	3/25/02	Yellowish brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.
SU26	CNSU26-S-15299	0.9-1.1	3/25/02	Organic-rich dark brown clay.
SU26	CNSU26-S-15300	4.7-4.8	3/25/02	Yellowish brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.
SU27	CNSU27-S-15301	0.9-1.1	3/25/02	Dark yellowish brown clay with humic staining.
SU27	CNSU27-S-15302	4.8-5	3/25/02	Grayish-brown silty clay with some iron and manganese inclusions.
SU28	CNSU28-S-15303	0.8-1.1	3/25/02	Organic-rich very dark brown clay. (Iron oxide in small root molds near surface.)
SU28	CNSU28-S-15304	4.7-5	3/25/02	Grayish brown silty clay with abundant finely disseminated iron and manganese inclusions. Moderately abundant calcareous inclusions; few granules.
SU29	CNSU29-S-15145	1.6-1.8	3/25/02	Organic-rich dark brown clay.
SU29	CNSU29-S-15146	4.6-4.8	3/25/02	Grayish brown silty clay with some iron and manganese inclusions.
SU30	CNSU30-S-15147	1.7-1.8	3/25/02	Dark yellowish brown clay with humic staining.
SU30	CNSU30-S-15148	4.9-5	3/25/02	Grayish brown silty clay with some iron and manganese inclusions.
SU31	CNSU31-S-15149	0.8-1	3/25/02	Organic-rich dark brown clay.
SU31	CNSU31-S-15150	4.8-4.9	3/25/02	Grayish-brown silty clay with some iron and manganese inclusions.
SU32	CNSU32-S-15151	1-1.2	3/25/02	Dark yellowish brown clay with humic staining.
SU32	CNSU32-S-15152	4.8-5	3/25/02	Grayish brown silty clay with some iron and manganese inclusions.
SU33	CNSU33-S-15153	1.1-1.2	3/25/02	Dark yellowish brown clay with humic staining.
SU33	CNSU33-S-15154	4.8-5	3/25/02	Grayish brown silty clay with some iron and manganese inclusions.

TABLE D.1 (Cont.)

Location	Sample	Sample Depth (ft BGL)	Sample Date	Sample Description
Near-surface soil samples (Cont.)				
SU34	CNSU34-S-15155	1.3-1.5	3/25/02	Dark yellowish brown clay with humic staining.
SU34	CNSU34-S-15156	4.2-4.5	3/25/02	Grayish brown silty clay with some iron and manganese inclusions.
SU35	CNSU35-S-15157	0.8-1	3/25/02	Dark yellowish brown clay with humic staining.
SU35	CNSU35-S-15158	3.6-3.8	3/25/02	Grayish brown silty clay with some iron and manganese inclusions.
SU36	CNSU36-S-15159	1-1.3	3/25/02	Dark yellowish brown clay with humic staining.
SU36	CNSU36-S-15160	4.2-4.5	3/25/02	Yellowish brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.
SU37	CNSU37-S-15161	1-1.2	3/25/02	Organic-rich dark brown clay.
SU37	CNSU37-S-15162	4.6-4.8	3/25/02	Yellowish brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.
SU38	CNSU38-S-15163	1-1.2	3/25/02	Dark yellowish brown clay with humic staining.
SU38	CNSU38-S-15164	4.8-5	3/25/02	Grayish brown silty clay with some iron and manganese inclusions.
SU39	CNSU39-S-15165	1.4-1.6	3/25/02	Organic-rich dark brown clay.
SU39	CNSU39-S-15166	4.4-4.6	3/25/02	Yellowish brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.
SU40	CNSU40-S-15167	0.8-1	3/25/02	Organic-rich dark brown clay.
SU40	CNSU40-S-15168	4.7-4.9	3/25/02	Yellowish brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.
SU41	CNSU41-S-15169	0.8-1	3/25/02	Dark yellowish brown clay with humic staining.
SU41	CNSU41-S-15170	4.8-4.9	3/25/02	Yellowish brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.
SU42	CNSU42-S-15171	1-1.2	3/25/02	Organic-rich dark brown clay.
SU42	CNSU42-S-15172	4.8-5	3/25/02	Grayish brown silty clay with some iron and manganese inclusions.
SU43	CNSU43-S-15173	0.9-1.2	3/25/02	Organic-rich dark brown clay.
SU43	CNSU43-S-15174	4.8-5	3/25/02	Grayish brown silty clay with some iron and manganese inclusions.

TABLE D.1 (Cont.)

Location	Sample	Sample Depth (ft BGL)	Sample Date	Sample Description
Subsurface soil samples				
SB01	CNSB01-S-15245	2	3/21/02	Clay, high plasticity, noncalcareous, some organics, dark yellowish brown, moist.
SB01	CNSB01-S-15246	4	3/21/02	Silty clay, occasional pebbles to 1 cm in length, medium plasticity, scattered carbonate and iron and manganese accumulations, yellowish brown with strong brown mottles, moist.
SB01	CNSB01-S-15247	6	3/21/02	Same as above.
SB01	CNSB01-S-15249	8	3/21/02	Silty clay as above, with trace pebbles to 1 in.
SB01	CNSB01-S-15250	10	3/21/02	Same as above.
SB01	CNSB01-S-15252	12	3/21/02	Silty clay, trace sand, moderate plasticity, strongly calcareous, extensive carbonate and manganese accumulations, yellowish brown, moist.
SB01	CNSB01-S-15253	14	3/21/02	Silty clay, trace sand, moderate plasticity, numerous manganese accumulations, yellowish and strong brown mottles, moist.
SB01	CNSB01-S-15254	16	3/21/02	Silty clay, trace pebbles to 1 in., moderately calcareous, occasional iron and manganese accumulations, yellowish brown with occasional strong brown mottles, moist.
SB01	CNSB01-S-15255	18	3/21/02	Same as above.
SB01	CNSB01-S-15256	20	3/21/02	Same as above with extensive carbonate.
SB01	CNSB01-S-15257	22	3/21/02	Silty clay, trace pebbles to 1 in., moderately calcareous, occasional iron and manganese accumulations, yellowish brown with occasional strong brown mottles, moist.
SB01	CNSB01-S-15259	24	3/21/02	Same as above.
SB01	CNSB01-S-15260	26	3/21/02	Clayey sand, 65% medium to coarse sand, plastic, moderately calcareous, clay layers at 26.2-26.3 ft BGL, some manganese accumulations, brownish yellow and strong brown iron accumulations, moist to wet.
SB01	CNSB01-S-15261	28	3/21/02	Clayey sand, same as above with more manganese accumulations. Water encountered at 28 ft BGL, with water level rising to 16 ft BGL.
SB06	CNSB06-S-15327	1-1.2	4/3/02	Clay, highly plastic, noncalcareous, organic-rich, very dark grayish brown.
SB06	CNSB06-S-15189	1.9-2	4/3/02	Clay, dark grayish brown, grading to grayish brown.
SB06	CNSB06-S-15328	4.6-4.8	4/3/02	Same as above, with increasing iron/iron oxide accumulations with depth (yellowish red).

TABLE D.1 (Cont.)

Location	Sample	Sample Depth (ft BGL)	Sample Date	Sample Description
Subsurface soil samples (Cont.)				
SB06	CNSB06-S-15188	6.9-7.1	4/3/02	Clay, noncalcareous, iron nodules (dark reddish brown), dark yellowish brown, increasing granules (< 5%) with depth.
SB06	CNSB06-S-15331	9-9.2	4/3/02	Clay, < 5% granules and pebbles (up to 1/2 in.), noncalcareous matrix, iron and manganese accumulations (calcareous, dark reddish brown) throughout, brown.
SB06	CNSB06-S-15332	10.9-11.1	4/3/02	Same as above.
SB06	CNSB06-S-15333	12.8-12.9	4/3/02	Same as above.
SB06	CNSB06-S-15334	14.9-15.1	4/3/02	Same as above. Sample collected beneath high concentration of unstained carbonates at 14 ft BGL.
SB06	CNSB06-S-15335	17-17.2	4/3/02	Clay, < 5% granules and pebbles (up to 1/2 in.), noncalcareous matrix, iron and manganese accumulations (calcareous, dark reddish brown) throughout, brown.
SB06	CNSB06-S-15336	18.9-19.1	4/3/02	Same as above.
SB06	CNSB06-S-15337	21-21.2	4/3/02	Silty clay, < 5% granules, matrix slightly calcareous, heavily manganese stained (very dark gray), some iron oxide accumulation, carbonate nodules up to 1.5 in. long, dark yellowish brown matrix, light brownish gray redox depletions.
SB06	CNSB06-S-15338	23-23.2	4/3/02	Same as above.
SB06	CNSB06-S-15339	25-25.2	4/3/02	Silty clay, 15% gravel and granules (up to 3/4 in.), 5% very coarse sand, some weathered sandstone pebbles, calcareous, abundant iron and manganese staining, grayish brown.
SB06	CNSB06-S-15340	27-27.2	4/3/02	Same as above. Sample collected above highly calcareous, cemented caliche zone.
SB06	CNSB06-S-15341	29-29.2	4/3/02	Silty clay, 10% gravel and granules, moderately to strongly calcareous, trace iron stains (much less than above), grayish brown.
SB06	CNSB06-S-15342	31-31.2	4/3/02	Same as above.
SB06	CNSB06-S-15343	33-33.2	4/3/02	Clay, 5% gravel and granules, numerous manganese, iron oxide accumulations (strong brown), moderately to strongly calcareous, dark brown.
SB06	CNSB06-S-15344	35-35.2	4/3/02	Same as above.
SB06	CNSB06-S-15190	37-37.2	4/4/02	Same as above. Collected above extensive carbonate accumulations at 38.2-38.3 ft BGL.
SB06	CNSB06-S-15191	39-39.2	4/4/02	Same as above. Collected above extensive carbonate accumulations at 39.6-40 ft BGL.

TABLE D.1 (Cont.)

Location	Sample	Sample Depth (ft BGL)	Sample Date	Sample Description
Subsurface soil samples (Cont.)				
SB06	CNSB06-S-15192	41-41.2	4/4/02	Silty clay, 5-10% granules, moderately calcareous, occasional iron oxide accumulations, light grayish brown, damp.
SB06	CNSB06-S-15193	43-43.2	4/4/02	Same as above.
SB06	CNSB06-S-15194	45-45.2	4/4/02	Same as above.
SB06	CNSB06-S-15177	47-47.2	4/4/02	Clay, < 5% granules, slightly calcareous, trace iron staining, light grayish brown, moist.
SB06	CNSB06-S-15178	49-49.2	4/4/02	Clay, as above, with 15% gravel and granules.
SB06	CNSB06-S-15179	51-51.2	4/4/02	Same as above. Sample collected just above iron oxide zone at 51.5-51.6 ft BGL.
SB06	CNSB06-S-15182	53-53.2	4/4/02	Clay, as above, with heavy iron oxide staining.
SB06	CNSB06-S-15183	55-55.2	4/4/02	Clay, as at 49-53 ft BGL.

TABLE D.2 Results of organic analyses by the headspace method at the AGEM Laboratory on soil samples collected during the Phase I investigation at Centralia.

				Concentration (µg/kg)	
Location	Sample	Depth (ft BGL)	Sample Date	Carbon Tetrachloride	Chloroform
Background near-surface soil sample					
QC	CNQCBG-S-15326	0.8-1	4/3/02	ND[a]	ND
Near-surface soil samples					
SU01	CNSU01-S-15096	0.9-1	3/20/02	0.15	ND
SU01	CNSU01-S-15097	4.7-4.9	3/20/02	0.66	ND
SU02	CNSU02-S-15098	1-1.2	3/20/02	0.53	ND
SU02	CNSU02-S-15099	5.8-6	3/20/02	0.14	1.14
SU03	CNSU03-S-15100	0.8-1	3/20/02	0.21	ND
SU03	CNSU03-S-15101	4.8-5	3/20/02	0.66	1.13
SU04	CNSU04-S-15102	0.9-1	3/20/02	ND	ND
SU04	CNSU04-S-15103	4.8-5	3/20/02	ND	1.18
SU05	CNSU05-S-15104	1-1.2	3/20/02	ND	ND
SU05	CNSU05-S-15105	4.8-5	3/20/02	ND	0.87
SU06	CNSU06-S-15106	0.5-0.8	3/23/02	ND	ND
SU06	CNSU06-S-15107	5-5.8	3/23/02	ND	ND
SU07	CNSU07-S-15108	0.7-0.9	3/23/02	0.9	3.01
SU07	CNSU07-S-15109	4.8-5	3/23/02	ND	ND
SU08	CNSU08-S-15110	2.4-2.6	3/23/02	ND	ND
SU08	CNSU08-S-15111	4.8-5	3/23/02	ND	ND
SU09	CNSU09-S-15112	1.4-1.6	3/23/02	0.21	ND
SU09	CNSU09-S-15113	4.35-4.55	3/23/02	0.17	ND
SU10	CNSU10-S-15114	0.6-0.8	3/23/02	0.98	ND
SU10	CNSU10-S-15116	4.7-4.9	3/23/02	0.11	ND
SU11	CNSU11-S-15117	0.5-0.7	3/23/02	1.2	ND
SU11	CNSU11-S-15118	4.5-4.7	3/23/02	ND	ND
SU12	CNSU12-S-15119	0.5-0.7	3/23/02	0.15	1.07
SU12	CNSU12-S-15120	4.6-4.8	3/23/02	0.12	ND
SU13	CNSU13-S-15121	1.5-1.7	3/23/02	0.79	0.76
SU13	CNSU13-S-15122	4.7-4.9	3/23/02	1.98	ND
SU14	CNSU14-S-15124	1-1.2	3/23/02	0.41	ND
SU14	CNSU14-S-15123	4.3-4.5	3/23/02	0.1	ND
SU15	CNSU15-S-15135	1-1.2	3/23/02	ND	ND
SU15	CNSU15-S-15136	4.5-4.7	3/23/02	0.24	1.3
SU16	CNSU16-S-15279	1-1.2	3/25/02	ND	ND
SU16	CNSU16-S-15280	4.5-4.7	3/25/02	ND	ND
SU17	CNSU17-S-15281	0.6-0.8	3/25/02	ND	ND
SU17	CNSU17-S-15282	3.8-4	3/25/02	ND	ND
SU18	CNSU18-S-15283	0.8-1.1	3/25/02	0.12	ND
SU18	CNSU18-S-15284	4.5-4.8	3/25/02	ND	ND
SU19	CNSU19-S-15285	0.8-1	3/25/02	ND	ND
SU19	CNSU19-S-15286	4.6-4.8	3/25/02	ND	ND

TABLE D.2 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Concentration (µg/kg) Carbon Tetrachloride	Chloroform
Near-surface soil samples (Cont.)					
SU20	CNSU20-S-15287	0.6-0.8	3/25/02	1.45	ND
SU20	CNSU20-S-15288	4.6-4.8	3/25/02	0.61	ND
SU21	CNSU21-S-15289	0.8-1	3/25/02	ND	ND
SU21	CNSU21-S-15290	4.6-4.8	3/25/02	0.17	ND
SU22	CNSU22-S-15291	0.6-0.8	3/25/02	ND	ND
SU22	CNSU22-S-15292	4.5-4.7	3/25/02	0.12	ND
SU23	CNSU23-S-15293	0.9-1.1	3/25/02	ND	ND
SU23	CNSU23-S-15294	4.5-5	3/25/02	ND	ND
SU24	CNSU24-S-15295	1-1.2	3/25/02	0.92	ND
SU24	CNSU24-S-15296	4.6-4.8	3/25/02	2.93	ND
SU25	CNSU25-S-15297	0.6-0.8	3/25/02	0.11	ND
SU25	CNSU25-S-15298	4.6-4.8	3/25/02	0.34	ND
SU26	CNSU26-S-15299	0.9-1.1	3/25/02	ND	ND
SU26	CNSU26-S-15300	4.7-4.8	3/25/02	0.14	ND
SU27	CNSU27-S-15301	0.9-1.1	3/25/02	0.24	ND
SU27	CNSU27-S-15302	4.8-5	3/25/02	0.2	ND
SU28	CNSU28-S-15303	0.8-1.1	3/25/02	ND	ND
SU28	CNSU28-S-15304	4.7-5	3/25/02	0.12	ND
SU29	CNSU29-S-15145	1.6-1.8	3/25/02	ND	ND
SU29	CNSU29-S-15146	4.6-4.8	3/25/02	ND	ND
SU30	CNSU30-S-15147	1.7-1.8	3/25/02	0.59	ND
SU30	CNSU30-S-15148	4.9-5	3/25/02	0.44	ND
SU31	CNSU31-S-15149	0.8-1	3/25/02	ND	ND
SU31	CNSU31-S-15150	4.8-4.9	3/25/02	0.21	ND
SU32	CNSU32-S-15151	1-1.2	3/25/02	0.78	ND
SU32	CNSU32-S-15152	4.8-5	3/25/02	ND	ND
SU33	CNSU33-S-15153	1.1-1.2	3/25/02	1.89	ND
SU33	CNSU33-S-15154	4.8-5	3/25/02	0.58	ND
SU34	CNSU34-S-15155	1.3-1.5	3/25/02	0.11	ND
SU34	CNSU34-S-15156	4.2-4.5	3/25/02	0.1	ND
SU35	CNSU35-S-15157	0.8-1	3/25/02	ND	ND
SU35	CNSU35-S-15158	3.6-3.8	3/25/02	ND	ND
SU36	CNSU36-S-15159	1-1.3	3/25/02	0.19	ND
SU36	CNSU36-S-15160	4.2-4.5	3/25/02	0.15	ND
SU37	CNSU37-S-15161	1-1.2	3/25/02	0.12	ND
SU37	CNSU37-S-15162	4.6-4.8	3/25/02	0.26	ND
SU38	CNSU38-S-15163	1-1.2	3/25/02	0.17	ND
SU38	CNSU38-S-15164	4.8-5	3/25/02	ND	ND
SU39	CNSU39-S-15165	1.4-1.6	3/25/02	ND	ND
SU39	CNSU39-S-15166	4.4-4.6	3/25/02	ND	ND
SU40	CNSU40-S-15167	0.8-1	3/25/02	ND	ND
SU40	CNSU40-S-15168	4.7-4.9	3/25/02	ND	ND
SU41	CNSU41-S-15169	0.8-1	3/25/02	0.14	1.05

TABLE D.2 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Concentration (µg/kg) Carbon Tetrachloride	Chloroform
Near-surface soil samples (Cont.)					
SU41	CNSU41-S-15170	4.8-4.9	3/25/02	ND	ND
SU42	CNSU42-S-15171	1-1.2	3/25/02	ND	ND
SU42	CNSU42-S-15172	4.8-5	3/25/02	0.22	ND
SU43	CNSU43-S-15173	0.9-1.2	3/25/02	ND	ND
SU43	CNSU43-S-15174	4.8-5	3/25/02	ND	ND

[a] ND, not detected at quantitation limits of 0.1 µg/kg for carbon tetrachloride and 0.75 µg/kg for chloroform.

TABLE D.3 Results of organic analyses by the purge-and-trap method at the AGEM Laboratory on soil samples collected during the Phase I investigation at Centralia.

				Concentration (µg/kg)	
Location	Sample	Depth (ft BGL)	Sample Date	Carbon Tetrachloride	Chloroform
Near-surface soil samples					
SU01	CNSU01-S-15096	0.9-1	3/20/02	ND[a]	ND
SU01	CNSU01-S-15097	4.7-4.9	3/20/02	ND	ND
SU02	CNSU02-S-15098	1-1.2	3/20/02	ND	ND
SU02	CNSU02-S-15099	5.8-6	3/20/02	ND	ND
SU03	CNSU03-S-15100	0.8-1	3/20/02	ND	ND
SU03	CNSU03-S-15101	4.8-5	3/20/02	ND	ND
SU04	CNSU04-S-15102	0.9-1	3/20/02	ND	ND
SU04	CNSU04-S-15103	4.8-5	3/20/02	ND	ND
SU05	CNSU05-S-15104	1-1.2	3/20/02	ND	ND
SU05	CNSU05-S-15105	4.8-5	3/20/02	ND	ND
SU06	CNSU06-S-15106	0.5-0.8	3/23/02	ND	ND
SU06	CNSU06-S-15107	5-5.8	3/23/02	ND	ND
SU07	CNSU07-S-15108	0.7-0.9	3/23/02	ND	ND
SU07	CNSU07-S-15109	4.8-5	3/23/02	ND	ND
SU08	CNSU08-S-15110	2.4-2.6	3/23/02	ND	ND
SU08	CNSU08-S-15111	4.8-5	3/23/02	ND	ND
SU09	CNSU09-S-15112	1.4-1.6	3/23/02	ND	ND
SU09	CNSU09-S-15113	4.35-4.55	3/23/02	ND	ND
SU10	CNSU10-S-15114	0.6-0.8	3/23/02	ND	ND
SU10	CNSU10-S-15116	4.7-4.9	3/23/02	ND	ND
SU11	CNSU11-S-15117	0.5-0.7	3/23/02	ND	ND
SU11	CNSU11-S-15118	4.5-4.7	3/23/02	ND	ND
SU12	CNSU12-S-15119	0.5-0.7	3/23/02	ND	ND
SU12	CNSU12-S-15120	4.6-4.8	3/23/02	ND	ND
SU13	CNSU13-S-15121	1.5-1.7	3/23/02	ND	ND
SU13	CNSU13-S-15122	4.7-4.9	3/23/02	ND	ND
SU14	CNSU14-S-15124	1-1.2	3/23/02	ND	ND
SU14	CNSU14-S-15123	4.3-4.5	3/23/02	ND	ND
SU15	CNSU15-S-15135	1-1.2	3/23/02	ND	ND
SU15	CNSU15-S-15136	4.5-4.7	3/23/02	ND	ND
SU16	CNSU16-S-15279	1-1.2	3/25/02	ND	ND
SU16	CNSU16-S-15280	4.5-4.7	3/25/02	ND	ND
SU17	CNSU17-S-15281	0.6-0.8	3/25/02	ND	ND
SU17	CNSU17-S-15282	3.8-4	3/25/02	ND	ND
SU18	CNSU18-S-15283	0.8-1.1	3/25/02	ND	ND
SU18	CNSU18-S-15284	4.5-4.8	3/25/02	ND	ND
SU19	CNSU19-S-15285	0.8-1	3/25/02	ND	ND
SU19	CNSU19-S-15286	4.6-4.8	3/25/02	ND	ND
SU20	CNSU20-S-15287	0.6-0.8	3/25/02	ND	ND
SU20	CNSU20-S-15288	4.6-4.8	3/25/02	ND	ND
SU21	CNSU21-S-15289	0.8-1	3/25/02	ND	ND
SU21	CNSU21-S-15290	4.6-4.8	3/25/02	ND	ND

TABLE D.3 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Concentration (µg/kg) Carbon Tetrachloride	Chloroform
Near-surface soil samples (Cont.)					
SU22	CNSU22-S-15291	0.6-0.8	3/25/02	ND	ND
SU22	CNSU22-S-15292	4.5-4.7	3/25/02	ND	ND
SU23	CNSU23-S-15293	0.9-1.1	3/25/02	ND	ND
SU23	CNSU23-S-15294	4.5-5	3/25/02	ND	ND
SU24	CNSU24-S-15295	1-1.2	3/25/02	ND	ND
SU24	CNSU24-S-15296	4.6-4.8	3/25/02	ND	ND
SU25	CNSU25-S-15297	0.6-0.8	3/25/02	ND	ND
SU25	CNSU25-S-15298	4.6-4.8	3/25/02	ND	ND
SU26	CNSU26-S-15299	0.9-1.1	3/25/02	ND	ND
SU26	CNSU26-S-15300	4.7-4.8	3/25/02	ND	ND
SU27	CNSU27-S-15301	0.9-1.1	3/25/02	ND	ND
SU27	CNSU27-S-15302	4.8-5	3/25/02	ND	ND
SU28	CNSU28-S-15303	0.8-1.1	3/25/02	ND	ND
SU28	CNSU28-S-15304	4.7-5	3/25/02	ND	ND
SU29	CNSU29-S-15145	1.6-1.8	3/25/02	ND	ND
SU29	CNSU29-S-15146	4.6-4.8	3/25/02	ND	ND
SU30	CNSU30-S-15147	1.7-1.8	3/25/02	ND	ND
SU30	CNSU30-S-15148	4.9-5	3/25/02	ND	ND
SU31	CNSU31-S-15149	0.8-1	3/25/02	ND	ND
SU31	CNSU31-S-15150	4.8-4.9	3/25/02	ND	ND
SU32	CNSU32-S-15151	1-1.2	3/25/02	ND	ND
SU32	CNSU32-S-15152	4.8-5	3/25/02	ND	ND
SU33	CNSU33-S-15153	1.1-1.2	3/25/02	ND	ND
SU33	CNSU33-S-15154	4.8-5	3/25/02	ND	ND
SU34	CNSU34-S-15155	1.3-1.5	3/25/02	ND	ND
SU34	CNSU34-S-15156	4.2-4.5	3/25/02	ND	ND
SU35	CNSU35-S-15157	0.8-1	3/25/02	ND	ND
SU35	CNSU35-S-15158	3.6-3.8	3/25/02	ND	ND
SU36	CNSU36-S-15159	1-1.3	3/25/02	ND	ND
SU36	CNSU36-S-15160	4.2-4.5	3/25/02	ND	ND
SU37	CNSU37-S-15161	1-1.2	3/25/02	ND	ND
SU37	CNSU37-S-15162	4.6-4.8	3/25/02	ND	ND
SU38	CNSU38-S-15163	1-1.2	3/25/02	ND	ND
SU38	CNSU38-S-15164	4.8-5	3/25/02	ND	ND
SU39	CNSU39-S-15165	1.4-1.6	3/25/02	ND	ND
SU39	CNSU39-S-15166	4.4-4.6	3/25/02	ND	ND
SU40	CNSU40-S-15167	0.8-1	3/25/02	ND	ND
SU40	CNSU40-S-15168	4.7-4.9	3/25/02	ND	ND
SU41	CNSU41-S-15169	0.8-1	3/25/02	ND	ND
SU41	CNSU41-S-15170	4.8-4.9	3/25/02	ND	ND
SU42	CNSU42-S-15171	1-1.2	3/25/02	ND	ND
SU42	CNSU42-S-15172	4.8-5	3/25/02	ND	ND
SU43	CNSU43-S-15173	0.9-1.2	3/25/02	ND	ND
SU43	CNSU43-S-15174	4.8-5	3/25/02	ND	ND

TABLE D.3 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Concentration (µg/kg) Carbon Tetrachloride	Chloroform
Subsurface soil samples					
SB01	CNSB01-S-15245	2	3/21/02	ND	ND
SB01	CNSB01-S-15246	4	3/21/02	ND	ND
SB01	CNSB01-S-15247	6	3/21/02	ND	ND
SB01	CNSB01-S-15249	8	3/21/02	ND	ND
SB01	CNSB01-S-15250	10	3/21/02	ND	ND
SB01	CNSB01-S-15252	12	3/21/02	ND	ND
SB01	CNSB01-S-15253	14	3/21/02	ND	ND
SB01	CNSB01-S-15254	16	3/21/02	ND	ND
SB01	CNSB01-S-15255	18	3/21/02	ND	ND
SB01	CNSB01-S-15256	20	3/21/02	ND	ND
SB01	CNSB01-S-15257	22	3/21/02	ND	ND
SB01	CNSB01-S-15259	24	3/21/02	ND	ND
SB01	CNSB01-S-15260	26	3/21/02	ND	ND
SB01	CNSB01-S-15261	28	3/21/02	ND	ND
SB06	CNSB06-S-15327	1-1.2	4/3/02	ND	ND
SB06	CNSB06-S-15189	1.9-2	4/3/02	ND	ND
SB06	CNSB06-S-15328	4.6-4.8	4/3/02	ND	ND
SB06	CNSB06-S-15188	6.9-7.1	4/3/02	ND	ND
SB06	CNSB06-S-15331	9-9.2	4/3/02	13	4 J[b]
SB06	CNSB06-S-15332	10.9-11.1	4/3/02	15	6.2 J
SB06	CNSB06-S-15333	12.8-12.9	4/3/02	10	4.5 J
SB06	CNSB06-S-15334	14.9-15.1	4/3/02	21	6.9 J
SB06	CNQCDU-S-15313	17-17.2	4/3/02	33	6 J
SB06	CNSB06-S-15336	18.9-19.1	4/3/02	18	ND
SB06	CNSB06-S-15337	21-21.2	4/3/02	15	3.9 J
SB06	CNSB06-S-15338	23-23.2	4/3/02	115	ND
SB06	CNSB06-S-15339	25-25.2	4/3/02	ND	12
SB06	CNSB06-S-15340	27-27.2	4/3/02	135	ND
SB06	CNSB06-S-15341	29-29.2	4/3/02	113	ND
SB06	CNSB06-S-15342	31-31.2	4/3/02	68	ND
SB06	CNSB06-S-15343	33-33.2	4/3/02	26	ND
SB06	CNSB06-S-15344	35-35.2	4/3/02	16	ND
SB06	CNSB06-S-15190	37-37.2	4/4/02	12	19
SB06	CNSB06-S-15191	39-39.2	4/4/02	ND	ND
SB06	CNSB06-S-15192	41-41.2	4/4/02	4.2 J	ND
SB06	CNSB06-S-15193	43-43.2	4/4/02	ND	ND
SB06	CNSB06-S-15194	45-45.2	4/4/02	ND	ND
SB06	CNSB06-S-15177	47-47.2	4/4/02	ND	ND
SB06	CNSB06-S-15178	49-49.2	4/4/02	ND	ND

TABLE D.3 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Concentration (µg/kg) Carbon Tetrachloride	Chloroform
Subsurface soil samples (Cont.)					
SB06	CNSB06-S-15179	51-51.2	4/4/02	ND	ND
SB06	CNSB06-S-15182	53-53.2	4/4/02	ND	ND
SB06	CNSB06-S-15183	55-55.2	4/4/02	ND	ND

[a] ND, contaminant not detected.

[b] J, estimated concentration below quantitation limit of 10 µg/kg.

TABLE D.4 Results of particle size analysis on subsurface soil samples collected during the Phase I investigation at Centralia, Kansas.

Location	Depth (ft BGL)	Particles Passing through Sieve Size (%)															
		1 in.	3/4 in.	1/2 in.	3/8 in.	#4	#10	#18	#20	#35	#40	#50	#60	#100	#140	#200	#270
SB01	2-3	100	100	100	100	100	100	99.6	99.4	98.7	98.4	97.6	97.1	95.6	94.9	94.2	92.9
SB01	17-18	100	100	100	100	99.8	98.5	96.9	96.5	93.7	92.3	88.6	86.4	79.7	76.1	73	69.5
SB01	25.7-26.6	100	100	100	97.1	97.1	96	94.7	94.1	90.8	79.9	69.8	38.2	27.4	26.6	23.3	20.9
SB01	28.3-28.7	100	100	100	100	99.4	96	85.2	82.2	69.8	65.1	56.8	53.3	46.1	43.2	41.3	39.8
SB01	30-30.8	100	100	100	97.9	94.9	89.4	85.1	83.7	75.7	71.7	62.1	57.4	46.3	42.4	40.1	38.3
SB01	31.4-32.6	100	100	100	100	99.2	96.5	91	89.3	79.9	75.7	65.6	60.1	46.5	41.4	37.7	35
SB01	33.3-34	100	100	100	100	97.7	94.5	92.6	92.2	89.6	87.8	81.8	76.1	51.6	36.9	30	24.2
SB01	37-38	100	100	100	100	100	97.8	96	95.5	92.7	91.1	87.4	85	78	74.1	70.2	67.3
SB01	41-42	100	100	100	100	100	100	99.8	99.8	99.6	99.5	97.9	93.9	73.6	53.1	48.3	45.9
SB01	58-59	100	100	100	100	100	100	100	100	100	100	100	100	93.7	86.4	84.3	82.7
SB01	64-65	100	100	100	100	100	100	99.9	99.9	99.8	99.8	99.8	99.8	99.7	99.4	96.5	86.6
SB01	85.4-86.7	100	100	100	100	100	100	100	100	99.9	99.9	99.9	99.8	72.5	41.5	28	18.5
SB01	90-90.8	100	100	100	100	100	100	100	100	100	100	100	100	100	99.1	98	97.2
SB06	25.7-26.7	100	100	100	100	100	100	98.5	98	95.3	93.9	90	87.7	80.3	77.1	74.1	69.8
SB06	56.7-57	100	74.3	65.6	62.8	58.8	52.2	44.7	43.2	36.4	34.1	30.1	28.3	24.1	22	20.4	18.6
SB06	59-60.7	100	100	100	100	100	100	100	99.7	98.9	98.5	97.8	97.4	93.1	83.6	66.7	48.4
SB06	62.4-63.5	100	100	100	100	100	96.5	93.2	91.9	81.9	74.6	51.7	41	22.9	18.6	16	14.5
SB06	63.7-64.3	100	100	100	100	100	99.7	99.1	99	98.1	97.4	96	95.1	70.7	49.2	35.9	24.4
SB06	67-68.8	100	100	100	98.8	98.7	98.1	95.6	95	91.7	90	83.9	79	61.7	51.5	43.4	34.1
SB09	40-41	100	100	100	100	100	100	99.3	99	96.2	93.4	81.3	69.2	28.4	16.5	12.2	9.2
SB09	43-43.5	100	100	100	100	99.5	98.4	94.3	91.7	74.6	67	47.1	37	16.5	9.3	8.2	7.6
SB09	44.5-45	100	100	100	100	100	100	99.9	99.9	99.7	99.6	99	97.4	64.3	48.7	38.5	28.8
SB09	46-46.5	100	100	100	100	100	100	100	100	100	100	99.9	99.8	93.2	76.1	61.5	41.6
SB10[a]	53.5-54.5	100	100	100	100	100	100	99.9	99.9	99.9	99.9	99.8	99.8	99.2	98.3	94.8	83.4
SB10[a]	58.5-59.5	100	100	100	100	100	100	100	100	100	100	99.9	99.9	99.8	99.5	94	79

[a] Sample from location initially designated SB05.

TABLE D.5 Compositions of soil samples collected during the Phase I field investigation at Centralia, Kansas.

Location	Depth (ft BGL)	Composition (%)			
		Gravel	Sand	Silt	Clay
SB01	2-3	0	5.8	44.5	49.7
SB01	17-18	0.2	26.8	35.6	37.4
SB01	25.7-26.6	2.9	73.8	12	11.3
SB01	28.3-28.7	0.6	58.1	16.9	24.4
SB01	30-30.8	5.1	54.8	19.2	20.9
SB01	31.4-32.6	0.8	61.5	16.6	21.1
SB01	33.3-34	2.3	67.7	24.4	5.6
SB01	37-38	0	29.8	34.9	35.3
SB01	41-42	0	51.7	17.1	31.2
SB01	58-59	0	15.7	67.2	17.1
SB01	64-65	0	3.5	68.9	27.6
SB01	85.4-86.7	0	72	23.4	4.6
SB01	90-90.8	0	2	64	34
SB06	25.7-26.7	0	25.9	32.3	41.8
SB06	56.7-57	41.2	38.4	20.4[a]	NA[b]
SB06	59-60.7	0	33.3	57.4	9.3
SB06	62.4-63.5	0	84	11.3	4.7
SB06	63.7-64.3	0	64.1	35.9[a]	NA
SB06	67-68.8	1.3	55.3	34.8	8.6
SB09	40-41	0	87.8	7.2	5
SB09	43-43.5	0.5	91.3	4.7	3.5
SB09	44.5-45	0	61.5	29.9	8.6
SB09	46-46.5	0	38.5	50.7	10.8
SB10	53.5-54.5	0	5.2	63.5	31.3
SB10	58.5-59.5	0	6	66.3	27.7

[a] Sample too small for hydrometer test. Percent silt determined at #200. Percent clay not determined.

[b] NA, not available.

Appendix E:

Field Guidance for Soil and Geologic Log Descriptions

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Appendix E:

Field Guidance for Soil and Geologic Log Descriptions

March 15, 2002

E.1 Soil/Geologic Logging

1. Retrieve core.

2. Note interval depth on log form

3. Open liner

4. Remove slough, if appropriate

5. Note on form % core recovered

6. Visually examine core and mark section/intervals to be described. Examples of interval boundaries include strong textural contrasts, strong color contrasts. Normally intervals less than 6 inches thick should be noted as contrasting inclusions rather than as separate intervals unless they have clear hydrostratigraphic significance (i.e., dense clay layer separating sands).

7. Sample for CT or moisture (as appropriate) from section/interval. Note # of sample(s) on log form.

8. Split core as needed to better view and modify boundaries of section/interval as appropriate.

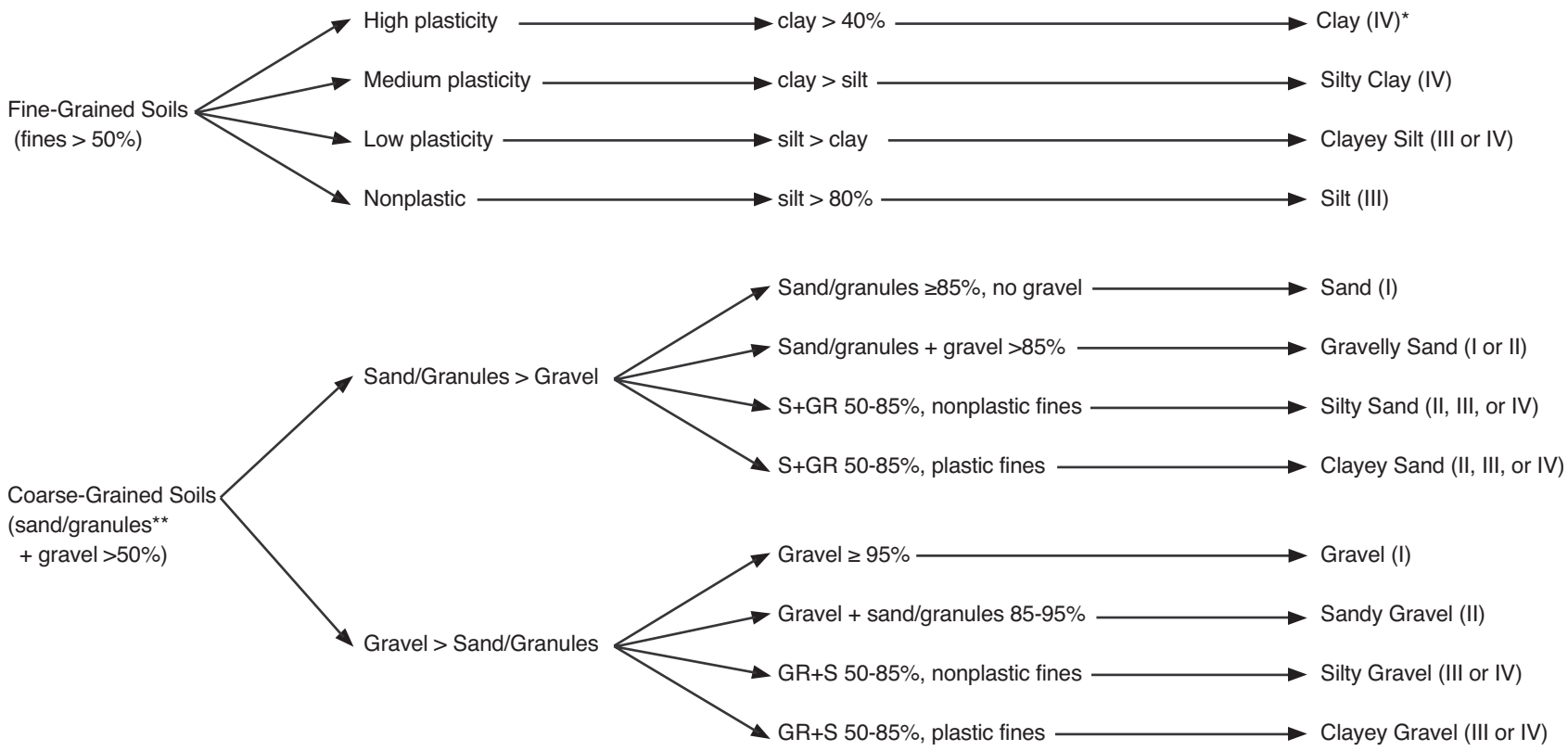
9. Describe each section/interval and note on log form as follows:

   Major texture (see Chart 1): If coarse-grained include % sand, % granules, % gravel, sorting, rounding; if fine-grained include plasticity; carbonates, Fe/Mn accumulations; sedimentary structures and other significant features (if appropriate); color; moisture.

Please describe on form in same order as above and use attached guidance for estimating % sand, % granules, % gravel, plasticity, color and moisture.

Chart 1. Guidance for Determining Major Textures in Field (Revised 6/25/02)

Note: Perform coarse-grained or fine-grained tests, as appropriate and use chart to determine major texture



* Hydrostratigraphic units: I = ≥1.0 ft/d, II = 0.1 to 1.0 ft/d, III = 0.01 to 0.1 ft/d, IV = ≤0.01 ft/d.
In coarse-grained materials where two units are shown, 65% is the dividing line between units.

** For purposes of determining major texture, add sand and granule percentages.

E.2 Guidance for Field Grain-Size Characterization

This section describes are series of tests that can be used, as needed, to help estimate grain-size percentages and material plasticity. Use latex gloves to prevent direct contact of skin with the soil material.

1. Coarse/Fine Grained Soil Test: If soil is not obviously coarse or fine-grained, excessively wet a small pinch of soil in palm and rub with forefinger. If soil feels very gritty it is coarse-grained (proceed to next test); if not, proceed to plasticity test for fine-grained soils on next page.

2. Granule/Gravel Percentages: If granules or gravel are present, place a representative scoop of soil in a #10 sieve. Place the separates in two piles on a clean surface and pick out any pieces of gravel (pea sized and larger) to make a third pile. Visually estimate the percent gravel and granules and use the sand/fines pile for the Clean/Dirty Test. Alternatively use graduated test tubes for a more precise estimate.

3. Clean/Dirty Test: Place sand + fines fraction from the sieve test or non-gravelly coarse-grained soil in palm and saturate with water. Squeeze into a ball. Hands will not be stained when fines are less than 5%. If hands are stained but no casts can be formed there is 5-15% fines. If hands are stained and weak casts can be formed there is >15% fines (do coarse-grained plasticity test on next page. Estimated sand percentage = 100 - % gravel - % granules - % fines.

Chart 2. Wentworth Sand/Gravel Grade Names

Sieve	Grade Limit	Wentworth Sand/Gravel Grade Names
	3.0"	Cobbles
	3/4"	Coarse to very coarse gravel
#4	0.19" = 4.75 mm	Fine to medium gravel
#10	2.0 mm	Granules
#18	1.0 mm	Very coarse sand
#35	0.5 mm	Coarse sand
#60	0.25 mm	Medium sand
#120	0.125 mm	Fine sand
#200	0.074 mm	Very fine sand

4. Coarse Grain-Size Description: After the major texture, provide additional description of coarse-grained material as appropriate. Wentworth coarse-grained grade names are summarized in

Chart 2, and a reference set of grain-sizes on each CPT unit may be helpful for comparison with a sample being described. Use Burmeister conventions for coarse grained subcomponents. For example: very fine to medium sand (70%); coarse to very coarse sand (70%), granules (10%), fine gravel (5%). Note: Burmeister conventions omit mention of subcomponent fractions <10%, but sand and gravel total percentages should include all fractions.

5. Plasticity Tests (Fines > 50%): When fines are >50%, record plasticity as N (non plastic), L (low), M (medium) or H (high). Use the following tests to evaluate plasticity (*Note*: not all tests need necessarily be performed for an interval, if the first test yield uncertain results, try the second, and if still uncertain try the third test):

Plasticity Test 1 (Stickiness): Saturate a piece of soil and press between thumb and forefinger. Observe the adhesion to thumb and forefinger when they are pulled apart: N = nonsticky (practically no adhesion, L = slight sticky (stick to thumb or forefinger), M - sticky (adheres to both fingers), H = very sticky (adheres to both, stretches decidedly).

Plasticity Test 2 (Thread Pull Test): Add about 3 teaspoons of soil to material used for stickiness test (sieve to remove >2 mm size fraction, if required), wet and mold so that is can be rolled into a thread without crumbling (if material sticks to hands it is too wet). Roll the moist soil with the palm of the hand on any clean surface to form a coarse thread and pull it apart. Observe difficulty of pulling thread apart: L = weak (easily pulled apart), M = medium tough, H = tough (hard to pull apart).

Plasticity Test 3 (Thread Support Test): Remold sample from Test 2 to form a 4 mm thread and hold it on the end and see if it supports itself. If it supports itself and a 2 mm thread does not = M (medium plasticity). If 2 mm thread supports itself = H (high plasticity). If 4 mm thread does not support itself, roll a 6 mm thread. If 6 mm thread supports itself = L (low plasticity). If it does not support itself = N (nonplastic).

6. Plasticity Tests (Coarse-grained, fines >15%). Pass about 3 teaspoons of soil through a #35 sieve to remove >0.5 mm fraction. Add water to <#35 sieve fraction until it is moldable like moist putty. Perform tests described above for fine-grained materials.

E.3 Guidance for Color Description

1. Break off a small piece of core representative of the dominant matrix color and using an unsmeared face of the fragment, find the closest match to a chip in the Munsell Soil Color Chart. Use natural light if possible or full-spectrum light if not.

2. Record the color on the facing page of the Munsell Soil Color Chart that corresponds to the chip matched and note the Hue in parentheses. For example: brown (10YR).

3. If several colors are codominant, record both colors with an "and". For example, "brown (10YR) and yellowish brown (10YR)" indicates that the colors are about equal and are codominant.

4. Record color of mottles after the dominant color using the term "with".

For example: brown (10YR) with light gray (10YR) mottles.

E.4 Soil Moisture Description Guidance

1. Place about 6 teaspoons of soil from the interval being described in the palm of the hand and squeeze firmly to form a ball about 3 to 4 cm in diameter. This is done in about five squeezes.

2. Use Chart 3 to estimate moisture status.

Chart 3. Guide for Describing Moisture Content of Soil (May need some adaptation for soils with gravel.) Form ball by squeezing a handful of soil very firmly about five times. Use appropriate texture column to determine moisture term to record.

Moisture Term	Texture			
	Coarse (>85% sand)	Moderately Coarse (50-85% sand)	Medium (silt, clayey silt)	Fine (clay, silty clay)
Wet (saturated)	Upon squeezing free water forms on ball of soil or a wet outline of ball is left on hand	Upon squeezing free water forms on ball of soil or a wet outline of ball is left on hand	Upon squeezing free water forms on ball of soil or a wet outline of ball is left on hand	Upon squeezing free water forms on ball of soil or a wet outline of ball is left on hand
Moist	Tends to stick together slightly, sometimes forms a very weak ball under pressure	Forms weak ball, breaks easily, will not stick	Forms a ball, is very pliable, slicks readily if clayey silt	Easily ribbons out between fingers, has slick feeling
Damp	--	Tends to ball under pressure but seldom holds together	Forms a ball somewhat plastic, will sometimes slick slightly with pressure	Forms a ball, ribbons out between thumb and forefinger
Dry	Appears to be dry, will not form a ball with pressure; dry, loose, single-grained, flows through fingers	Appears to be dry, will not form a ball; dry, loose, flows through fingers	Somewhat crumbly but holds together from pressure; powdery, dry, sometimes slightly crusted but easily brokendown into powdery condition	Somewhat pliable, will ball under pressure; hard, baked, cracked, sometimes has loose crumbs on surface

Adapted from USDA 1993 *Soil Survey Manual* and Israelson and Hansens' 1962 *Irrigation Principles and Practices*. Note that the dry to moist terms in this chart all fall within the moist water state class in the *Soil Survey Manual*, while the term "wet" corresponds to field capacity or nonsatiated or satiated water class in the *Soil Survey Manual*.

Appendix F:

Water Level Data

TABLE F.1 Specifications for temporary piezometers at Centralia and manual water level measurements in April 2002.

Piezometer	Elevation (ft AMSL)		Piezometer Depth (ft BGL)	Screen Interval (ft BGL)	Measurement		Water Level	
	Ground Surface	Reference[a]			Date	Time	Depth (ft BGL)	Elevation (ft AMSL)
SB01t	1325.3	1325.3	45	40-45	4/10/02	8:45	22.37	1302.93
SB01t	1325.3	1325.3	45	40-45	4/12/02	8:39	22.26	1303.04
SB03t	1333.11	1333.11	62	54-62	4/6/02	8:15	53.8	1279.31
SB03t	1333.11	1333.11	62	54-62	4/10/02	8:25	42.27	1290.84
SB04t	1336.08	1336.08	60	56-60	4/10/02	8:32	23.98	1312.1
SB04t	1336.08	1336.08	60	56-60	4/12/02	8:50	23.92	1312.16
SB05t	1321.59	1321.59	37	32-37	4/10/02	8:40	14.47	1307.12
SB05t	1321.59	1321.59	37	32-37	4/12/02	8:37	14.45	1307.14
SB06t	1336.9	1336.9	66	61-66	4/10/02	8:30	24.7	1312.2
SB06t	1336.9	1336.9	66	61-66	4/12/02	8:58	24.62	1312.28
SB07t	1331.84	1331.84	56	46-56	4/12/02	8:46	19.86	1311.98
SB08t	1333.02	1333.02	58	53-58	4/10/02	8:55	20.98	1312.04
SB08t	1333.02	1333.02	58	53-58	4/12/02	8:55	20.95	1312.07
SB09t	1311.33	1311.33	41.5	36.5-41.5	4/10/02	8:50	8.6	1302.73
SB09t	1311.33	1311.33	41.5	36.5-41.5	4/12/02	8:41	8.65	1302.68

[a] Surveyed reference point for measuring water level depth.

TABLE F.2 Specifications for permanent piezometers at Centralia.

Piezometer	Elevation (ft AMSL)		Piezometer Depth (ft BGL)	Screen Interval (ft BGL)
	Ground Surface	Reference[a]		
SB01	1325.6	1325.16	50	40-50
SB04	1336.2	1335.73	61	51-61
SB05	1321.6	1321.28	42	32-42
SB07	1332.4	1331.94	55	48-55
SB08	1333.0	1332.56	62	52-62
SB09	1311.5	1311.04	42	32-42

[a] Surveyed reference point for measuring water level depth.

TABLE F.3 Water level depths in permanent piezometers at Centralia, from April 25, 2002, to June 3, 2002.

Recording Transducer Reading								Barometric Reading		
		Depth to Groundwater (ft BGL)								
Date	Time	SB01	SB04	SB05	SB07	SB08	SB09	Date	Time	Pressure (psi)
4/25/02	12:00:00	17.450	23.378	14.178	18.893	20.161	8.432	4/25/02	12:00:00	14.216
4/25/02	16:00:03	18.075	23.361	14.158	18.867	20.147	8.396	4/25/02	16:00:00	14.176
4/25/02	20:00:06	18.571	23.343	14.148	18.846	20.132	8.373	4/25/02	20:00:00	14.168
4/26/02	0:00:09	18.980	23.346	14.150	18.842	20.138	8.367	4/26/02	0:00:00	14.160
4/26/02	4:00:12	19.323	23.333	14.141	18.827	20.122	8.358	4/26/02	4:00:00	14.152
4/26/02	8:00:15	19.601	23.331	14.139	18.825	20.122	8.354	4/26/02	8:00:00	14.162
4/26/02	12:00:18	19.832	23.331	14.141	18.821	20.124	8.354	4/26/02	12:00:00	14.131
4/26/02	16:00:21	20.021	23.298	14.122	18.795	20.091	8.325	4/26/02	16:00:00	14.078
4/26/02	20:00:24	20.181	23.265	14.100	18.752	20.057	8.295	4/26/02	20:00:00	14.047
4/27/02	0:00:27	20.320	23.236	14.082	18.720	20.031	8.268	4/27/02	0:00:00	13.971
4/27/02	4:00:30	20.425	23.174	14.030	18.645	19.966	8.211	4/27/02	4:00:00	13.920
4/27/02	8:00:33	20.517	23.143	13.996	18.606	19.941	8.182	4/27/02	8:00:00	13.845
4/27/02	12:00:36	20.563	23.057	13.923	18.521	19.853	8.108	4/27/02	12:00:00	13.764
4/27/02	16:00:39	20.599	22.999	13.863	18.408	19.785	8.036	4/27/02	16:00:00	13.773
4/27/02	20:00:42	20.674	23.022	13.869	18.369	19.816	8.043	4/27/02	20:00:00	13.887
4/28/02	0:00:45	20.747	23.065	13.889	18.377	19.861	8.078	4/28/02	0:00:00	13.943
4/28/02	4:00:48	20.824	23.115	13.913	18.392	19.904	8.106	4/28/02	4:00:00	14.022
4/28/02	8:00:51	20.897	23.156	13.941	18.414	19.945	8.134	4/28/02	8:00:00	14.082
4/28/02	12:00:54	20.969	23.193	13.967	18.437	19.984	8.159	4/28/02	12:00:00	14.096
4/28/02	16:00:57	21.025	23.189	13.969	18.425	19.982	8.148	4/28/02	16:00:00	14.064
4/28/02	20:01:00	21.070	23.187	13.967	18.397	19.978	8.127	4/28/02	20:00:00	14.089
4/29/02	0:01:03	21.113	23.191	13.967	18.393	19.985	8.123	4/29/02	0:00:00	14.086
4/29/02	4:01:06	21.153	23.187	13.963	18.382	19.978	8.112	4/29/02	4:00:00	14.060
4/29/02	8:01:09	21.192	23.191	13.961	18.371	19.984	8.100	4/29/02	8:00:00	14.092
4/29/02	12:01:12	21.228	23.197	13.965	18.363	19.989	8.102	4/29/02	12:00:00	14.061
4/29/02	16:01:15	21.250	23.170	13.950	18.333	19.962	8.075	4/29/02	16:00:00	14.016
4/29/02	20:01:18	21.258	23.144	13.930	18.298	19.939	8.047	4/29/02	20:00:00	14.019
4/30/02	0:01:21	21.271	23.127	13.917	18.279	19.923	8.035	4/30/02	0:00:00	13.991
4/30/02	4:01:24	21.277	23.111	13.902	18.255	19.906	8.020	4/30/02	4:00:00	13.962
4/30/02	8:01:27	21.284	23.088	13.886	18.227	19.884	7.999	4/30/02	8:00:00	13.959
4/30/02	12:01:30	21.293	23.078	13.878	18.219	19.875	7.995	4/30/02	12:00:00	13.932
4/30/02	16:01:33	21.292	23.053	13.859	18.191	19.849	7.976	4/30/02	16:00:00	13.920
4/30/02	20:01:36	21.295	23.045	13.850	18.176	19.842	7.971	4/30/02	20:00:00	13.927
5/1/02	0:01:39	21.295	23.026	13.837	18.164	19.824	7.965	5/1/02	0:00:00	13.911
5/1/02	4:01:42	21.299	23.010	13.826	18.154	19.806	7.957	5/1/02	4:00:00	13.871
5/1/02	8:01:45	21.299	22.995	13.812	18.140	19.793	7.948	5/1/02	8:00:00	13.875
5/1/02	12:01:48	21.293	22.967	13.793	18.114	19.765	7.929	5/1/02	12:00:00	13.845
5/1/02	16:01:51	21.293	22.962	13.785	18.104	19.761	7.927	5/1/02	16:00:00	13.890
5/1/02	20:01:54	21.314	23.002	13.804	18.144	19.801	7.969	5/1/02	20:00:00	13.948
5/2/02	0:01:57	21.338	23.026	13.821	18.181	19.824	8.001	5/2/02	0:00:00	13.994
5/2/02	4:02:00	21.361	23.049	13.837	18.219	19.847	8.026	5/2/02	4:00:00	14.007
5/2/02	8:02:03	21.385	23.068	13.850	18.251	19.867	8.045	5/2/02	8:00:00	14.044
5/2/02	12:02:06	21.406	23.074	13.859	18.275	19.877	8.058	5/2/02	12:00:00	14.030
5/2/02	16:02:09	21.421	23.068	13.859	18.281	19.871	8.049	5/2/02	16:00:00	14.008
5/2/02	20:02:12	21.430	23.068	13.858	18.275	19.869	8.041	5/2/02	20:00:00	14.029
5/3/02	0:02:15	21.445	23.076	13.859	18.284	19.878	8.054	5/3/02	0:00:00	14.039
5/3/02	4:02:18	21.457	23.074	13.863	18.296	19.880	8.060	5/3/02	4:00:00	14.040
5/3/02	8:02:21	21.470	23.092	13.869	18.311	19.892	8.069	5/3/02	8:00:00	14.045
5/3/02	12:02:24	21.479	23.096	13.871	18.318	19.898	8.071	5/3/02	12:00:00	14.043

TABLE F.3 (Cont.)

Recording Transducer Reading								Barometric Reading		
		Depth to Groundwater (ft BGL)								
Date	Time	SB01	SB04	SB05	SB07	SB08	SB09	Date	Time	Pressure (psi)
5/3/02	16:02:27	21.487	23.090	13.869	18.322	19.894	8.068	5/3/02	16:00:00	14.028
5/3/02	20:02:30	21.494	23.090	13.869	18.318	19.896	8.067	5/3/02	20:00:00	14.048
5/4/02	0:02:33	21.503	23.099	13.872	18.326	19.904	8.079	5/4/02	0:00:00	14.050
5/4/02	4:02:36	21.511	23.099	13.872	18.329	19.906	8.079	5/4/02	4:00:00	14.069
5/4/02	8:02:39	21.526	23.134	13.891	18.365	19.938	8.105	5/4/02	8:00:00	14.115
5/4/02	12:02:42	21.539	23.142	13.898	18.387	19.947	8.119	5/4/02	12:00:00	14.101
5/4/02	16:02:45	21.549	23.136	13.898	18.389	19.945	8.121	5/4/02	16:00:00	14.085
5/4/02	20:02:48	21.554	23.146	13.904	18.391	19.952	8.119	5/4/02	20:00:00	14.112
5/5/02	0:02:51	21.565	23.152	13.907	18.402	19.962	8.130	5/5/02	0:00:00	14.116
5/5/02	4:02:54	21.573	23.148	13.906	18.402	19.954	8.128	5/5/02	4:00:00	14.096
5/5/02	8:02:57	21.576	23.148	13.904	18.401	19.954	8.125	5/5/02	8:00:00	14.086
5/5/02	12:03:00	21.575	23.132	13.895	18.387	19.940	8.111	5/5/02	12:00:00	14.024
5/5/02	16:03:03	21.558	23.092	13.869	18.346	19.902	8.073	5/5/02	16:00:00	13.975
5/5/02	20:03:06	21.545	23.074	13.830	18.303	19.884	8.046	5/5/02	20:00:00	13.957
5/6/02	0:03:09	21.530	23.055	13.817	18.281	19.863	8.031	5/6/02	0:00:00	13.976
5/6/02	4:03:12	21.511	23.006	13.765	18.237	19.818	7.999	5/6/02	4:00:00	13.972
5/6/02	8:03:15	21.503	23.020	13.758	18.221	19.830	7.995	5/6/02	8:00:00	13.967
5/6/02	12:03:18	21.492	23.022	13.745	18.185	19.830	7.982	5/6/02	12:00:00	13.969
5/6/02	16:03:21	21.486	23.014	13.736	18.132	19.822	7.964	5/6/02	16:00:00	13.960
5/6/02	20:03:24	21.479	23.004	13.732	18.084	19.822	7.951	5/6/02	20:00:00	13.971
5/7/02	0:03:27	21.477	23.016	13.732	18.048	19.830	7.949	5/7/02	0:00:00	13.983
5/7/02	4:03:30	21.473	23.022	13.732	18.018	19.836	7.945	5/7/02	4:00:00	13.998
5/7/02	8:03:33	21.475	23.035	13.736	17.999	19.847	7.949	5/7/02	8:00:00	14.006
5/7/02	12:03:36	21.475	23.029	13.732	17.977	19.845	7.942	5/7/02	12:00:00	13.977
5/7/02	16:03:39	21.466	23.002	13.713	17.930	19.816	7.909	5/7/02	16:00:00	13.922
5/7/02	20:03:42	21.451	22.983	13.696	17.885	19.796	7.882	5/7/02	20:00:00	13.924
5/8/02	0:03:45	21.434	22.954	13.678	17.846	19.769	7.860	5/8/02	0:00:00	13.857
5/8/02	4:03:48	21.413	22.927	13.654	17.799	19.744	7.835	5/8/02	4:00:00	13.866
5/8/02	8:03:51	21.402	22.930	13.650	17.789	19.746	7.840	5/8/02	8:00:00	13.875
5/8/02	12:03:54	21.392	22.923	13.643	17.773	19.812	7.837	5/8/02	12:00:00	13.832
5/8/02	16:03:57	21.383	22.899	13.632	17.750	19.721	7.827	5/8/02	16:00:00	13.863
5/8/02	20:04:00	21.385	22.930	13.647	17.767	19.752	7.861	5/8/02	20:00:00	13.938
5/9/02	0:04:03	21.404	22.993	13.682	17.834	19.812	7.920	5/9/02	0:00:00	14.017
5/9/02	4:04:06	21.428	23.029	13.708	17.894	19.847	7.962	5/9/02	4:00:00	14.064
5/9/02	8:04:09	21.453	23.064	13.735	17.947	19.884	7.998	5/9/02	8:00:00	14.112
5/9/02	12:04:12	21.479	23.097	13.761	17.992	19.919	8.029	5/9/02	12:00:00	14.115
5/9/02	16:04:15	21.498	23.096	13.765	18.007	19.919	8.025	5/9/02	16:00:00	14.104
5/9/02	20:04:18	21.511	23.103	13.769	18.013	19.925	8.025	5/9/02	20:00:00	14.127
5/10/02	0:04:21	21.528	23.129	13.783	18.039	19.952	8.044	5/10/02	0:00:00	14.136
5/10/02	4:04:24	21.541	23.129	13.785	18.044	19.950	8.038	5/10/02	4:00:00	14.146
5/10/02	8:04:27	21.552	23.144	13.791	18.059	19.966	8.044	5/10/02	8:00:00	14.168
5/10/02	12:04:30	21.563	23.156	13.800	18.074	19.982	8.053	5/10/02	12:00:00	14.152
5/10/02	16:04:33	21.565	23.123	13.782	18.054	19.950	8.027	5/10/02	16:00:00	14.095
5/10/02	20:04:36	21.556	23.105	13.765	18.027	19.929	8.000	5/10/02	20:00:00	14.084
5/11/02	0:04:39	21.548	23.063	13.719	17.998	19.904	7.979	5/11/02	0:00:00	14.043
5/11/02	4:04:42	21.520	23.004	13.635	17.921	19.826	7.876	5/11/02	4:00:00	13.974
5/11/02	8:04:45	21.494	22.996	13.591	17.849	19.808	7.686	5/11/02	8:00:00	13.968
5/11/02	12:04:48	21.464	22.973	13.549	17.780	19.781	7.482	5/11/02	12:00:00	13.949
5/11/02	16:04:51	21.434	22.928	13.484	17.671	19.750	7.288	5/11/02	16:00:00	13.938

TABLE F.3 (Cont.)

Recording Transducer Reading								Barometric Reading		
		Depth to Groundwater (ft BGL)								
Date	Time	SB01	SB04	SB05	SB07	SB08	SB09	Date	Time	Pressure (psi)
5/11/02	20:04:54	21.413	22.930	13.471	17.615	19.758	7.174	5/11/02	20:00:00	13.993
5/12/02	0:04:57	21.400	22.944	13.443	17.581	19.764	7.067	5/12/02	0:00:00	14.018
5/12/02	4:05:00	21.391	22.969	13.425	17.545	19.787	6.871	5/12/02	4:00:00	14.038
5/12/02	8:05:03	21.383	22.995	13.406	17.508	19.787	6.784	5/12/02	8:00:00	14.087
5/12/02	12:05:06	21.383	22.989	13.382	17.473	19.806	6.719	5/12/02	12:00:00	14.113
5/12/02	16:05:09	21.383	22.995	13.364	17.439	19.818	6.612	5/12/02	16:00:00	14.116
5/12/02	20:05:12	21.383	22.998	13.343	17.398	19.824	6.519	5/12/02	20:00:00	14.152
5/13/02	0:05:15	21.387	23.019	13.334	17.369	19.843	6.462	5/13/02	0:00:00	14.163
5/13/02	4:05:18	21.391	23.020	13.321	17.341	19.851	6.401	5/13/02	4:00:00	14.178
5/13/02	8:05:21	21.391	23.035	13.301	17.321	19.855	6.354	5/13/02	8:00:00	14.187
5/13/02	12:05:24	21.389	23.043	13.286	17.295	19.857	6.312	5/13/02	12:00:00	14.175
5/13/02	16:05:27	21.385	23.020	13.264	17.257	19.842	6.285	5/13/02	16:00:00	14.150
5/13/02	20:05:30	21.377	22.985	13.234	17.218	19.816	6.272	5/13/02	20:00:00	14.147
5/14/02	0:05:33	21.370	22.979	13.212	17.191	19.806	6.268	5/14/02	0:00:00	14.138
5/14/02	4:05:36	21.361	22.965	13.186	17.173	19.791	6.264	5/14/02	4:00:00	14.139
5/14/02	8:05:39	21.353	22.965	13.168	17.157	19.783	6.266	5/14/02	8:00:00	14.142
5/14/02	12:05:42	21.344	22.950	13.147	17.140	19.766	6.266	5/14/02	12:00:00	14.104
5/14/02	16:05:45	21.327	22.905	13.114	17.103	19.727	6.254	5/14/02	16:00:00	14.056
5/14/02	20:05:48	21.308	22.857	13.079	17.062	19.690	6.252	5/14/02	20:00:00	14.052
5/15/02	0:05:51	21.289	22.841	13.057	17.047	19.672	6.268	5/15/02	0:00:00	14.031
5/15/02	4:05:54	21.269	22.808	13.023	17.025	19.637	6.264	5/15/02	4:00:00	14.008
5/15/02	8:05:57	21.248	22.787	12.995	17.004	19.612	6.266	5/15/02	8:00:00	13.989
5/15/02	12:06:00	21.225	22.758	12.968	16.975	19.581	6.264	5/15/02	12:00:00	13.948
5/15/02	16:06:03	21.205	22.726	12.942	16.951	19.555	6.268	5/15/02	16:00:00	13.945
5/15/02	20:06:06	21.188	22.709	12.924	16.944	19.540	6.291	5/15/02	20:00:00	13.969
5/16/02	0:06:09	21.177	22.697	12.911	16.951	19.530	6.321	5/16/02	0:00:00	13.978
5/16/02	4:06:12	21.163	22.664	12.879	16.942	19.499	6.323	5/16/02	4:00:00	13.964
5/16/02	8:06:15	21.156	22.685	12.881	16.959	19.509	6.351	5/16/02	8:00:00	13.995
5/16/02	12:06:18	21.156	22.693	12.885	16.985	19.520	6.384	5/16/02	12:00:00	14.018
5/16/02	16:06:21	21.156	22.703	12.888	17.010	19.530	6.418	5/16/02	16:00:00	14.044
5/16/02	20:06:24	21.162	22.703	12.890	17.036	19.534	6.450	5/16/02	20:00:00	14.081
5/17/02	0:06:27	21.171	22.718	12.897	17.066	19.548	6.485	5/17/02	0:00:00	14.095
5/17/02	4:06:30	21.180	22.713	12.883	17.081	19.544	6.498	5/17/02	4:00:00	14.111
5/17/02	8:06:33	21.188	22.736	12.897	17.111	19.561	6.525	5/17/02	8:00:00	14.124
5/17/02	12:06:36	21.195	22.750	12.901	17.139	19.575	6.544	5/17/02	12:00:00	14.129
5/17/02	16:06:39	21.199	22.744	12.899	17.145	19.569	6.547	5/17/02	16:00:00	14.124
5/17/02	20:06:42	21.205	22.744	12.897	17.161	19.577	6.563	5/17/02	20:00:00	14.149
5/18/02	0:06:45	21.212	22.758	12.901	17.169	19.587	6.589	5/18/02	0:00:00	14.162
5/18/02	4:06:48	21.218	22.767	12.908	17.193	19.598	6.608	5/18/02	4:00:00	14.192
5/18/02	8:06:51	21.225	22.795	12.920	17.223	19.622	6.637	5/18/02	8:00:00	14.215
5/18/02	12:06:54	21.237	22.802	12.925	17.244	19.627	6.654	5/18/02	12:00:00	14.193
5/18/02	16:06:57	21.235	22.789	12.916	17.236	19.616	6.648	5/18/02	16:00:00	14.157
5/18/02	20:07:00	21.231	22.775	12.905	17.220	19.608	6.640	5/18/02	20:00:00	14.173
5/19/02	0:07:03	21.233	22.783	12.903	17.229	19.614	6.659	5/19/02	0:00:00	14.179
5/19/02	4:07:06	21.231	22.777	12.897	17.229	19.608	6.663	5/19/02	4:00:00	14.183
5/19/02	8:07:09	21.231	22.789	12.901	17.248	19.620	6.680	5/19/02	8:00:00	14.203
5/19/02	12:07:12	21.231	22.793	12.903	17.259	19.624	6.694	5/19/02	12:00:00	14.195
5/19/02	16:07:15	21.229	22.779	12.894	17.253	19.612	6.690	5/19/02	16:00:00	14.168
5/19/02	20:07:18	21.224	22.775	12.886	17.248	19.608	6.688	5/19/02	20:00:00	14.183

TABLE F.3 (Cont.)

Recording Transducer Reading								Barometric Reading		
		Depth to Groundwater (ft BGL)								
Date	Time	SB01	SB04	SB05	SB07	SB08	SB09	Date	Time	Pressure (psi)
5/20/02	0:07:21	21.224	22.783	12.884	17.257	19.618	6.707	5/20/02	0:00:00	14.188
5/20/02	4:07:24	21.222	22.781	12.883	17.261	19.614	6.713	5/20/02	4:00:00	14.197
5/20/02	8:07:27	21.222	22.795	12.888	17.280	19.626	6.732	5/20/02	8:00:00	14.222
5/20/02	12:07:30	21.225	22.798	12.888	17.295	19.629	6.743	5/20/02	12:00:00	14.198
5/20/02	16:07:33	21.220	22.779	12.879	17.280	19.614	6.741	5/20/02	16:00:00	14.166
5/20/02	20:07:36	21.212	22.775	12.873	17.272	19.612	6.745	5/20/02	20:00:00	14.186
5/21/02	0:07:39	21.212	22.783	12.872	17.281	19.620	6.766	5/21/02	0:00:00	14.186
5/21/02	4:07:42	21.209	22.771	12.862	17.279	19.606	6.764	5/21/02	4:00:00	14.186
5/21/02	8:07:45	21.205	22.785	12.868	17.289	19.616	6.777	5/21/02	8:00:00	14.186
5/21/02	12:07:48	21.199	22.767	12.855	17.281	19.600	6.770	5/21/02	12:00:00	14.137
5/21/02	16:07:51	21.184	22.734	12.831	17.255	19.569	6.751	5/21/02	16:00:00	14.081
5/21/02	20:07:54	21.165	22.697	12.805	17.212	19.536	6.728	5/21/02	20:00:00	14.060
5/22/02	0:07:57	21.147	22.684	12.786	17.188	19.520	6.722	5/22/02	0:00:00	14.034
5/22/02	4:08:00	21.126	22.657	12.764	17.160	19.493	6.709	5/22/02	4:00:00	14.017
5/22/02	8:08:03	21.107	22.647	12.755	17.150	19.485	6.711	5/22/02	8:00:00	14.004
5/22/02	12:08:06	21.088	22.622	12.735	17.130	19.460	6.701	5/22/02	12:00:00	13.973
5/22/02	16:08:09	21.071	22.594	12.712	17.103	19.433	6.694	5/22/02	16:00:00	13.965
5/22/02	20:08:12	21.051	22.579	12.700	17.090	19.415	6.695	5/22/02	20:00:00	13.956
5/23/02	0:08:15	21.038	22.583	12.698	17.094	19.419	6.713	5/23/02	0:00:00	13.962
5/23/02	4:08:18	21.023	22.560	12.685	17.084	19.398	6.714	5/23/02	4:00:00	13.955
5/23/02	8:08:21	21.010	22.565	12.685	17.094	19.404	6.730	5/23/02	8:00:00	13.972
5/23/02	12:08:24	21.010	22.587	12.698	17.118	19.427	6.766	5/23/02	12:00:00	14.015
5/23/02	16:08:27	21.015	22.600	12.707	17.148	19.441	6.792	5/23/02	16:00:00	14.031
5/23/02	20:08:30	21.019	22.608	12.716	17.170	19.445	6.813	5/23/02	20:00:00	14.066
5/24/02	0:08:33	21.032	22.635	12.722	17.204	19.474	6.855	5/24/02	0:00:00	14.076
5/24/02	4:08:36	21.038	22.633	12.740	17.225	19.472	6.863	5/24/02	4:00:00	14.098
5/24/02	8:08:39	21.049	22.661	12.757	17.255	19.499	6.891	5/24/02	8:00:00	14.100
5/24/02	12:08:42	21.058	22.674	12.755	17.276	19.517	6.901	5/24/02	12:00:00	14.093
5/24/02	16:08:45	21.058	22.643	12.740	17.259	19.482	6.876	5/24/02	16:00:00	14.042
5/24/02	20:08:48	21.045	22.604	12.688	17.208	19.443	6.834	5/24/02	20:00:00	14.069
5/25/02	0:08:51	21.038	22.645	12.670	17.197	19.445	6.811	5/25/02	0:00:00	14.051
5/25/02	4:08:54	21.030	22.598	12.666	17.182	19.441	6.817	5/25/02	4:00:00	14.060
5/25/02	8:08:57	21.026	22.637	12.676	17.180	19.466	6.821	5/25/02	8:00:00	14.111
5/25/02	12:09:00	21.028	22.661	12.688	17.173	19.482	6.830	5/25/02	12:00:00	14.104
5/25/02	16:09:03	21.026	22.639	12.681	17.139	19.472	6.813	5/25/02	16:00:00	14.069
5/25/02	20:09:06	21.021	22.616	12.674	17.101	19.464	6.800	5/25/02	20:00:00	14.079
5/26/02	0:09:09	21.019	22.633	12.679	17.086	19.476	6.808	5/26/02	0:00:00	14.080
5/26/02	4:09:12	21.015	22.633	12.674	17.064	19.476	6.804	5/26/02	4:00:00	14.084
5/26/02	8:09:15	21.015	22.643	12.674	17.051	19.478	6.806	5/26/02	8:00:00	14.090
5/26/02	12:09:18	21.010	22.657	12.676	17.045	19.482	6.806	5/26/02	12:00:00	14.064
5/26/02	16:09:21	21.000	22.620	12.657	17.005	19.454	6.785	5/26/02	16:00:00	14.013
5/26/02	20:09:24	20.985	22.577	12.633	16.963	19.421	6.762	5/26/02	20:00:00	14.006
5/27/02	0:09:27	20.979	22.563	12.587	16.935	19.433	6.710	5/27/02	0:00:00	14.091
5/27/02	4:09:30	20.957	22.707	12.513	16.862	19.351	6.577	5/27/02	4:00:00	14.016
5/27/02	8:09:33	20.938	22.569	12.500	16.865	19.384	6.373	5/27/02	8:00:00	14.050
5/27/02	12:09:36	20.923	22.571	12.477	16.828	19.390	6.192	5/27/02	12:00:00	14.035
5/27/02	16:09:39	20.906	22.536	12.452	16.779	19.376	6.050	5/27/02	16:00:00	14.004
5/27/02	20:09:42	20.888	22.513	12.426	16.719	19.361	5.949	5/27/02	20:00:00	14.000
5/28/02	0:09:45	20.874	22.528	12.415	16.687	19.375	5.896	5/28/02	0:00:00	14.020

TABLE F.3 (Cont.)

Recording Transducer Reading								Barometric Reading		
		Depth to Groundwater (ft BGL)								
Date	Time	SB01	SB04	SB05	SB07	SB08	SB09	Date	Time	Pressure (psi)
5/28/02	4:09:48	20.865	22.527	12.402	16.663	19.375	5.848	5/28/02	4:00:00	14.012
5/28/02	8:09:51	20.852	22.527	12.383	16.634	19.369	5.808	5/28/02	8:00:00	14.026
5/28/02	12:09:54	20.844	22.532	12.372	16.620	19.375	5.789	5/28/02	12:00:00	14.028
5/28/02	16:09:57	20.833	22.523	12.355	16.597	19.361	5.776	5/28/02	16:00:00	13.992
5/28/02	20:10:00	20.822	22.499	12.333	16.571	19.347	5.774	5/28/02	20:00:00	13.996
5/29/02	0:10:03	20.814	22.501	12.320	16.560	19.349	5.789	5/29/02	0:00:00	14.003
5/29/02	4:10:06	20.807	22.493	12.304	16.550	19.340	5.791	5/29/02	4:00:00	14.006
5/29/02	8:10:09	20.799	22.497	12.291	16.547	19.340	5.802	5/29/02	8:00:00	14.005
5/29/02	12:10:12	20.794	22.509	12.283	16.544	19.338	5.812	5/29/02	12:00:00	13.997
5/29/02	16:10:15	20.786	22.480	12.265	16.531	19.320	5.817	5/29/02	16:00:00	13.952
5/29/02	20:10:18	20.775	22.451	12.243	16.505	19.301	5.827	5/29/02	20:00:00	13.964
5/30/02	0:10:21	20.767	22.449	12.233	16.505	19.299	5.855	5/30/02	0:00:00	13.971
5/30/02	4:10:24	20.762	22.453	12.226	16.511	19.303	5.876	5/30/02	4:00:00	13.971
5/30/02	8:10:27	20.756	22.457	12.217	16.511	19.297	5.888	5/30/02	8:00:00	13.989
5/30/02	12:10:30	20.750	22.457	12.213	16.524	19.295	5.911	5/30/02	12:00:00	13.983
5/30/02	16:10:33	20.747	22.445	12.204	16.526	19.289	5.926	5/30/02	16:00:00	13.954
5/30/02	20:10:36	20.743	22.424	12.191	16.512	19.277	5.941	5/30/02	20:00:00	13.971
5/31/02	0:10:39	20.739	22.431	12.191	16.524	19.281	5.971	5/31/02	0:00:00	13.974
5/31/02	4:10:42	20.735	22.426	12.182	16.531	19.277	5.989	5/31/02	4:00:00	13.975
5/31/02	8:10:45	20.735	22.437	12.180	16.539	19.283	6.006	5/31/02	8:00:00	13.996
5/31/02	12:10:48	20.735	22.451	12.181	16.552	19.283	6.030	5/31/02	12:00:00	13.985
5/31/02	16:10:51	20.732	22.426	12.176	16.548	19.273	6.042	5/31/02	16:00:00	13.953
5/31/02	20:10:54	20.726	22.406	12.163	16.539	19.260	6.055	5/31/02	20:00:00	13.965
6/1/02	0:10:57	20.724	22.416	12.167	16.554	19.268	6.086	6/1/02	0:00:00	13.977
6/1/02	4:11:00	20.720	22.408	12.161	16.563	19.260	6.103	6/1/02	4:00:00	13.967
6/1/02	8:11:03	20.719	22.416	12.157	16.559	19.260	6.112	6/1/02	8:00:00	13.984
6/1/02	12:11:06	20.715	22.416	12.154	16.567	19.256	6.125	6/1/02	12:00:00	13.959
6/1/02	16:11:09	20.709	22.396	12.144	16.563	19.246	6.137	6/1/02	16:00:00	13.930
6/1/02	20:11:12	20.704	22.381	12.137	16.554	19.236	6.150	6/1/02	20:00:00	13.947
6/2/02	0:11:15	20.700	22.387	12.137	16.561	19.240	6.179	6/2/02	0:00:00	13.954
6/2/02	4:11:18	20.692	22.375	12.130	16.563	19.229	6.187	6/2/02	4:00:00	13.936
6/2/02	8:11:21	20.687	22.377	12.124	16.559	19.225	6.192	6/2/02	8:00:00	13.931
6/2/02	12:11:24	20.679	22.369	12.111	16.552	19.209	6.196	6/2/02	12:00:00	13.896
6/2/02	16:11:27	20.664	22.338	12.098	16.537	19.190	6.196	6/2/02	16:00:00	13.866
6/2/02	20:11:30	20.651	22.325	12.089	16.520	19.180	6.207	6/2/02	20:00:00	13.875
6/3/02	0:11:33	20.643	22.328	12.089	16.526	19.184	6.240	6/3/02	0:00:00	13.880
6/3/02	4:11:36	20.636	22.321	12.083	16.526	19.176	6.251	6/3/02	4:00:00	13.905
6/3/02	8:11:39	20.636	22.352	12.098	16.556	19.201	6.295	6/3/02	8:00:00	13.925
6/3/02	12:11:42	20.636	22.344	12.096	16.567	19.192	6.308			

Appendix G:

Water Sample Data

TABLE G.1 Groundwater samples collected during the Phase I field investigation at Centralia, Kansas (first mobilization).

Location	Sample	Depth (ft BGL)	Sample Date	Sample Description
SB01	CNSB01-W-15322	40-45	3/27/02	Insufficient water for field parameters from indicated screen interval after unsuccessful attempt at screen interval at 30-35 ft BGL.
SB01	CNSB01-W-15324	46-51	4/03/02	Water oxidized with heavy silt load. Sample collected from zone of silty clay, sand > 85%, very fine grained, highly calcareous.
SB01	CNSB01-W-15349	46-51	4/03/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB01-W-15324).
SB01	CNSB01-W-15346	51-56	4/03/02	Sample from zone of silty clay with sand inclusions/bioturbated, very fine grained, highly calcareous. Limited water recovery.
SB01	CNSB01-W-15207	51-56	4/05/02	Sampling for water characterization parameters. Location previously sampled as CNSB01-W-15346 for volatile organic analysis with limited water recovery.
SB01	CNSB01-W-15208	51-56	4/05/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB01-W-15207). Water level prior to sampling at 27.8 ft BGL.
SB01	CNSB01-W-15347	56-61	4/03/02	Slow, limited water recovery. Sample collected for volatile organic analysis. Screen left in place temporarily for subsequent sampling for other parameters.
SB01	CNSB01-W-15209	56-61	4/05/02	Water level at 24 ft BGL in the morning prior to sampling at 1300 hr for water characterization parameters. Location previously sampled as CNSB01-W-15347 for organic analysis.
SB01	CNSB01-W-15210	56-61	4/05/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB01-W-15209).
SB01	CNSB01-W-15348	61-66	4/03/02	At contact zone between clay and silty clay, very fine grained, with sand mottles.
SB01	CNSB01-W-15350	61-66	4/03/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB01-W-15348).
SB01	CNSB01-W-15352	66-69	4/04/02	Slow, very limited water recovery (40 mL for volatile organic analysis), insufficient for field parameters. Screen left in place overnight for additional sampling.
SB01	CNSB01-W-15363	66-69	4/05/02	Sampling for water characterization parameters. Location previously sampled as CNSB01-W-15352 for volatile organic analysis with limited water recovery.
SB01	CNSB01-W-15364	66-69	4/05/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB01-W-15363).
SB01	CNSB01-W-15353	69-74	4/04/02	Very turbid water, dark gray in color, very silty. Limited recovery.
SB01	CNSB01-W-15354	69-74	4/04/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB01-W-15353).
SB01	CNSB01-W-15361	69-74	4/05/02	Sample for water characterization parameters associated with sample CNSN01-W-15353 collected for volatile organic analysis.

TABLE G.1 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Sample Description
SB01	CNSB01-W-15362	69-74	4/05/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB01-W-15361).
SB01	CNSB01-W-15356	74-78	4/04/02	Clear water, slightly oxidized, increasing as more water withdrawn. Aliquots collected for volatile organic analysis. Partial aliquots collected for cations and alkalinity.
SB01	CNSB01-W-15357	74-78	4/04/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB01-W-15356).
SB01	CNSB01-W-15359	74-78	4/05/02	Return to sampling location to complete collection of aliquots for water characterization parameters.
SB01	CNSB01-W-15360	74-78	4/05/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB01-W-15359).
SB01	CNSB01-W-15311	86-91	3/27/02	SB01 water sampling location approximately 30 ft northeast of soil sampling location.
SB01	CNSB01-W-15312	86-91	3/27/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB01-W-15311).
SB03	CNSB03A-W-15305	55.5-58.5	3/26/02	Sampling in loose, wet sand. Water oxidized and carrying fine sand. Good recovery.
SB03	CNSB03A-W-15306	55.5-58.5	3/26/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB03A-W-15305).
SB04	CNSB04-W-15274	52.5-55.5	3/22/02	Sample from screened interval after unsuccessful tries at 16.7-19.7 ft BGL and 32.8-35.8 ft BGL. Water level 46.10 ft BGL after 5 min. Very cloudy; 800 mL purged. Monitored for methane during push (no detection) after hydrogen sulfide odor was noticed at a depth of approximately 16 ft BGL.
SB04	CNSB04-W-15275	52.5-55.5	3/22/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB04-W-15274).
SB04	CNSB04-W-15315	56-60	3/27/02	Sample from sand and gravel sequence. Oxidized water with heavy, fine sediment.
SB04	CNSB04-W-15316	56-60	3/27/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB04-W-15315).
SB04	CNSB04-W-15211	60-65	4/06/02	Water abundant, oxidized, low turbidity.
SB04	CNSB04-W-15212	60-65	4/06/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB04-W-15211).
SB04	CNSB04-W-15382	65-70	4/06/02	Water level at 62 ft BGL prior to sampling and rising rapidly.
SB04	CNSB04-W-15383	65-70	4/06/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB04-W-15382).

TABLE G.1 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Sample Description
SB04	CNSB04-W-15214	70-75	4/06/02	Abundant, clear water recovery. Water level at 66 ft BGL prior to sampling and rising rapidly.
SB04	CNSB04-W-15379	70-75	4/06/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB04-W-15214).
SB04	CNSB04-W-15375	87-91	4/05/02	Abundant clear water with virtually no suspended sediment present. Water level prior to sampling at 64 ft BGL, rising to 23 ft BGL after sampling completed (15 min).
SB04	CNSB04-W-15377	87-91	4/05/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB04-W-15375).
SB04	CNSB04-W-15318	99-104	3/27/02	Good water recovery.
SB04	CNSB04-W-15319	99-104	3/27/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB04-W-15318).
SB05	CNSB05-W-15264	34-37	3/21/02	Water level at 26 ft BGL prior to sampling of screened interval. Water turbid. Hydrogen sulfide odor in ECPT truck during push.
SB05	CNSB05-W-15265	37-40.2	3/22/02	Water level at 34.2 ft BGL prior to sampling of screened interval. Oxidized, heavily sedimented, turbid water, with very fine sand in solution. Turbidity lessened during collection of sample aliquots.
SB05	CNSB05-W-15266	37-40.2	3/22/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB05-W-15265).
SB06	CNSB06-W-15222	56-61	4/11/02	Water level at 51 ft BGL prior to sampling of screened interval.
SB06	CNSB06-W-15223	56-61	4/11/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB06-W-15222).
SB06	CNSB06-W-15141	61-66	4/05/02	Sample collected without purging 5 ft south of SB06 core hole.
SB06	CNSB06-W-15205	61-66	4/05/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB06-W-15141).
SB06	CNSB06-W-15395	66-71	4/11/02	Water level at 56 ft BGL (dropping to 50 ft BGL after 3 min) prior to sampling of screened interval.
SB06	CNSB06-W-15396	66-71	4/11/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB06-W-15395).
SB06	CNSB06-W-15398	71-76	4/12/02	Water level at 45 ft BGL (and rising) prior to sampling of screened interval.
SB06	CNSB06-W-15399	71-76	4/12/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB06-W-15398).

TABLE G.1 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Sample Description
SB06	CNSB06-W-15403	76-81	4/12/02	Water level stable at 23.62 ft BGL (after lunch break) prior to sampling of screened interval.
SB06	CNSB06-W-15404	76-81	4/12/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB06-W-15403).
SB06	CNSB06-W-15400	81-86	4/12/02	Water level at 37 ft BGL (and rising) prior to sampling of screened interval.
SB06	CNSB06-W-15401	81-86	4/12/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB06-W-15400).
SB06	CNSB06-W-15409	86-91	4/12/02	Water level at 47 ft BGL (and rising) prior to sampling of screened interval.
SB06	CNSB06-W-15410	86-91	4/12/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB06-W-15409).
SB07	CNSB07-W-15240	46-50	4/08/02	Sample from indicated screened interval.
SB07	CNSB07-W-15241	46-50	4/08/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB07-W-15240).
SB07	CNSB07-W-15242	54-59	4/08/02	Bailed sample above indicated screened interval.
SB07	CNSB07-W-15243	54-59	4/08/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB07-W-15242).
SB07	CNSB07-W-15244	64-69	4/09/02	Water level at 65.8 ft BGL prior to sampling of screened interval.
SB07	CNSB07-W-15225	64-69	4/09/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB07-W-15244).
SB07	CNSB07-W-15229	69-74	4/09/02	Sample from screened interval after unsuccessful attempts at screened intervals of 74-78 ft BGL (dry), 50-54 ft BGL (dry), and 59-64 ft BGL (10 mL recovery with no detection of total nitrogen by field measurement).
SB07	CNSB07-W-15230	69-74	4/09/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB07-W-15229).
SB07	CNSB07-W-15217	95-100	4/10/02	Sample from screened interval after unsuccessful attempt at screened interval of 85-90 ft BGL.
SB07	CNSB07-W-15218	95-100	4/10/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB07-W-15217).
SB08	CNSB08-W-15238	53-58	4/08/02	Bailed sample from temporary piezometer. Because of a surface elevation change over a small distance, this sampling interval is equivalent to the sampling interval at 58-62 ft BGL from which sample CNSB08-W-15451 was collected.

TABLE G.1 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Sample Description
SB08	CNSB08-W-15239	53-58	4/08/02	Preserved aliquot for total nitrogen analysis. Because of a surface elevation change over a small distance, this sampling interval is equivalent to the sampling interval at 58-62 ft BGL from which sample CNSB08-W-15452 was collected.
SB08	CNSB08-W-15365	53-58	4/09/02	ECPT push sample. Abundant clear water.
SB08	CNSB08-W-15366	53-58	4/09/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB08-W-15365).
SB08	CNSB08-W-15451	58-62	4/12/02	Water heavily oxidized and highly turbid.
SB08	CNSB08-W-15452	58-62	4/12/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB08-W-15451).
SB08	CNSB08-W-15367	62-67	4/10/02	Abundant water recovery. Oxidized, moderate turbidity, settled quickly.
SB08	CNSB08-W-15368	62-67	4/10/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB08-W-15367).
SB08	CNSB08-W-15447	67-72	4/12/02	Slow water recovery.
SB08	CNSB08-W-15448	67-72	4/12/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB08-W-15447).
SB08	CNSB08-W-15453	72-77	4/12/02	ECPT push sample.
SB08	CNSB08-W-15454	72-77	4/12/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB08-W-15453).
SB08	CNSB08-W-15449	77-82	4/12/02	Abundant, highly turbid, oxidized water.
SB08	CNSB08-W-15450	77-82	4/12/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB08-W-15449).
SB09	CNSB09-W-15372	32-37	4/10/02	Abundant water recovery. Slightly oxidized, low turbidity.
SB09	CNSB09-W-15374	32-37	4/10/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB09-W-15372).
SB09	CNSB09-W-15215	36.5-41.5	4/09/02	Temporary 1/2-in. PVC screen set at indicated depth. Water level prior to sampling with 3/8-in. bailer at 20.98 ft BGL.
SB09	CNSB09-W-15216	36.5-41.5	4/09/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB09-W-15215).
SB09	CNSB09-W-15388	37-42	4/11/02	ECPT push sample.
SB09	CNSB09-W-15389	37-42	4/11/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB09-W-15388).

TABLE G.1 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Sample Description
SB09	CNSB09-W-15386	42-47	4/11/02	Abundant slightly oxidized water. Water collected above the screened interval, with the water level after sampling at only 9.6 ft BGL.
SB09	CNSB09-W-15387	42-47	4/11/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB09-W-15386).
SB09	CNSB09-W-15391	47-52	4/11/02	Abundant oxidized water.
SB09	CNSB09-W-15392	47-52	4/11/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB09-W-15391).
SB09	CNSB09-W-15445	52-57	4/11/02	Oxidized, highly turbid water with heavy sediment load. Ample water for sampling, but slower recovery than at shallower screen intervals at this location.
SB09	CNSB09-W-15446	52-57	4/11/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB09-W-15445).
SB10	CNSB05-W-15196	38-41	4/06/02	ECPT sampling location initially identified as SB05 now reidentified as SB10.
SB10	CNSB05-W-15197	38-41	4/06/02	Preserved for total nitrogen analysis (associated with CNSB05-W-15196). Approximately 2 mL of 50% H_2SO_4 required to buffer to pH < 2. After 1 hr acid still reacting with calcareous fines in bottom of vial. pH OK. Decanted to new vial to eliminate fines; bubbling stopped.
SB10	CNSB05-W-15200	41-45	4/06/02	Sample over indicated screened interval.
SB10	CNSB05-W-15201	41-45	4/06/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB05-W-15200).
SB10	CNSB05-W-15198	45-50	4/06/02	Sample over indicated screened interval.
SB10	CNSB05-W-15199	45-50	4/06/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB05-W-15198).
SB10	CNSB05-W-15202	55-58	4/06/02	Sample over indicated screened interval after unsuccessful attempts at screened intervals of 50-55 ft BGL and 58-62 ft BGL.
SB10	CNSB05-W-15203	55-58	4/06/02	Preserved aliquot for total nitrogen analysis (associated with sample CNSB05-W-15202).

TABLE G.2 Field measurements made during collection of groundwater samples in the Phase I field investigation at Centralia, Kansas.

Location	Sample	Depth (ft BGL)	Sample Date	Temper-ature (°C)	pH	Conductivity (µS/cm)
SB01	CNSB01-W-15322	40-45	3/27/02	NR[a]	NR	NR
SB01	CNSB01-W-15324	46-51	4/3/02	16.2	7.71	716
SB01	CNSB01-W-15346	51-56	4/3/02	14.1	7.83	666
SB01	CNSB01-W-15207	51-56	4/5/02	13.1	6.95	669
SB01	CNSB01-W-15347	56-61	4/3/02	15.3	8.21	638
SB01	CNSB01-W-15209	56-61	4/5/02	NR	7.07	648
SB01	CNSB01-W-15348	61-66	4/3/02	13.8	8.53	663
SB01	CNSB01-W-15352	66-69	4/4/02	NR	NR	NR
SB01	CNSB01-W-15363	66-69	4/5/02	NR	7.24	669
SB01	CNSB01-W-15353	69-74	4/4/02	17.9	8.14	665
SB01	CNSB01-W-15361	69-74	4/5/02	NR	7.52	658
SB01	CNSB01-W-15356	74-78	4/4/02	14.7	8.67	662
SB01	CNSB01-W-15359	74-78	4/5/02	NR	7.5	635
SB01	CNSB01-W-15311	86-91	3/27/02	15.5	7.23	677
SB03	CNSB03A-W-15305	55.5-58.5	3/26/02	15.7	7.94	772
SB04	CNSB04-W-15274	52.5-55.5	3/22/02	15.1	7.98	802
SB04	CNSB04-W-15315	56-60	3/27/02	14.1	8.29	800
SB04	CNSB04-W-15211	60-65	4/6/02	14.1	6.75	887
SB04	CNSB04-W-15382	65-70	4/6/02	16.4	6.78	798
SB04	CNSB04-W-15214	70-75	4/6/02	15	6.59	749
SB04	CNSB04-W-15375	87-91	4/5/02	15.2	6.79	732
SB04	CNSB04-W-15318	99-104	3/27/02	16.7	8.23	688
SB05	CNSB05-W-15264	34-37	3/21/02	13	8	821
SB05	CNSB05-W-15265	37-40.2	3/22/02	13.3	7.85	917
SB06	CNSB06-W-15222	56-61	4/11/02	NR	7.1	763
SB06	CNSB06-W-15141	61-66	4/5/02	13.4	7.16	931
SB06	CNSB06-W-15395	66-71	4/11/02	NR	7.32	764
SB06	CNSB06-W-15398	71-76	4/12/02	16.4	7.23	737
SB06	CNSB06-W-15403	76-81	4/12/02	NR	7.5	628
SB06	CNSB06-W-15400	81-86	4/12/02	16.8	7.37	707
SB06	CNSB06-W-15409	86-91	4/12/02	18	7.29	693
SB07	CNSB07-W-15240	46-50	4/8/02	16.8	7.16	653
SB07	CNSB07-W-15242	54-59	4/8/02	16.7	7.22	610
SB07	CNSB07-W-15244	64-69	4/9/02	15.8	7.34	574
SB07	CNSB07-W-15229	69-74	4/9/02	16.5	7.41	575
SB07	CNSB07-W-15217	95-100	4/10/02	NR	7.34	618
SB08	CNSB08-W-15238	53-58[b]	4/8/02	16.6	7.27	698
SB08	CNSB08-W-15365	53-58	4/9/02	15.7	6.69	694
SB08	CNSB08-W-15451	58-62	4/12/02	17	7.57	707

TABLE G.2 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Temper-ature (°C)	pH	Conductivity (µS/cm)
SB08	CNSB08-W-15367	62-67	4/10/02	13.8	6.58	674
SB08	CNSB08-W-15447	67-72	4/12/02	15.1	7.51	611
SB08	CNSB08-W-15453	72-77	4/12/02	16.7	7.53	594
SB08	CNSB08-W-15449	77-82	4/12/02	16	7.46	587
SB09	CNSB09-W-15372	32-37	4/10/02	19.7	6.27	934
SB09	CNSB09-W-15215	36.5-41.5	4/9/02	NR	6.95	905
SB09	CNSB09-W-15388	37-42	4/11/02	16.4	7.04	972
SB09	CNSB09-W-15386	42-47	4/11/02	15.3	7.14	936
SB09	CNSB09-W-15391	47-52	4/11/02	16.9	7.59	720
SB09	CNSB09-W-15445	52-57	4/11/02	16.4	7.58	582
SB10	CNSB05-W-15196	38-41	4/6/02	15	6.97	737
SB10	CNSB05-W-15200	41-45	4/6/02	NR	7.25	673
SB10	CNSB05-W-15198	45-50	4/6/02	15.6	7.19	658
SB10	CNSB05-W-15202	55-58	4/6/02	NR	7.34	610

[a] NR, field measurement not recorded.

[b] Because of a surface elevation change over a small distance, this sampling interval is equivalent to the sampling interval at 58-62 ft BGL from which sample CNSB08-W-15451 was collected.

TABLE G.3 Results of organic analyses at AGEM Laboratory by the purge-and-trap method on groundwater samples collected during the Phase I investigation at Centralia, Kansas.

				Concentration (µg/L)	
Location	Sample	Depth (ft BGL)	Sample Date	Carbon Tetrachloride	Chloroform
SB01	CNSB01-W-15322	40-45	3/27/02	128	31
SB01	CNSB01-W-15324	46-51	4/3/02	17	1.6
SB01	CNSB01-W-15346	51-56	4/3/02	ND[a]	ND
SB01	CNSB01-W-15347	56-61	4/3/02	ND	ND
SB01	CNSB01-W-15348	61-66	4/3/02	ND	ND
SB01	CNSB01-W-15352	66-69	4/4/02	ND	ND
SB01	CNSB01-W-15353	69-74	4/4/02	ND	ND
SB01	CNSB01-W-15356	74-78	4/4/02	ND	ND
SB01	CNSB01-W-15311	86-91	3/27/02	ND	ND
SB03	CNSB03A-W-15305	55.5-58.5	3/26/02	ND	ND
SB04	CNSB04-W-15274	52.5-55.5	3/22/02	1.3	ND
SB04	CNSB04-W-15315	56-60	3/27/02	33	1.1
SB04	CNSB04-W-15211	60-65	4/6/02	28	1.2
SB04	CNSB04-W-15382	65-70	4/6/02	3.8	ND
SB04	CNSB04-W-15214	70-75	4/6/02	ND	ND
SB04	CNSB04-W-15375	87-91	4/5/02	ND	ND
SB04	CNSB04-W-15318	99-104	3/27/02	ND	ND
SB05	CNSB05-W-15264	34-37	3/21/02	82	11
SB05	CNSB05-W-15265	37-40.2	3/22/02	122	11
SB06	CNSB06-W-15222	56-61	4/11/02	7.4	1.3
SB06	CNSB06-W-15141	61-66	4/5/02	51	2.3
SB06	CNSB06-W-15395	66-71	4/11/02	16	ND
SB06	CNSB06-W-15398	71-76	4/12/02	4.3	ND
SB06	CNSB06-W-15403	76-81	4/12/02	ND	ND
SB06	CNSB06-W-15400	81-86	4/12/02	ND	ND
SB06	CNSB06-W-15409	86-91	4/12/02	ND	ND
SB07	CNSB07-W-15240	46-50	4/8/02	6.4	ND
SB07	CNSB07-W-15242	54-59	4/8/02	ND (0.7 J[b])	ND
SB07	CNSB07-W-15244	64-69	4/9/02	ND	ND
SB07	CNSB07-W-15229	69-74	4/9/02	ND (0.8 J)	ND
SB07	CNSB07-W-15217	95-100	4/10/02	ND	ND
SB08	CNSB08-W-15238	53-58[c]	4/8/02	130	1.3
SB08	CNSB08-W-15365	53-58	4/9/02	30	1 (0.9 J)
SB08	CNSB08-W-15451	58-62	4/12/02	176	5.7
SB08	CNSB08-W-15367	62-67	4/10/02	12[d]	ND
SB08	CNSB08-W-15447	67-72	4/12/02	ND	ND

TABLE G.3 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Concentration (µg/L) Carbon Tetrachloride	Chloroform
SB08	CNSB08-W-15453	72-77	4/12/02	ND	ND
SB08	CNSB08-W-15449	77-82	4/12/02	ND	ND
SB09	CNSB09-W-15372	32-37	4/10/02	ND	ND
SB09	CNSB09-W-15215	36.5-41.5	4/9/02	ND	ND
SB09	CNSB09-W-15388	37-42	4/11/02	ND	ND
SB09	CNSB09-W-15386	42-47	4/11/02	ND	ND
SB09	CNSB09-W-15391	47-52	4/11/02	ND	ND
SB09	CNSB09-W-15445	52-57	4/11/02	ND	ND
SB10	CNSB05-W-15196	38-41	4/6/02	6.5	ND (0.6 J)
SB10	CNSB05-W-15200	41-45	4/6/02	1.2	ND
SB10	CNSB05-W-15198	45-50	4/6/02	ND (0.6 J)	ND
SB10	CNSB05-W-15202	55-58	4/6/02	ND	ND

[a] ND, contaminant not detected.

[b] J, estimated concentration below the quantitation limit of 1 µg/L for the purge-and-trap method.

[c] Because of a surface elevation change over a small distance, this sampling interval is equivalent to the sampling interval at 58-62 ft BGL from which sample CNSB08-W-15451 was collected.

[d] Carbon tetrachloride detected in replicate sample CNSB08-W-15370 from this depth at 13 µg/L (Table H.11).

TABLE G.4 Results of inorganic analyses on groundwater samples collected during the Phase I field investigation at Centralia, Kansas.

				Concentration (mg/L)							
Location	Sample	Depth (ft BGL)	Sample Date	Total Alkalinity	Aluminum	Calcium	Chloride	Iron	Magnesium	Manganese	Phosphorus
SB01	CNSB01-W-15324	46-51	4/3/02	340	< 0.2	67.4	37.5	< 0.1	27.9	0.098	< 0.25
SB01	CNSB01-W-15207	51-56	4/5/02	350	< 0.2	72	4.51	< 0.1	30.5	0.316	< 0.25
SB01	CNSB01-W-15209	56-61	4/5/02	460	< 0.2	63.5	3.89	< 0.1	28.1	0.122	< 0.25
SB01	CNSB01-W-15348	61-66	4/3/02	350	< 0.2	66.4	5.67	< 0.1	28.3	0.173	< 0.25
SB01	CNSB01-W-15363	66-69	4/5/02	370	< 0.2	69	7.03	0.19	28.8	0.155	< 0.25
SB01	CNSB01-W-15354[a]	69-74	4/4/02								
SB01	CNSB01-W-15361	69-74	4/5/02	410	< 0.2	69.7	4.46	< 0.1	29.9	0.037	< 0.25
SB01	CNSB01-W-15356	74-78	4/4/02	380	< 0.2	68.4	5.9	< 0.1	29.8	0.441	< 0.25
SB01	CNSB01-W-15359	74-78	4/5/02	370	< 0.2	68.6	3.95	< 0.1	30.7	0.070	< 0.25
SB01	CNSB01-W-15311	86-91	3/27/02	350	< 0.2	69.8	6.73	< 0.1	30.2	0.698	< 0.25
SB03	CNSB03A-W-15305	55.5-58.5	3/26/02	290	< 0.2	72.4	31.6	< 0.1	32.2	2.440	< 0.25
SB04	CNSB04-W-15274	52.5-55.5	3/22/02	400	< 0.2	79.6	26.5	0.168	29.7	0.118	< 0.25
SB04	CNSB04-W-15315	56-60	3/27/02	410	< 0.2	71.1	31.4	< 0.1	29.2	0.029	< 0.25
SB04	CNSB04-W-15211	60-65	4/6/02	340	< 0.2	74.6	38.6	< 0.1	30.7	0.297	< 0.25
SB04	CNSB04-W-15382	65-70	4/6/02	370	< 0.2	70.3	36.4	< 0.1	30.6	0.255	< 0.25
SB04	CNSB04-W-15214	70-75	4/6/02	360	< 0.2	65.8	18	< 0.1	29.8	0.156	< 0.25
SB04	CNSB04-W-15375	87-91	4/5/02	360	< 0.2	73.6	11	< 0.1	31.4	0.098	< 0.25
SB04	CNSB04-W-15318	99-104	3/27/02	390	< 0.2	73	13.6	< 0.1	32.2	0.170	< 0.25
SB05	CNSB05-W-15264	34-37	3/21/02	316	< 0.2	94.4	98.1	< 0.1	35.8	0.423	< 0.25
SB05	CNSB05-W-15265	37-40.2	3/22/02	320	< 0.2	101	96.7	0.149	38.8	0.157	< 0.25
SB06	CNSB06-W-15223[a]	56-61	4/11/02								
SB06	CNSB06-W-15141	61-66	4/5/02	390	< 0.2	87.3	79.4	< 0.1	35.3	1.180	< 0.25
SB06	CNSB06-W-15396[a]	66-71	4/11/02								
SB06	CNSB06-W-15399[a]	71-76	4/12/02								
SB06	CNSB06-W-15404[a]	76-81	4/12/02								
SB06	CNSB06-W-15401[a]	81-86	4/12/02								
SB06	CNSB06-W-15410[a]	86-91	4/12/02								

TABLE G.4 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Concentration (mg/L) Potassium	Silicon	Sodium	Sulfate	Zinc	Preserved Sample Identifier	Total Nitrogen (mg/L)
SB01	CNSB01-W-15324	46-51	4/3/02	6.42	12.8	43.8	6.94	< 0.02	CNSB01-W-15349	1.16
SB01	CNSB01-W-15207	51-56	4/5/02	6.3	14.9	31.6	2.03	0.12	CNSB01-W-15208	0.24
SB01	CNSB01-W-15209	56-61	4/5/02	< 5	14	28.1	3.34	< 0.02	CNSB01-W-15210	0.04
SB01	CNSB01-W-15348	61-66	4/3/02	< 5	9.88	37.9	5.76	< 0.02	CNSB01-W-15350	0.11
SB01	CNSB01-W-15363	66-69	4/5/02	5.72	15.4	32.7	2.43	< 0.02	CNSB01-W-15364	0.32
SB01	CNSB01-W-15354[a]	69-74	4/4/02						CNSB01-W-15354	0.11
SB01	CNSB01-W-15361	69-74	4/5/02	6	9.94	33.2	5.86	< 0.02	CNSB01-W-15362	0.05[b]
SB01	CNSB01-W-15356	74-78	4/4/02	6.58	7.87	39.2	6.66	< 0.02	CNSB01-W-15357	0.20
SB01	CNSB01-W-15359	74-78	4/5/02	5.08	9.33	31	5.95	0.03	CNSB01-W-15360	0.04[b]
SB01	CNSB01-W-15311	86-91	3/27/02	< 5	13.2	27.6	7.29	< 0.02	CNSB01-W-15312	0.02
SB03	CNSB03A-W-15305	55.5-58.5	3/26/02	6.5	8.9	27.9	29.8	< 0.02	CNSB03A-W-15306	0.34
SB04	CNSB04-W-15274	52.5-55.5	3/22/02	< 5	15.1	60.6	9.7	< 0.02	CNSB04-W-15275	1.50
SB04	CNSB04-W-15315	56-60	3/27/02	5.96	15.4	53.3	10.1	< 0.02	CNSB04-W-15316	3.22
SB04	CNSB04-W-15211	60-65	4/6/02	15.7	12.6	53.1	12.1	< 0.02	CNSB04-W-15212	8.16
SB04	CNSB04-W-15382	65-70	4/6/02	5.68	16	38.8	10.3	< 0.02	CNSB04-W-15383	1.23
SB04	CNSB04-W-15214	70-75	4/6/02	< 5	15.7	33.9	9.16	< 0.02	CNSB04-W-15379	1.50
SB04	CNSB04-W-15375	87-91	4/5/02	< 5	16.4	33.6	8.11	< 0.02	CNSB04-W-15377	0.72
SB04	CNSB04-W-15318	99-104	3/27/02	7.62	15.3	30.3	10.8	< 0.02	CNSB04-W-15319	0.04
SB05	CNSB05-W-15264	34-37	3/21/02	< 5	12.4	25.2	10.3	< 0.02	CNSB05-W-15264	2.20
SB05	CNSB05-W-15265	37-40.2	3/22/02	< 5	16.2	25.8	9.1	< 0.02	CNSB05-W-15266	3.10
SB06	CNSB06-W-15223[a]	56-61	4/11/02						CNSB06-W-15223	0.48
SB06	CNSB06-W-15141	61-66	4/5/02	5.23	13.6	50.3	10	< 0.02	CNSB06-W-15205	1.90
SB06	CNSB06-W-15396[a]	66-71	4/11/02						CNSB06-W-15396	1.19
SB06	CNSB06-W-15399[a]	71-76	4/12/02						CNSB06-W-15399	0.83
SB06	CNSB06-W-15404[a]	76-81	4/12/02						CNSB06-W-15404	0.74
SB06	CNSB06-W-15401[a]	81-86	4/12/02						CNSB06-W-15401	0.17
SB06	CNSB06-W-15410[a]	86-91	4/12/02						CNSB06-W-15410	0.47

TABLE G.4 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Concentration (mg/L) Total Alkalinity	Aluminum	Calcium	Chloride	Iron	Magnesium	Manganese	Phosphorus
SB07	CNSB07-W-15240	46-50	4/8/02	390	< 0.2	70	20.1	< 0.1	25.7	0.130	< 0.25
SB07	CNSB07-W-15243[a]	54-59	4/8/02								
SB07	CNSB07-W-15244	64-69	4/9/02	< 0.2	66.5	6.3	< 0.1	28.9	0.443	< 0.25	
SB07	CNSB07-W-15230[a]	69-74	4/9/02								
SB07	CNSB07-W-15217	95-100	4/10/02	< 0.2	66.7	4.63	< 0.1	26.8	0.030	< 0.25	
SB08	CNSB08-W-15238	53-58	4/8/02	< 0.2	74.1	27.3	< 0.1	29.8	0.134	< 0.25	
SB08	CNSB08-W-15365	53-58	4/9/02	< 0.2	68.2	18.5	< 0.1	28.8	0.302	< 0.25	
SB08	CNSB08-W-15452[a]	58-62	4/12/02								
SB08	CNSB08-W-15368[a]	62-67	4/10/02								
SB08	CNSB08-W-15448[a]	67-72	4/12/02								
SB08	CNSB08-W-15454[a]	72-77	4/12/02								
SB08	CNSB08-W-15450[a]	77-82	4/12/02								
SB09	CNSB09-W-15372	32-37	4/10/02	540	< 0.2	106	11.2	< 0.1	37	0.367	< 0.25
SB09	CNSB09-W-15215	36.5-41.5	4/9/02	480	< 0.2	71.5	11.4	< 0.1	30.5	0.125	< 0.25
SB09	CNSB09-W-15388	37-42	4/11/02	510	< 0.2	112	14.2	< 0.1	40.7	0.308	< 0.25
SB09	CNSB09-W-15386	42-47	4/11/02	510	< 0.2	110	12.4	< 0.1	40.7	0.220	< 0.25
SB09	CNSB09-W-15391	47-52	4/11/02	410	< 0.2	93.8	10.2	< 0.1	37.6	0.027	< 0.25
SB09	CNSB09-W-15445	52-57	4/11/02	330	< 0.2	71.4	2.83	< 0.1	28.9	0.029	< 0.25
SB10	CNSB05-W-15196	38-41	4/6/02	380	< 0.2	72	20.6	< 0.1	27	0.064	< 0.25
SB10	CNSB05-W-15201	41-45	4/6/02								
SB10	CNSB05-W-15198	45-50	4/6/02	340	< 0.2	65.4	14.4	< 0.1	26.4	0.165	< 0.25
SB10	CNSB05-W-15202	55-58	4/6/02	340	< 0.2	73.1	3.52	< 0.1	28.6	0.074	< 0.25

TABLE G.4 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Concentration (mg/L) Potassium	Silicon	Sodium	Sulfate	Zinc	Preserved Sample Identifier	Total Nitrogen (mg/L)
SB07	CNSB07-W-15240	46-50	4/8/02	< 5	15.1	33.1	4.43	0.04	CNSB07-W-15241	0.35
SB07	CNSB07-W-15243[a]	54-59	4/8/02						CNSB07-W-15243	0.21
SB07	CNSB07-W-15244	64-69	4/9/02	6.62	7.9	39.6	1.89	< 0.02	CNSB07-W-15225	0.12
SB07	CNSB07-W-15230[a]	69-74	4/9/02						CNSB07-W-15230	0.18
SB07	CNSB07-W-15217	95-100	4/10/02	< 5	14.2	32.3	7.89	< 0.02	CNSB07-W-15218	0.02
SB08	CNSB08-W-15238	53-58[c]	4/8/02	< 5	14.8	30.7	8.37	< 0.02	CNSB08-W-15239	1.72
SB08	CNSB08-W-15365	53-58	4/9/02	5.56	13.2	31.1	6.34	< 0.02	CNSB08-W-15366	0.33
SB08	CNSB08-W-15452[a]	58-62	4/12/02						CNSB08-W-15452	2.27
SB08	CNSB08-W-15368[a]	62-67	4/10/02						CNSB08-W-15368	0.36
SB08	CNSB08-W-15448[a]	67-72	4/12/02						CNSB08-W-15448	0.17
SB08	CNSB08-W-15454[a]	72-77	4/12/02						CNSB08-W-15454	0.14
SB08	CNSB08-W-15450[a]	77-82	4/12/02						CNSB08-W-15450	0.06
SB09	CNSB09-W-15372	32-37	4/10/02	< 5	15.4	57.1	24.5	< 0.02	CNSB09-W-15374	6.19
SB09	CNSB09-W-15215	36.5-41.5	4/9/02	< 5	13	27	24.7	0.07	CNSB09-W-15216	5.64
SB09	CNSB09-W-15388	37-42	4/11/02	< 5	15	49.9	27.4	< 0.02	CNSB09-W-15389	6.55
SB09	CNSB09-W-15386	42-47	4/11/02	< 5	16	47.7	23.9	< 0.02	CNSB09-W-15387	7.00
SB09	CNSB09-W-15391	47-52	4/11/02	< 5	16.6	15.3	4.42	< 0.02	CNSB09-W-15392	3.21
SB09	CNSB09-W-15445	52-57	4/11/02	< 5	14.7	14.8	2.11	0.04	CNSB09-W-15446	0.34
SB10	CNSB05-W-15196	38-41	4/6/02	< 5	14.8	45.5	2.93	< 0.02	CNSB05-W-15197	1.02
SB10	CNSB05-W-15201	41-45	4/6/02						CNSB05-W-15201	0.70
SB10	CNSB05-W-15198	45-50	4/6/02	< 5	14.8	38.5	2.02	< 0.02	CNSB05-W-15199	0.50
SB10	CNSB05-W-15202	55-58	4/6/02	< 5	14.1	28.7	1.93	< 0.02	CNSB05-W-15203	0.14

[a] Preserved sample collected for total nitrogen analysis only.

[b] Insufficient water was initially available at this depth for all of the desired analyses. The screen was left in place for 10-24 hr to allow additional groundwater to collect for inorganic analyses. Losses of nitric acid vapor in the open hole during this period could have affected the total nitrogen results.

[c] Because of a surface elevation change over a small distance, this sampling interval is equivalent to the sampling interval at 58-62 ft BGL from which sample CNSB08-W-15452 was collected.

TABLE G.5 Results of tritium analyses on groundwater samples collected during the Phase I field investigation at Centralia, Kansas.

Location	Sample	Depth (ft BGL)	Sample Date	Tritium ± Error (TU)[a]
SB01	CNSB01-W-15322	40-45	3/27/02	0.29 ± 0.10
SB01	CNSB01-W-15207	51-56	4/5/02	0.34 ± 0.09
SB01	CNSB01-W-15311	86-91	3/27/02	0.04 ± 0.09
SB03	CNSB03A-W-15305	55.5-58.5	3/26/02	-0.08 ± 0.10
SB04	CNSB04-W-15274	52.5-55.5	3/22/02	0.04 ± 0.09
SB04	CNSB04-W-15315	56-60	3/27/02	0.21 ± 0.10
SB04	CNSB04-W-15375	87-91	4/5/02	-0.01 ± 0.09
SB04	CNSB04-W-15318	99-104	3/27/02	0.09 ± 0.11
SB05	CNSB05-W-15264	34-37	3/21/02	0.4 ± 0.4
SB05	CNSB05-W-15265	37-40.2	3/22/02	0.6 ± 0.4
SB06	CNSB06-W-15141	61-66	4/5/02	2.45 ± 0.09
SB07	CNSB07-W-15240	46-50	4/8/02	0.04 ± 0.09
SB07	CNSB07-W-15244	64-69	4/9/02	0.04 ± 0.09
SB07	CNQCDU-W-15226	64-69	4/9/02	0.05 ± 0.09
SB07	CNSB07-W-15217	95-100	4/10/02	0.17 ± 0.09
SB08	CNSB08-W-15238	53-58	4/8/02	0.15 ± 0.09
SB08	CNSB08-W-15367	62-67	4/10/02	0.13 ± 0.09
SB09	CNSB09-W-15372	32-37	4/10/02	9.2 ± 0.3
SB09	CNSB09-W-15215	36.5-41.5	4/9/02	10.5 ± 0.3
SB10	CNSB05-W-15200	41-45	4/6/02	0.03 ± 0.09

[a] TU, tritium unit; 1 TU = 1 atom of tritium per 10^{18} atoms of hydrogen.

Appendix H:

Quality Control for Sample Collection, Handling, and Analysis

Appendix H:

Quality Control for Sample Collection, Handling, and Analysis

Soil and groundwater sampling was conducted during the Phase I investigation at Centralia to verify an association of carbon tetrachloride contamination with the former CCC/USDA facility and to identify contaminant migration pathways at the former facility. Quality assurance/quality control samples were collected throughout the investigation to monitor sample collection, handling, and analysis activities. The QA/QC procedures for sample collection, handling, and analysis followed during the Phase I effort are described in detail in the *Master Work Plan* (Argonne 2002b) and the Centralia Phase I *Work Plan* (Argonne 2002a). Evaluation of the organic analytical data was consistent with EPA guidelines (EPA 1994).

H.1 Monitoring of Sample Collection, Handling, and Analysis

Sample collection and handling activities were monitored by the documentation of samples as they were collected and the use of chain-of-custody (COC) forms and custody seals to ensure sample integrity during the handling and shipment of samples for analysis. Minor discrepancies in some sample identifications as listed on the COC records, sample containers, or analytical data reports were resolved by comparison of the various documentation records. The COC records and complete QA/QC documentation are on file at Argonne.

The QA/QC samples collected included a background near-surface soil sample, equipment rinsates, and trip blanks. Blind field replicate samples were collected, and samples were selected for duplicate analyses as a measure of analytical precision. A field blank of water used during the field investigation for equipment decontamination was collected, and samples of the drummed decontamination waste water were collected before disposal. The QA/QC samples are listed in Table H.1. Analytical results for carbon tetrachloride and chloroform in QA/QC samples collected to monitor sample collection and handling activities are in Table H.2.

H.1.1 Background Near-Surface Soil Sample

A background near-surface soil sample (CNQCBG-S-15326) was collected to provide a baseline for the near-surface soil survey conducted in March 2002. Contamination was not detected.

H.1.2 Equipment Rinsates

Reusable sampling bailers were used during collection of groundwater samples with the ECPT vehicle. Rinsates from the decontaminated bailers and ECPT rods were collected periodically to ensure that cross-contamination did not occur during collection of groundwater samples. Disposable sampling equipment was used during collection of other samples. Neither carbon tetrachloride nor chloroform was detected in the rinsate samples.

The analytical results for bailer rinsate CNSB04-W-15213 are qualified because of low surrogate recovery during its analysis (Table H.2), as discussed in Section H.3.1. However, the qualification does not indicate the potential that decontamination procedures were not followed. A review of the sampling documentation showed that this rinsate was collected on April 6, 2002, from the decontaminated bailer used to collect groundwater sample CNSB04-W-15211, in which carbon tetrachloride was detected at 28 μg/L, and prior to collection of groundwater sample CNSB04-W-15214, in which no carbon tetrachloride was detected (Table G.3 in Appendix G).

H.1.3 Trip Blanks

Trip blanks were prepared and included in shipments of soil or water samples sent to each analytical laboratory for organic analysis, as an indicator of cross-contamination of samples during shipment. Neither carbon tetrachloride nor chloroform was detected in the trip blanks. Trace concentrations of the BTEX (benzene, toluene, ethylbenzene, and xylene) family of compounds were detected in four of the eight soil trip blanks.

Analytical problems were observed in the analysis of three trip blanks sent to the AGEM Laboratory with water samples for organic analysis (Table H.2):

1. The results for trip blank CNQCTB-W-15237, included in the shipment of seven water samples listed on COC form 2159, are qualified because of low surrogate recovery during analysis on April 9, 2002.

2. The results for trip blank CNQCTB-W-15232, included in the shipment of eight water samples listed on COC form 2156, are qualified because of low surrogate recovery during analysis on April 10, 2002.

3. Trip blank CNQCTB-W-15405, included in the shipment of 18 water samples listed on COC form 2195 and COC form 2168, was not analyzed on April 15, 2002, because of instrument failure. A second trip blank aliquot included with the shipment was broken during shipment.

Table H.3 summarizes the analytical results for the three trip blanks in question and their associated water samples. The lack of contamination in the majority of the water samples shipped with each trip blank and the evident consistency between groundwater samples and their associated replicates indicate that cross-contamination of samples in these three shipments did not occur.

H.1.4 Replicate Samples/Duplicate Analyses

As an indicator of the consistency of the sampling methodology followed and to provide a measure of analytical precision, blind replicate soil and groundwater samples were collected. In addition, samples were selected by the AGEM Laboratory for duplicate organic analyses. On the basis of its organic results, the AGEM Laboratory also selected samples for shipment to a second laboratory for verification analysis. Blind replicate samples, samples selected for duplicate analyses, and samples selected for verification organic analysis are listed in Table H.1.

H.1.5 Waste Characterization Samples

A blank of the water used for equipment decontamination during the Phase I field investigation was collected, along with a sample from each of two drums containing the equipment decontamination waste water (Table H.1). Carbon tetrachloride and chloroform were not detected.

H.1.6 Sampling Irregularities

The following sampling irregularities warrant discussion:

1. No unique preprinted sampling label was affixed to a rinsate sample collected in association with groundwater sample CNSB01-W-15311. During analysis at the AGEM Laboratory, a sample identifier of CNSB01-W-15311 (rinsate) was assigned.

2. During the collection of groundwater samples from SB05, numerous attempts were made at several spots in the vicinity to get the sampling device down to the desired interval. After some of the samples were taken, it was clear that they had been obtained too far from the original SB05 to represent that location. These more distant samples were subsequently assigned a new location designation, SB10, but their sample identification numbers on the COC forms, and hence in the database, retain the prefix CNSB05.

3. During collection of two groundwater samples for inorganic analysis, the water was collected with a pump rather than a bailer, the sand point was purged prior to sampling, or both. This difference in technique was found to make some difference in the duplicate analyses for total nitrogen. The data involved are denoted with a footnote in the results presented in Table G.4.

H.2 Quality Control for Organic Analysis of Soil Samples

Near-surface soil sampling was conducted at 43 locations at the former CCC/USDA facility. Ninety-nine near-surface soil samples (including 12 blind replicate samples and 1 background near-surface soil sample) were collected for carbon tetrachloride and chloroform analysis at the AGEM Laboratory with a modification of EPA Method 5021 (headspace analysis by gas chromatography with electron capture detection) to determine whether a pattern of carbon tetrachloride concentrations was evident that might indicate potential subsurface zones of contamination. Typical detection limits achieved were 0.10 μg/kg for carbon tetrachloride and 0.75 μg/kg for chloroform.

Subsurface soil sampling was conducted at 2 soil boring locations (SB01 and SB06), where 49 soil samples (including 7 blind field replicate samples) were collected. The near-surface and subsurface soils were analyzed at the AGEM Laboratory for VOCs, including carbon tetrachloride and chloroform, by using EPA Methods 5030B and 8260B (purge-and-trap GC-MS method), as referenced in the EPA's SW-846 (http://www.epa.gov/epaoswer/hazwaste/test/main.htm), to achieve a detection limit of 10 μg/kg. To verify the accuracy of these analytical results, random soil samples were split and prepared for verification analysis at Severn-Trent Laboratory, Colchester, Vermont, with the same analytical method.

The following sections describe quality control measures followed during analysis of the soil samples and discuss the quality of the organic analytical data from each laboratory. Analytical data from the AGEM Laboratory are discussed in Section H.2.1, and analytical data from Severn-Trent Laboratory are discussed in Section H.2.2. The analytical results from the AGEM Laboratory and Severn-Trent Laboratory are compared in Section H.2.3.

H.2.1 Organic Analysis of Soil Samples at the AGEM Laboratory

Soil samples were quick-frozen on dry ice as they were collected. At the laboratory, the VOCs present in each soil sample were extracted with methanol from the sample matrix.

For the headspace soil analyses, the methanol extract was placed in a sealed headspace vial with the internal standard solution. The samples were placed in a headspace sampler and analyzed by using a modification of EPA Method 5021. An 11-point calibration of the GC system was established on the basis of known quantities of carbon tetrachloride and chloroform ranging in concentration from 0.125 ng to 4 ng. A limitation of the chloroform analysis was the presence of chloroform (at very low concentrations) in the methanol extract used for sample preparation. Dual analyses were performed for 20 near-surface soil sampling locations through the analysis of blind field replicate samples or duplicate analyses of samples selected by the laboratory. Table H.4 summarizes the analytical results for the dual analyses. Consistency is evident in the analysis of the near-surface soil samples by the headspace method, and the analytical data obtained with this method are acceptable for qualitative determination of contaminant distribution.

For the purge-and-trap soil analyses, an aliquot of the methanol extract was purged, and the volatile species were transferred to a sorbent tube. After purging, the sorbent tube was heated and backflushed with an inert gas to desorb the components into the GC-MS system. The compounds eluting from the GC column were identified by retention time and by comparison with reference library spectra. The concentration of each component was calculated by comparison of the MS response for the quantitation ion to the response on corresponding calibration curves, for internal standards, or both.

Soil samples were analyzed at the AGEM Laboratory with the purge-and-trap method in 16 sample delivery groups (SDGs), as shown in Table H.5. The QA/QC procedures followed included initial and continuing calibration of instruments, analysis of laboratory blanks, monitoring

of surrogate spike recovery, analysis of replicate samples, and duplicate analyses of selected samples. Significant results include the following:

- Soil samples were received with custody seals intact and at appropriate temperature. All samples were analyzed within required holding times.

- Contaminants of concern were not detected in the laboratory method blanks.

- For each SDG, analytical instrument calibration was monitored by the analysis of calibration check standards. Table H.5 shows the relative percent difference (RPD) between the known and calculated concentrations of the standards. The concentrations of calibration check standards measured in all SDGs were within the acceptable range of ±20%.

- Surrogate standard determinations were performed on the samples and blanks by using the surrogate spike compounds fluorobenzene, 1,2-dichlorobenzene-d_4, and 4-bromofluorobenzene. Table H.5 shows the percent recovery of these system-monitoring compounds for each of the analyses. With one exception, reanalysis was conducted when the surrogate recovery limit of 80-120% was not met in the initial analysis. Surrogate recovery was less than 80% in the analysis of near-surface soil sample CNSU19-S-15286 (4.6-4.8 ft BGL) in SDG 02-4-1. Contamination was not detected in analysis of the sample by the headspace method (Table D.2 in Appendix D), and the purge-and-trap data for sample CNSU19-S-15286 are accepted without qualification.

- As a measure of consistency in the sampling and analytical methodologies, dual analyses of soil samples collected at 31 sampling locations were conducted through the analysis of blind replicate samples submitted to the laboratory or duplicate analyses of samples selected by the laboratory. Blind replicates of 19 soil samples were collected in the field. Five of the replicates and 13 additional soil samples were selected by the AGEM Laboratory for duplicate organic analyses by the purge-and-trap method. Table H.6 summarizes the results for the initial samples and their replicate or duplicate analyses.

Agreement is excellent, indicating consistency in both the sampling and analytical methodologies. Specific observations are as follows:

- For samples in which no carbon tetrachloride was detected, the associated replicate or duplicate analysis also had no detection of carbon tetrachloride. For samples in which carbon tetrachloride was detected, the RPD between the detected concentrations in the initial sample and the associated replicate or duplicate analysis were 0-35.7%.

- Similar consistency is evident for the chloroform results, with one exception. In the initial analysis of subsurface soil sample CNSB06-S-15339, chloroform was detected near the quantitation limit, but chloroform was not detected in a duplicate analysis of the sample.

The analytical data from AGEM Laboratory are acceptable for quantitative determination of contaminant distribution in the near-surface and subsurface soils.

H.2.2 Organic Analysis of Soil Samples at Severn-Trent Laboratory

In accordance with the QA/QC procedures defined in the *Master Work Plan* (Argonne 2002b), selected soil samples analyzed at the AGEM Laboratory for VOCs with EPA Methods 5030B and 8260B were subjected to verification analysis at a second laboratory with the same analytical procedure. The analytical results from the two laboratories are compared in Section H.2.3. Below is a discussion of the quality of the organic analytical data from Severn-Trent Laboratory.

Nineteen replicate soil samples were sent in two shipments to Severn-Trent Laboratory, with a trip blank in each. Complete data packages in two SDGs were provided for the samples. The QA/QC procedures followed included initial and continuing calibration of instruments, analysis of laboratory blanks, monitoring of surrogate spike recovery, and spike analysis of laboratory control samples. Significant results include the following:

- Soil samples shipped to Severn-Trent Laboratory were received with custody seals intact and at appropriate temperature. All samples were analyzed within required holding times.

- Analytical instruments were properly tuned; initial and continuing calibration checks remained within the allowable range.

- Low concentrations (< 10 µg/kg) of bromomethane, chloromethane, methylene chloride, and 1,2,4-trichlorobenzene were detected in the methanol used for soil extraction, and trace concentrations of naphthalene were detected in the instrument blanks associated with each SDG. Carbon tetrachloride and chloroform were not detected.

- Surrogate standard determinations were performed on samples and blanks by using the surrogate spike compounds toluene-d8, 1,2-dichloroethane-d_4, 4-bromofluorobenzene, and 1,2-dichlorobenzene-d_4. Table H.7 shows the percent recovery of the system-monitoring compounds for each of the analyses. In the analysis of laboratory quality control sample LWSI MEOHLCS, two spike formulations, each having the surrogate compounds as constituents, were added. The apparently high surrogate concentration values reflect the higher spike amounts and are within the quality control limits.

- To evaluate the matrix effect of samples on the analytical methodology, a matrix spike/matrix spike duplicate (MD/MSD) analysis of a soil sample or a laboratory quality control sample was performed with each SDG by using a suite of spike compounds that included carbon tetrachloride and chloroform. Table H.8 shows the percent recovery and RPD values for carbon tetrachloride and chloroform in the spike/spike duplicate analyses. Quality control limits were met for these compounds. Some compounds unrelated to the investigation, including isobutyl alcohol, propionitrile, and 1,4-dioxane, were poorly recovered, while the recovery of fluorobenzene was elevated.

- The organic analytical data from Severn-Trent Laboratory for the replicate soil samples are acceptable for comparison to the AGEM Laboratory data.

H.2.3 Verification Organic Analysis of Soil Samples

In accordance with the QA/QC procedures defined in the *Master Work Plan* (Argonne 2002b), selected soil samples analyzed at the AGEM Laboratory with EPA Methods 5030B

and 8260B were subjected to verification analysis at a second laboratory. Split replicates of 19 of the 148 soil samples analyzed at the AGEM Laboratory (13% of the soil samples) were prepared for verification analysis at Severn-Trent Laboratory. Table H.9 compares the carbon tetrachloride and chloroform results for the soil samples analyzed at both laboratories.

For samples analyzed at the AGEM Laboratory with carbon tetrachloride detected above the quantitation limit of 10 µg/kg, replicates were analyzed at Severn-Trent Laboratory with similar results. For these verification soil samples, the calculated RPD values between the two analytical laboratories were 3.1-22.9%. A replicate of the sample with the highest RPD value of 22.9% was also submitted for verification analysis, with a resulting RPD of 7.4%. At 2 of the 13 locations for which the AGEM Laboratory reported no detection of carbon tetrachloride, Severn-Trent Laboratory reported estimated values below the quantitation limit.

In the vertical-profile sampling at SB06, the AGEM Laboratory detected chloroform above the quantitation limit of 10 µg/kg for the purge-and-trap method, at 12 µg/kg in the subsurface soil sample at 25 ft BGL and at 19 µg/kg in the subsurface soil sample at 37 ft BGL. Neither of these samples was submitted for verification analysis. The presence of chloroform at low concentrations, below the quantitation limit, at other depths at the SB06 location was confirmed by verification analysis at Severn-Trent Laboratory.

The soil analytical data from the AGEM Laboratory, obtained with EPA Methods 5030B and 8260B, are supported by the data from Severn-Trent Laboratory.

H.3 Quality Control for Organic Analysis of Water Samples

Fifty-seven groundwater samples (including nine blind field replicate samples) were collected for organic analysis. These samples and the associated quality control samples were shipped immediately to the AGEM Laboratory for analysis with EPA Method 524.2 (EPA 1989b). As one measure of the precision of the analytical process, samples were selected by the laboratory for duplicate analyses. To verify the accuracy of the analytical results obtained with EPA Method 524.2, duplicate (split) samples were collected for verification analysis at Clayton Laboratory, Novi, Michigan, with CLP methodology (EPA 1989b). On the basis of results obtained by the AGEM Laboratory, selected duplicate samples were subjected to the verification analysis.

The following sections describe quality control measures followed during analysis of the water samples and the quality of the organic analytical data from each laboratory. Analytical data from the AGEM Laboratory are discussed in Section H.3.1, and analytical data from Clayton Laboratory are discussed in Section H.3.2. The analytical results from the AGEM Laboratory and Clayton Laboratory are compared in Section H.3.3.

H.3.1 Organic Analysis of Water Samples at AGEM Laboratory

Water samples shipped to the AGEM Laboratory were analyzed by the purge-and-trap method with a GC-MS system. For these analyses, VOCs present in the groundwater sample were extracted (purged) from the sample matrix by bubbling an inert gas through the sample. The purged components were trapped in a specified sorbent tube. After the purging, the sorbent tube was heated and backflushed with an inert gas to desorb the components into the GC-MS system. The compounds eluting from the GC column were identified by retention time and by comparison with reference library spectra. The concentration of each component was calculated by comparison of the MS response for the quantitation ion to the response for corresponding calibration curves and/or internal standards. The internal standard recovery limits were 80-120%. If the internal standard was outside these limits, the data were flagged accordingly. Calibration checks with each SDG were required to be within ±20% of the standard.

Water samples submitted to the AGEM Laboratory for organic analysis were analyzed in 14 SDGs. Table H.10 identifies the groundwater and associated quality control samples analyzed in each of the SDGs. The QA/QC procedures followed included analysis of instrument calibration check standards, analysis of laboratory blanks, monitoring of surrogate spike recovery, and duplicate laboratory analyses. Significant results include the following:

- Samples shipped to the AGEM Laboratory were received with custody seals intact and at appropriate temperature. All samples were analyzed within required holding times.

- Contaminants of concern were not detected in laboratory method blanks analyzed with the samples.

- For each SDG, analytical instrument calibration was monitored by the analysis of calibration check standards. Table H.10 shows the RPD values between the

known and calculated concentrations of the standards. The concentrations of calibration check standards measured in all SDGs were within the acceptable range of ±20%. To meet instrument calibration requirements, some water samples were reanalyzed at dilution (as identified in Table H.10).

- Surrogate standard determinations were performed on samples and blanks by using surrogate spike compounds fluorobenzene, 1,2-dichlorobenzene-d_4, and 4-bromofluorobenzene. Table H.10 shows the percent recovery of these system-monitoring compounds for each of the analyses. With the exceptions described below, the surrogate recoveries were within the specified range of 80-120% for all water samples, either in the initial analysis of the sample or in a successful reanalysis.

  - In the duplicate analysis of groundwater sample CNSB04-W-15274 in SDG 02-3-26, the recovery of surrogate compound 1,2-dichlorobenzene-d_4 was 122%. The high recovery would not inhibit the detection of contamination, and the data from this analysis are accepted without qualification.

  - In the analysis of equipment rinsate CNSB04-W-15213 in SDG 02-4-8, the recovery of two of the three surrogate compounds was below the quality control limit of 80%. Reanalysis of the sample in SDG 02-4-10 also exhibited low recovery. The data for this sample are accepted with qualification.

  - In the analysis of trip blank CNQCTB-W-15237 in SDG 02-4-9, the recovery of one of the three surrogate compounds was below the quality control limit of 80%. The data are accepted with qualification.

  - In the analysis of trip blank CNQCTB-W-15232 in SDG 02-4-10, the recovery of two of the three surrogate compounds was below the quality control limit of 80%. The data are accepted with qualification.

  - Instrument failure prevented a successful analysis of trip blank CNQCTB-W-15405 in SDG 02-4-15.

- As a measure of consistency in the sampling and analytical methodologies, dual analyses of water samples collected at 18 sampling locations were conducted

through the analysis of blind replicate samples submitted to the laboratory or duplicate analyses of samples selected by the laboratory. Nine blind replicate groundwater samples were collected in the field. Three of the replicate samples and ten additional groundwater samples were selected by the AGEM Laboratory for duplicate organic analyses by the purge-and-trap method. Table H.11 summarizes the analytical results for the initial samples and their associated replicate or duplicate analyses. Agreement is excellent, indicating consistency in both the sampling and analytical methodologies. Specific observations are as follows:

- For samples in which no carbon tetrachloride was detected, the associated replicate or duplicate analysis also had no detection of carbon tetrachloride. For samples in which carbon tetrachloride was detected, the RPD values between the detected concentrations in the initial sample and the associated replicate or duplicate analysis were 0-12.9%.

- Similar consistency is evident for the chloroform results, with calculated RPD values of 0-4.4% for the paired samples in which the compound was detected.

The analytical data from the AGEM Laboratory are acceptable for quantitative determination of contaminant distribution in groundwater.

H.3.2 Organic Analysis of Water Samples at Clayton Laboratory

In accordance with the QA/QC procedures defined in the *Master Work Plan* (Argonne 2002b), the analyses of water samples at the AGEM Laboratory with EPA Method 524.2 were verified with EPA-defined CLP methodology. On the basis of its results, the AGEM Laboratory selected replicate samples (identified in Table H.1) for the verification analysis. A comparison of the AGEM Laboratory and CLP analytical results for the replicate samples is in Section H.3.3. Below is a discussion of the quality of the organic analytical data obtained with CLP methodology.

Six replicate groundwater samples were shipped to the Clayton Laboratory for organic analysis with CLP methodology. The samples were sent in one shipment with a trip blank. A complete CLP data package was provided. The QA/QC procedures followed included initial and

continuing calibration of instruments, analysis of laboratory blanks, monitoring of surrogate spike recovery, and MS/MSD analyses. Significant results include the following:

- Samples shipped to the CLP laboratory were received with custody seals intact and at appropriate temperature. All samples were analyzed within required holding times.

- Analytical instruments were properly tuned; initial and continuing calibration checks remained within the allowable range.

- Contaminants of concern were not detected in the trip blank or laboratory method blanks. Acetone and 2-butanone were present at low concentrations in the trip blank. Acetone, 1,2-dichlorobenzene, 1,3-dichlorobenzene, and 1,2,4-trichlorobenzene were present at low concentrations in laboratory blanks.

- Surrogate standard determinations were performed on samples and blanks by using the surrogate spike compounds toluene-d_8, 4-bromofluorobenzene, and 1,2-dichloroethane-d_4. Table H.12 shows the percent recovery of the system-monitoring compounds for each of the CLP analyses. Recovery of the surrogate spikes was within the acceptable range (identified in Table H.12) specific to each surrogate for all analyses.

- An MS/MSD analysis was performed in accordance with CLP protocol by using matrix spike compounds 1,1-dichloroethene, trichloroethene, benzene, toluene, and chlorobenzene to evaluate the matrix effect of samples on the analytical methodology. Table H.13 shows the percent recovery of each spike compound in the MS/MSD analysis, as well as the calculated RPD between the spike and spike duplicate results. The recovery of each spike compound was within the specified quality control range, although the RPD values for benzene and toluene were slightly above their respective advisory criteria.

Organic analytical data from Clayton Laboratory for the replicate groundwater samples are acceptable for comparison to the AGEM Laboratory data.

H.3.3 Verification Organic Analysis of Water Samples

In accordance with the QA/QC procedures defined in the *Master Work Plan* (Argonne 2002b), selected replicates of the groundwater samples analyzed at the AGEM Laboratory with EPA Method 524.2 were subjected to verification analysis with EPA-defined CLP methodology. Six of the 57 groundwater samples analyzed at the AGEM Laboratory (10.5% of the groundwater samples) were also analyzed with CLP methodology. Table H.14 compares the carbon tetrachloride and chloroform results for groundwater samples obtained with EPA Method 524.2 and CLP methodology.

Analytical results for water samples analyzed at the AGEM Laboratory with EPA Method 524.2 are supported by the analytical results for replicate samples analyzed at Clayton Laboratory with CLP methodology. For samples in which carbon tetrachloride was detected, the calculated RPD values between the two laboratories were 0-26.6%, with a maximum difference in the reported concentrations (for sample CNSB06-W-15141) of 14 μg/L. For samples in which chloroform was detected, the calculated RPD values between the two laboratories were 8.3-15.4%, with a maximum difference in the reported concentrations < 1 μg/L.

H.4 Quality Control for Inorganic Analyses of Groundwater Samples

Groundwater samples were collected for inorganic analysis during the Phase I investigation to aid in geochemical characterization of the aquifers. Groundwater samples collected for total nitrogen analysis with EPA Method 353 were preserved in the field by the addition of sulfuric acid to achieve a pH of 2. Groundwater samples collected for other inorganic analyses were shipped immediately to Severn-Trent Laboratory for preservation, filtration, and analysis. These analyses included alkalinity with EPA Method 310, dissolved anion concentrations (chloride and sulfate) with EPA Method 300, and dissolved metals (aluminum, calcium, iron, magnesium, manganese, phosphorus, potassium, silicon, sodium, and zinc) with EPA Method 6010.

Inorganic analysis of the groundwater samples was conducted in ten SDGs. The QA/QC procedures followed included instrument calibration through analysis of spiked calibration check standards, verification of interelement and background correction factors through the analysis of interference check samples for inductively coupled plasma (ICP) procedures, analysis of laboratory

quality control samples, and duplicate analyses of selected samples. Significant points are the following:

- Initial and continuing calibration of analytical equipment was verified according to method protocol by the analysis of instrument check standards to determine instrument drift. Accuracy was measured as the percent recovery of known concentrations of the metals and anions of concern added to the calibration check standards.

- Interelement and background correction factors for ICP analyses were determined through the analysis of ICP interference check samples, with results falling within the control range of ±20% of the established mean value for each SDG.

- Accuracy in the analytical methodology followed was measured by the analysis of laboratory quality control samples with each SDG. The recoveries of known concentrations of the inorganic constituents in spiked laboratory quality control samples, shown in Table H.15, were within the desired range of 80% to 120%.

- Precision was measured by duplicate analyses of selected samples. Three blind replicate samples were submitted for analysis, and six samples (including one of the replicates) were selected by the laboratory for duplicate analyses. Good precision in the inorganic analyses is indicated by the low RPD values between the initial and duplicate analyses (Table H.16).

The inorganic results from Severn-Trent Laboratory for groundwater samples are acceptable on the basis of the recovery of known concentrations of the analytes of concern in laboratory quality control samples analyzed with the groundwater samples and the RPD values in duplicate analyses.

H.5 Quality Control for Isotopic Analyses of Groundwater Samples

Selected groundwater samples were analyzed for tritium at the University of Miami Tritium Laboratory in Miami, Florida. Tritium concentrations were reported on the basis of the U.S. National Institute of Science and Technology tritium water standard #4926, as measured on

September 3, 1961, and again on September 3, 1978, with a half-life of 12.32 yr (revised January 2002). Concentrations were reported in tritium units (TU), equivalent to 3.193 picocuries per kilogram of water. Because counting efficiency and background concentration are different for each instrument, the reported concentrations were corrected for cosmic intensity and gas pressure. Typical efficiencies are equivalent to 1 count per minute (cpm) per TU. Background is about 0.3 cpm, known to ±0.02 cpm.

Good precision in the tritium analyses was evident in the dual analyses of samples from nine sampling locations, including eight samples selected by the laboratory and one sample-blind replicate pair sent to the laboratory. Standard deviations in the dual analyses ranged from 0.01 TU to 0.14 TU.

H.6 Quality Control for Organic Analyses of Waste Characterization Samples

A blank of the water used during the Phase I field investigation for equipment decontamination and a sample from each of two drums containing the equipment decontamination waste water were collected for organic analysis at Severn-Trent Laboratory with EPA Methods 5030B and 8260B. Surrogates recovery was good in each of the analyses (Table H.17), as were the recoveries of target analytes in laboratory quality control samples (Table H.18). Contamination was not detected.

TABLE H.1 Quality control samples collected during the Phase I investigation at Centralia, Kansas.

Location	Sample	Depth (ft BGL)	Sample Date	Description
Background near-surface soil sample				
QC	CNQCBG-S-15326	0.8-1	4/3/02	Background soil sample collected with hand auger from road right-of-way 30 ft west of eighth power pole along Rt. 187.
Equipment rinsates				
QC	CNQCRI-W-15276	-[a]	3/22/02	Rinsate of ECPT sampling bailer after collection of sample CNSB04-W-14274.
QC	CNBR01-W-15267	-	3/22/02	Rinsate of ECPT sampling bailer after collection of sample CNSB05-W-15265.
QC	CNSB03A-W-15308	-	3/26/02	Rinsate of ECPT sampling bailer after collection of sample CNSB03A-W-15305 and replicate CNSB03A-W-15307.
QC	CNSB04-W-15317	-	3/27/02	Rinsate of ECPT sampling bailer after collection of sample CNSB04-W-15315.
QC	CNSB01-15311 (rinsate)	-	3/27/02	Rinsate of ECPT sampling bailer after collection of sample CNSB01-W-15311.
QC	CNSB01-W-15345	-	4/3/02	Rinsate of ECPT sampling bailer after collection of sample CNSB01-W-15324.
QC	CNSB01-W-15351	-	4/3/02	Rinsate of ECPT sampling bailer after collection of sample CNSB01-W-15348.
QC	CNQCRI-W-15206	-	4/5/02	Rinsate of ECPT sampling bailer after collection of sample CNSB06-W-15141.
QC	CNSB04-W-15378	-	4/5/02	Rinsate of ECPT sampling bailer after collection of sample CNSB04-W-15375 and replicate CNSB04-W-15376.
QC	CNQCRI-W-15236	-	4/6/02	Rinsate of ECPT sampling bailer after collection of sample CNSB05-W-15202 and replicate CNQCDU-W-15204.
QC	CNSB04-W-15213	-	4/6/02	Rinsate of ECPT sampling bailer after collection of sample CNSB04-W-15211.
QC	CNQCRI-W-15234	-	4/8/02	Rinsate of ECPT sampling bailer after collection of sample CNSB07-W-15240 .
QC	CNQCRI-W-15233	-	4/8/02	Rinsate of ECPT sampling bailer after collection of sample CNSB07-W-15242 .
QC	CNQCRI-W-15228	-	4/9/02	Rinsate of ECPT sampling bailer after collection of sample CNSB07-W-15244 and replicate CNQCDU-W-15227.
QC	CNQCRI-W-15231	-	4/9/02	Rinsate of ECPT sampling bailer after collection of sample CNSB07-W-15229.
QC	CNQCDU-W-15219	-	4/10/02	Rinsate of ECPT sampling bailer after collection of sample CNSB07-W-15217.
QC	CNSB08-W-15369	-	4/10/02	Rinsate of ECPT sampling bailer after collection of sample CNSB08-W-15367.
QC	CNSB09-W-15385	-	4/10/02	Rinsate of ECPT sampling bailer after collection of sample CNSB09-W-15372 and replicate CNSB09-W-15373.
QC	CNQCRI-W-15224	-	4/11/02	Rinsate of ECPT sampling bailer after collection of sample CNSB06-W-15222.

TABLE H.1 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Description
Equipment rinsates (Cont.)				
QC	CNQCRI-W-15397	-	4/11/02	Rinsate of ECPT sampling bailer after collection of sample CNSB06-W-15395.
QC	CNSB09-W-15390	-	4/11/02	Rinsate of ECPT sampling bailer after collection of sample CNSB09-W-15388.
QC	CNSB09-W-15394	-	4/11/02	Rinsate of ECPT sampling rod after collection of sample CNSB09-W-15391 and replicate CNSB09-W-15393.
QC	CNQCBR-W-15402	-	4/12/02	Rinsate of ECPT sampling bailer after collection of sample CNSB06-W-15400.
QC	CNQCRI-W-15408	-	4/12/02	Rinsate of ECPT sampling bailer after collection of sample CNSB06-W-15403 and replicate CNQCDU-W-15406.
QC	CNSB08-W-15455	-	4/12/02	Rinsate of ECPT sampling bailer after collection of sample CNSB08-W-15453.
Trip blanks sent to AGEM Laboratory with soil samples for organic analysis				
QC	CNTB01-S-15262	-	3/21/02	Trip blank sent to AGEM Laboratory with soil samples listed on COC forms 2125, 1092, and 1093.
QC	CNQCTB-S-15277	-	3/23/02	Trip blank sent to AGEM Laboratory with soil samples listed on COC form 2151.
QC	CNQCTB-S-15278	-	3/24/02	Trip blank sent to AGEM Laboratory with soil samples listed on COC form 2153.
QC	CNQCTB-S-15185	-	3/25/02	Trip blank sent to AGEM Laboratory with soil samples listed on COC forms 2161 and 2162.
QC	CNQCTB-S-15186	-	3/25/02	Trip blank sent to AGEM Laboratory with soil samples listed on COC form 2163.
QC	CNQCTB-S-15187	-	3/25/02	Trip blank sent to AGEM Laboratory with soil samples listed on COC forms 2164 and 2165.
QC	CNQCTB-S-15139	-	4/4/02	Trip blank sent to AGEM Laboratory with soil samples listed on COC forms 2175 and 2176.
QC	CNQCTB-S-15140	-	4/4/02	Trip blank sent to AGEM Laboratory with soil samples listed on COC form 2177.
Trip blanks sent to Severn-Trent Laboratory with soil samples for verification organic analysis				
QC	CN-MEOHBLANK-27MAR02	-	3/27/02	Blank of methanol used for soil extraction sent to Severn-Trent Laboratory with soil samples listed on COC form 107.
QC	CN-MEOHBLANK-09APR02	-	4/9/02	Blank of methanol used for soil extraction sent to Severn-Trent Laboratory with soil samples listed on COC form 116.

TABLE H.1 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Description
Blind field replicate soil samples				
SB01	CNSB01-S-15248	6	3/21/02	Replicate of subsurface soil sample CNSB01-S-15247.
SB01	CNSB01-S-15251	10	3/21/02	Replicate of subsurface soil sample CNSB01-S-15250.
SB01	CNSB01-S-15258	22	3/21/02	Replicate of subsurface soil sample CNSB01-S-15257.
SB06	CNQCDU-S-15313	17-17.2	4/3/02	Replicate of subsurface soil sample CNSB06-S-15335.
SB06	CNQCDU-S-15314	27-27.2	4/3/02	Replicate of subsurface soil sample CNSB06-S-15340. May have greater amount of iron oxide than initial sample.
SB06	CNQCDU-S-15180	45-45.2	4/4/02	Replicate of subsurface soil sample CNSB06-S-15194.
SB06	CNQCDU-S-15181	47-47.2	4/4/02	Replicate of subsurface soil sample CNSB06-S-15177.
SU06	CNQCDU-S-15095	0.5-0.8	3/23/02	Replicate of near-surface soil sample CNSU06-S-15106.
SU06	CNQCDU-S-15125	5-5.8	3/23/02	Replicate of near-surface soil sample CNSU06-S-15107.
SU13	CNQCDU-S-15115	1.5-1.7	3/23/02	Replicate of near-surface soil sample CNSU13-S-15121.
SU13	CNQCDU-S-15126	4.7-4.9	3/23/02	Replicate of near-surface soil sample CNSU13-S-15122.
SU18	CNQCDU-S-15128	0.8-1.1	3/25/02	Replicate of near-surface soil sample CNSU18-S-15283.
SU18	CNQCDU-S-15129	4.5-4.8	3/25/02	Replicate of near-surface soil sample CNSU18-S-15284.
SU28	CNQCDU-S-15130	0.8-1.1	3/25/02	Replicate of near-surface soil sample CNSU28-S-15303.
SU28	CNQCDU-S-15131	4.7-5	3/25/02	Replicate of near-surface soil sample CNSU28-S-15304.
SU36	CNQCDU-S-15132	1-1.3	3/25/02	Replicate of near-surface soil sample CNSU36-S-15159.
SU36	CNQCDU-S-15133	4.2-4.5	3/25/02	Replicate of near-surface soil sample CNSU36-S-15160.
SU43	CNQCDU-S-15134	0.9-1.2	3/25/02	Replicate of near-surface soil sample CNSU43-S-15173.
SU43	CNQCDU-S-15175	4.8-5	3/25/02	Replicate of near-surface soil sample CNSU43-S-15174.
Soil samples selected by AGEM Laboratory for duplicate organic analysis by headspace method				
SB01	CNSB01-S-15257	22	3/21/02	Subsurface soil sample.
SB06	CNSB06-S-15332	10.9-11.1	4/3/02	Subsurface soil sample.
SB06	CNSB06-S-15335	17-17.2	4/3/02	Subsurface soil sample.
SB06	CNQCDU-S-15313	17-17.2	4/3/02	Subsurface soil replicate.
SB06	CNSB06-S-15342	31-31.2	4/3/02	Subsurface soil sample.
SB06	CNSB06-S-15344	35-35.2	4/3/02	Subsurface soil sample.
SU08	CNSU08-S-15110	2.4-2.6	3/23/02	Near-surface soil sample.
SU13	CNQCDU-S-15115	1.5-1.7	3/23/02	Near-surface soil replicate.

TABLE H.1 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Description
Soil samples selected by AGEM Laboratory for duplicate organic analysis by headspace method (Cont.)				
SU18	CNQCDU-S-15129	4.5-4.8	3/25/02	Near-surface soil replicate.
SU19	CNSU19-S-15286	4.6-4.8	3/25/02	Near-surface soil sample.
SU23	CNSU23-S-15294	4.5-5	3/25/02	Near-surface soil sample.
SU38	CNSU38-S-15163	1-1.2	3/25/02	Near-surface soil sample.
SU39	CNSU39-S-15165	1.4-1.6	3/25/02	Near-surface soil sample.
SU39	CNSU39-S-15166	4.4-4.6	3/25/02	Near-surface soil sample.
SU41	CNSU41-S-15169	0.8-1	3/25/02	Near-surface soil sample.
SU41	CNSU41-S-15170	4.8-4.9	3/25/02	Near-surface soil sample.
Soil samples selected by AGEM Laboratory for duplicate organic analysis by purge-and-trap method				
SB06	CNSB06-S-15333	12.8-12.9	4/3/02	Subsurface soil sample.
SB06	CNSB06-S-15337	21-21.2	4/3/02	Subsurface soil sample.
SB06	CNSB06-S-15339	25-25.2	4/3/02	Subsurface soil sample.
SB06	CNSB06-S-15342	31-31.2	4/3/02	Subsurface soil sample.
SB06	CNSB06-S-15194	45-45.2	4/4/02	Subsurface soil sample.
SB06	CNSB06-S-15178	49-49.2	4/4/02	Subsurface soil sample.
SU03	CNSU03-S-15100	0.8-1	3/20/02	Near-surface soil sample.
SU06	CNQCDU-S-15125	5-5.8	3/23/02	Near-surface soil replicate.
SU10	CNSU10-S-15116	4.7-4.9	3/23/02	Near-surface soil sample.
SU18	CNQCDU-S-15128	0.8-1.1	3/25/02	Near-surface soil replicate.
SU18	CNQCDU-S-15129	4.5-4.8	3/25/02	Near-surface soil replicate.
SU22	CNSU22-S-15292	4.5-4.7	3/25/02	Near-surface soil sample.
SU25	CNSU25-S-15298	4.6-4.8	3/25/02	Near-surface soil sample.
SU26	CNSU26-S-15299	0.9-1.1	3/25/02	Near-surface soil sample.
SU34	CNSU34-S-15155	1.3-1.5	3/25/02	Near-surface soil sample.
SU34	CNSU34-S-15156	4.2-4.5	3/25/02	Near-surface soil sample.
SU43	CNQCDU-S-15175	4.8-5	3/25/02	Near-surface soil replicate.

TABLE H.1 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Description
Soil samples selected for verification organic analysis at Severn-Trent Laboratory				
SB01	CNSB01-S-15245	2	3/21/02	Clay, high plasticity, noncalcareous, some organics, dark yellowish brown, moist.
SB06	CNQCDU-S-15313	17-17.2	4/3/02	Replicate of sample CNSB06-S-15335.
SB06	CNSB06-S-15336	18.9-19.1	4/3/02	Clay, < 5% granules and pebbles (up to 0.5 in.), noncalcareous matrix, iron and manganese accumulations (calcareous, dark reddish brown) throughout, brown.
SB06	CNSB06-S-15340	27-27.2	4/3/02	Grayish brown, carbonate-rich clay with some iron stains, rounded pebbles. (Same material as above without mineral inclusions.)
SB06	CNQCDU-S-15314	27-27.2	4/3/02	Replicate of sample CNSB06-S-15340. May have greater amount of iron oxide than initial sample.
SB06	CNSB06-S-15341	29-29.2	4/3/02	Silty clay, 10% gravel and granules, moderately to strongly calcareous, trace iron stains (much less than above), grayish brown.
SB06	CNSB06-S-15342	31-31.2	4/3/02	Same as above.
SB06	CNQCDU-S-15180	45-45.2	4/4/02	Replicate of sample CNSB06-S-15194.
SB06	CNSB06-S-15183	55-55.2	4/4/02	Clay, as at 49-53 ft BGL.
SU01	CNSU01-S-15096	0.9-1	3/20/02	Organic-rich dark brown clay.
SU03	CNSU03-S-15100	0.8-1	3/20/02	Dark brown slightly reddish clay.
SU08	CNSU08-S-15110	2.4-2.6	3/23/02	Disturbed or fill.
SU13	CNQCDU-S-15126	4.7-4.9	3/23/02	Replicate of sample CNSU13-S-15122.
SU17	CNSU17-S-15282	3.8-4	3/25/02	Grayish brown silty clay with abundant finely disseminated iron and manganese inclusions. Moderately abundant calcareous inclusions; few granules.
SU20	CNSU20-S-15288	4.6-4.8	3/25/02	Grayish brown silty clay with abundant finely disseminated iron and manganese inclusions. Moderately abundant calcareous inclusions; few granules.
SU23	CNSU23-S-15293	0.9-1.1	3/25/02	Organic-rich very dark brown clay. (Iron oxide in small root molds near surface.)
SU25	CNSU25-S-15298	4.6-4.8	3/25/02	Yellowish brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.
SU33	CNSU33-S-15153	1.1-1.2	3/25/02	Dark yellowish brown clay with humic staining.
SU36	CNSU36-S-15160	4.2-4.5	3/25/02	Yellowish brown silty clay with dark brown mottles, occasional pebbles, scattered calcium carbonate, large iron and manganese accumulations.

TABLE H.1 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Description
Trip blanks sent to AGEM Laboratory with water samples for organic analysis				
QC	CNQCTB-W-15137	-	3/24/02	Trip blank sent to AGEM Laboratory with water samples listed on COC form 2126.
QC	CNQCTB-W-15176	-	3/26/02	Trip blank sent to AGEM Laboratory with water samples listed on COC form 2169.
QC	CNQCTB-W-15325	-	3/27/02	Trip blank sent to AGEM Laboratory with water samples listed on COC form 2171.
QC	CNSB01-W-15323	-	3/27/02	Trip blank sent to AGEM Laboratory with water samples listed on COC form 3000.
QC	CNTB01-W-15355	-	4/4/02	Trip blank sent to AGEM Laboratory with water samples listed on COC form 1678.
QC	CNQCTB-W-15195	-	4/6/02	Trip blank sent to AGEM Laboratory with water samples listed on COC form 2134.
QC	CNQCTB-W-15237	-	4/8/02	Trip blank sent to AGEM Laboratory with water samples listed on COC form 2159.
QC	CNQCTB-W-15232	-	4/9/02	Trip blank sent to AGEM Laboratory with water samples listed on COC form 2156.
QC	CNQCTB-W-15220	-	4/10/02	Trip blank sent to AGEM Laboratory with water samples listed on COC form 2185.
QC	CNQCTB-W-15221	-	4/11/02	Trip blank sent to AGEM Laboratory with water samples listed on COC form 2180.
QC	CNQCTB-W-15405		4/12/02	Trip blank sent to AGEM Laboratory with water samples listed on COC forms 2168 and 2195.
Trip blanks sent to Clayton Laboratory with water samples for verification of organic analysis				
QC	CN-TripBlank-040902	-	4/9/02	Trip blank sent to Clayton Laboratory with water samples listed on COC form 119.
Blind replicate water samples collected for organic analysis				
SB03	CNSB03A-W-15307	55.5-58.8	3/26/02	Replicate of sample CNSB03A-W-15305.
SB04	CNSB04-W-15384	65-70	4/6/02	Replicate of sample CNSB04-W-15382.
SB04	CNSB04-W-15376	87-91	4/5/02	Replicate of sample CNSB04-W-15375.
SB06	CNQCDU-W-15406	76-81	4/12/02	Replicate of sample CNSB06-W-15403.
SB07	CNQCDU-W-15226	64-69	4/9/02	Replicate of sample CNSB07-W-15244.
SB08	CNSB08-W-15370	62-67	4/10/02	Replicate of sample CNSB08-W-15367.
SB09	CNSB09-W-15373	32-37	4/10/02	Replicate of sample CNSB09-W-15372.
SB09	CNSB09-W-15393	47-52	4/11/02	Replicate of sample CNSB09-W-15391.
SB10	CNQCDU-W-15204	55-58	4/6/02	Replicate of sample CNSB05-W-15202.

TABLE H.1 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Description
Water samples selected by AGEM Laboratory for duplicate organic analysis				
SB01	CNSB01-W-15322	40-45	3/27/02	Low recovery.
SB01	CNSB01-W-15347	56-61	4/3/02	Slow, limited water recovery.
SB04	CNSB04-W-15274	52.5-55.5	3/22/02	Very cloudy; 800 mL purged prior to sampling.
SB04	CNSB04-W-15315	56-60	3/27/02	Sample from sand and gravel sequence. Oxidized water with heavy, fine sediment.
SB04	CNSB04-W-15318	99-104	3/27/02	Good water recovery.
SB06	CNSB06-W-15222	56-61	4/11/02	Low recovery from indicated screen interval.
SB06	CNSB06-W-15141	61-66	4/5/02	Sample collected without purging 5 ft south of SB06 core hole.
SB07	CNSB07-W-15244	64-69	4/9/02	Water level at 65.8 ft BGL prior to sampling of screened interval.
SB07	CNQCDU-W-15226	64-69	4/9/02	Replicate of sample CNSB07-W-15244.
SB08	CNSB08-W-15451	58-62	4/12/02	Water heavily oxidized and highly turbid.
SB08	CNSB08-W-15370	62-67	4/10/02	Replicate of sample CNSB08-W-15367.
SB09	CNSB09-W-15393	47-52	4/11/02	Replicate of sample CNSB09-W-15391.
SB10	CNSB05-W-15200	41-45	4/6/02	Sampled over indicated screened interval.
Water samples selected for verification organic analysis by CLP methodology				
SB04	CNSB04-W-15211	60-65	4/6/02	Water abundant, oxidized, low turbidity.
SB04	CNSB04-W-15382	65-70	4/6/02	Water level at 62 ft BGL prior to sampling and rising rapidly.
SB04	CNSB04-W-15214	70-75	4/6/02	Abundant, clear water recovery. Water level at 66 ft BGL prior to sampling and rising rapidly.
SB04	CNSB04-W-15376	87-91	4/5/02	Replicate of sample CNSB04-W-15375.
SB06	CNSB06-W-15141	61-66	4/5/02	Sample collected without purging 5 ft south of SB06 core hole.
SB10	CNSB05-W-15196	38-41	4/6/02	ECPT sampling location initially identified as SB05 now reidentified as SB10.
Blind replicate water samples collected for inorganic analysis				
SB07	CNQCDU-W-15226	64-69	4/9/02	Replicate of sample CNSB07-W-15244.
SB10	CNQCDU-W-15204	55-58	4/6/02	Replicate of sample CNSB05-W-15202.

TABLE H.1 (Cont.)

Location	Sample	Depth (ft BGL)	Sample Date	Description
Blind replicate water samples (preserved) collected for total nitrogen analysis				
SB06	CNQCDU-W-15407	76-81	4/12/02	Replicate of sample CNSB06-W-15404.
SB07	CNQCDU-W-15227	64-69	4/9/02	Replicate of sample CNSB07-W-15225.
SB10	CNQCDU-W-15235	55-58	4/6/02	Replicate of sample CNSB05-W-15203.
Water samples selected for duplicate inorganic analysis by Severn-Trent Laboratory				
SB06	CNSB06-W-15141	61-66	4/5/02	Selected for duplicate cation analyses.
SB06	CNSB06-W-15396	66-71	4/11/02	Selected for duplicate total nitrogen analysis.
SB07	CNSB07-W-15241	46-50	4/8/02	Selected for duplicate total nitrogen analysis.
SB07	CNQCDU-W-15227	64-69	4/9/02	Replicate of sample CNSB07-W-15225, selected for duplicate total nitrogen analysis.
SB10	CNSB05-W-15198	45-50	4/6/02	Selected for duplicate anion and alkalinity analyses.
SB10	CNSB05-W-15202	55-58	4/6/02	Selected for duplicate cation, anion, and alkalinity analyses.
Waste characterization samples				
QC	CNQCDR01-W-15413	-	4/12/02	Initial sample from drum #1 containing water accumulated from equipment decontamination, not analyzed because of analytical instrument failure.
QC	CNQCDR02-W-15414	-	4/12/02	Initial sample from drum #2 containing water accumulated from equipment decontamination, not analyzed because of analytical instrument failure.
QC	CNCITY-W-15416	-	4/24/02	Blank of water used for equipment decontamination.
QC	CNQCDR1-W-15411	-	4/24/02	Second sample from drum #1 containing water accumulated from equipment decontamination.
QC	CNQCDR2-W-15412	-	4/24/02	Second sample from drum #2 containing water accumulated from equipment decontamination.
QC	CNTRIP-W-15415	-	4/24/02	Trip blank sent to Severn-Trent Laboratory with waste characterization samples listed on COC form 2130.

[a] Depth not applicable.

TABLE H.2 Results of carbon tetrachloride and chloroform analyses on quality control samples collected to monitor sample collection and handling activities.

Sample	Sample Date	Concentration (µg/kg in soil; µg/L in water) Carbon Tetrachloride	Chloroform	Reporting Limit
Background soil sample				
CNQCBG-S-15326	4/3/02	ND	ND	10
Equipment rinsates				
CNQCRI-W-15276	3/22/02	ND	ND	1
CNBR01-W-15267	3/22/02	ND	ND	1
CNSB03A-W-15308	3/26/02	ND	ND	1
CNSB04-W-15317	3/27/02	ND	ND	1
CNSB01-W-15311 (rinsate)	3/27/02	ND	ND	1
CNSB01-W-15345	4/3/02	ND	ND	1
CNSB01-W-15351	4/3/02	ND	ND	1
CNQCRI-W-15206	4/5/02	ND	ND	1
CNSB04-W-15378	4/5/02	ND	ND	1
CNQCRI-W-15236	4/6/02	ND	ND	1
CNSB04-W-15213	4/6/02	ND S[a]	ND S	1
CNQCRI-W-15234	4/8/02	ND	ND	1
CNQCRI-W-15233	4/8/02	ND	ND	1
CNQCRI-W-15228	4/9/02	ND	ND	1
CNQCRI-W-15231	4/9/02	ND	ND	1
CNQCDU-W-15219	4/10/02	ND	ND	1
CNSB08-W-15369	4/10/02	ND	ND	1
CNSB09-W-15385	4/10/02	ND	ND	1
CNQCRI-W-15224	4/11/02	ND	ND	1
CNQCRI-W-15397	4/11/02	ND	ND	1
CNSB09-W-15390	4/11/02	ND	ND	1
CNSB09-W-15394	4/11/02	ND	ND	1
CNQCBR-W-15402	4/12/02	ND	ND	1
CNQCRI-W-15408	4/12/02	ND	ND	1
CNSB08-W-15455	4/12/02	ND	ND	1
Trip blanks sent to AGEM Laboratory with soil samples for organic analysis				
CNTB01-S-15262	3/21/02	ND	ND	10
CNQCTB-S-15277	3/23/02	ND	ND	10
CNQCTB-S-15278	3/24/02	ND	ND	10
CNQCTB-S-15185	3/25/02	ND	ND	10
CNQCTB-S-15186	3/25/02	ND	ND	10
CNQCTB-S-15187	3/25/02	ND	ND	10

TABLE H.2 (Cont.)

Sample	Sample Date	Concentration (µg/kg in soil; µg/L in water) Carbon Tetrachloride	Chloroform	Reporting Limit
Trip blanks sent to AGEM Laboratory with soil samples for organic analysis (Cont.)				
CNQCTB-S-15139[b]	4/4/02	NA	NA	NA
CNQCTB-S-15140	4/4/02	ND	ND	10
Trip blanks sent to STL with soil samples for verification organic analysis				
CN-MEOHBLANK-27MAR02	3/27/02	ND	ND	10
CN-MEOHBLANK-09APR02	4/9/02	ND	ND	10
Trip blanks sent to AGEM Laboratory with water samples for organic analysis				
CNQCTB-W-15137	3/24/02	ND	ND	1
CNQCTB-W-15176	3/26/02	ND	ND	1
CNQCTB-W-15325	3/27/02	ND	ND	1
CNSB01-W-15323	3/27/02	ND	ND	1
CNTB01-W-15355	4/4/02	ND	ND	1
CNQCTB-W-15195	4/6/02	ND	ND	1
CNQCTB-W-15237	4/8/02	ND S	ND S	1
CNQCTB-W-15232	4/9/02	ND S	ND S	1
CNQCTB-W-15220	4/10/02	ND	ND	1
CNQCTB-W-15221	4/11/02	ND	ND	1
CNQCTB-W-15405[c]	4/12/02	NA	NA	NA
Trip blank sent to Clayton Laboratory with water samples for verification organic analysis				
CN-TripBlank-040902	4/9/02	ND	ND	5

[a] S, surrogate recovery below quality control limit of 80%.

[b] Not analyzed (NA) by the purge-and-trap method. Contamination was not detected in analysis by the headspace method.

[c] Not analyzed because of instrument failure. Second vial was broken during shipment.

TABLE H.3 Analytical results for samples shipped with trip blanks associated with analytical problems.

Location	Sample	Depth (ft BGL)	Concentration (µg/L) Carbon Tetrachloride	Chloroform	Sample Type[a]	Date Sampling	Shipping	Analysis	COC Form
Samples included with trip blank CNQCTB-W-15237, listed on COC form 2159									
QC	CNQCTB-W-15237	-[b]	ND[c]	ND	TB	4/8/02	4/8/02	4/9/02	2159
QC	CNQCRI-W-15236	-	ND	ND	RI	4/6/02	4/8/02	4/9/02	2159
SB04	CNSB04-W-15382	65-70	3.8	ND	GW	4/6/02	4/8/02	4/9/02	2159
SB04	CNSB04-W-15384	65-70	3.6	ND	GW-REP	4/6/02	4/8/02	4/9/02	2159
SB04	CNSB04-W-15214	70-75	ND	ND	GW	4/6/02	4/8/02	4/9/02	2159
SB10	CNSB05-W-15200	41-45	1.2	ND	GW	4/6/02	4/8/02	4/9/02	2159
SB10	CNSB05-W-15202	55-58	ND	ND	GW	4/6/02	4/8/02	4/9/02	2159
SB10	CNQCDU-W-15204	55-58	ND	ND	GW-REP	4/6/02	4/8/02	4/9/02	2159
Samples included with trip blank CNQCTB-W-15232, listed on COC form 2156									
QC	CNQCTB-W-15232	-	ND	ND	TB	4/9/02	4/9/02	4/10/02	2156
QC	CNQCRI-W-15233	-	ND	ND	RI	4/8/02	4/9/02	4/11/02	2156
QC	CNQCRI-W-15234	-	ND	ND	RI	4/8/02	4/9/02	4/11/02	2156
QC	CNQCRI-W-15228	-	ND	ND	RI	4/9/02	4/9/02	4/11/02	2156
SB07	CNSB07-W-15240	46-50	6.4	ND	GW	4/8/02	4/9/02	4/10/02	2156
SB07	CNSB07-W-15242	54-59	ND	ND	GW	4/8/02	4/9/02	4/10/02	2156
SB07	CNSB07-W-15244	64-69	ND	ND	GW	4/9/02	4/9/02	4/11/02	2156
SB07	CNQCDU-W-15226	64-69	ND	ND	GW-REP	4/9/02	4/9/02	4/10/02	2156
SB08	CNSB08-W-15238	53-58	130	1.3	GW	4/8/02	4/9/02	4/10/02	2156
Samples included with trip blank CNQCTB-W-15405, listed on COC form 2195 and COC form 2168									
QC	CNQCTB-W-15405	-	IF	IF	TB	4/12/02	4/12/02	4/15/02	2195
QC	CNSB08-W-15455	-	ND	ND	RI	4/12/02	4/12/02	4/18/02	2195
QC	CNQCRI-W-15408	-	ND	ND	RI	4/12/02	4/12/02	4/18/02	2195
QC	CNQCDR01-W-15413	-	IF	IF	BT	4/12/02	4/12/02	4/15/02	2195
QC	CNQCDR02-W-15414	-	IF	IF	BT	4/12/02	4/12/02	4/15/02	2195

TABLE H.3 (Cont.)

Location	Sample	Depth (ft BGL)	Concentration (µg/L) Carbon Tetrachloride	Chloroform	Sample Type[a]	Date Sampling	Shipping	Analysis	COC Form
Samples included with trip blank CNQCTB-W-15405, listed on COC form 2195 and COC form 2168 (Cont.)									
SB06	CNSB06-W-15403	76-81	ND	ND	GW	4/12/02	4/12/02	4/15/02	2195
SB06	CNQCDU-W-15406	76-81	ND	ND	GW-REP	4/12/02	4/12/02	4/15/02	2195
SB06	CNSB06-W-15409	86-91	ND	ND	GW	4/12/02	4/12/02	4/15/02	2195
SB08	CNSB08-W-15451	58-62	176	5.7	GW	4/12/02	4/12/02	4/18/02	2195
SB08	CNSB08-W-15447	67-72	ND	ND	GW	4/12/02	4/12/02	4/15/02	2195
SB08	CNSB08-W-15453	72-77	ND	ND	GW	4/12/02	4/12/02	4/18/02	2195
SB08	CNSB08-W-15449	77-82	ND	ND	GW	4/12/02	4/12/02	4/15/02	2195
QC	CNQCRI-W-15224	-	ND	ND	RI	4/11/02	4/12/02	4/18/02	2168
QC	CNQCRI-W-15397	-	ND	ND	RI	4/11/02	4/12/02	4/18/02	2168
QC	CNQCBR-W-15402	-	ND	ND	RI	4/12/02	4/12/02	4/18/02	2168
SB06	CNSB06-W-15222	56-61	7.6	1.3	GW	4/11/02	4/12/02	4/15/02	2168
SB06	CNSB06-W-15395	66-71	16	ND	GW	4/11/02	4/12/02	4/15/02	2168
SB06	CNSB06-W-15398	71-76	4.3	ND	GW	4/12/02	4/12/02	4/15/02	2168
SB06	CNSB06-W-15400	81-86	ND	ND	GW	4/12/02	4/12/02	4/15/02	2168

[a] Abbreviations: BT, equipment decontamination waste water; GW, groundwater; GW-REP, groundwater replicate; RI, rinsate; TB, trip blank.

[b] Depth not applicable.

[c] ND, not detected.

[d] IF, instrument failure.

TABLE H.4 Results of dual organic analyses on soil samples at the AGEM Laboratory by the headspace method.

Location	Depth (ft BGL)	Concentration (µg/kg) Carbon Tetrachloride	Chloroform	Sample Identifier	Analysis Type
SU06	0.5-0.8	ND[a]	ND	CNSU06-S-15106	Primary sample
		ND	ND	CNQCDU-S-15095	Replicate
SU06	5-5.8	ND	ND	CNSU06-S-15107	Primary sample
		ND	0.96	CNQCDU-S-15125	Replicate
SU08	2.4-2.6	ND	ND	CNSU08-S-15110	Primary sample
		ND	ND	CNSU08-S-15110DUP	Duplicate analysis
SU13	1.5-1.7	0.79	0.76	CNSU13-S-15121	Primary sample
		0.42	ND	CNQCDU-S-15115	Replicate
		0.52	ND	CNQCDU-S-15115DUP	Duplicate analysis
SU13	4.7-4.9	1.98	ND	CNSU13-S-15122	Primary sample
		1.76	ND	CNQCDU-S-15126	Replicate
SU18	0.8-1.1	0.12	ND	CNSU18-S-15283	Primary sample
		ND	ND	CNQCDU-S-15128	Replicate
SU18	4.5-4.8	ND	ND	CNSU18-S-15284	Primary sample
		ND	ND	CNQCDU-S-15129	Replicate
		ND	ND	CNQCDU-S-15129DUP	Duplicate analysis
SU19	4.6-4.8	ND	ND	CNSU19-S-15286	Primary sample
		ND	ND	CNSU19-S-15286DUP	Duplicate analysis
SU23	4.5-5	ND	ND	CNSU23-S-15294	Primary sample
		ND	ND	CNSU23-S-15294DUP	Duplicate analysis
SU28	0.8-1.1	ND	ND	CNSU28-S-15303	Primary sample
		ND	ND	CNQCDU-S-15130	Replicate
SU28	4.7-5	0.12	ND	CNSU28-S-15304	Primary sample
		ND	ND	CNQCDU-S-15131	Replicate
SU36	1-1.3	0.19	ND	CNSU36-S-15159	Primary sample
		ND	0.79	CNQCDU-S-15132	Replicate
SU36	4.2-4.5	0.15	ND	CNSU36-S-15160	Primary sample
		0.15	ND	CNQCDU-S-15133	Replicate
SU38	1-1.2	0.17	ND	CNSU38-S-15163	Primary sample
		0.18	ND	CNSU38-S-15163DUP	Duplicate analysis

TABLE H.4 (Cont.)

Location	Depth (ft BGL)	Concentration (µg/kg) Carbon Tetrachloride	Chloroform	Sample Identifier	Analysis Type
SU39	1.4-1.6	ND	ND	CNSU39-S-15165	Primary sample
		ND	ND	CNSU39-S-15165DUP	Duplicate analysis
SU39	4.4-4.6	ND	ND	CNSU39-S-15166	Primary sample
		ND	ND	CNSU39-S-15166DUP	Duplicate analysis
SU41	0.8-1	0.14	1.05	CNSU41-S-15169	Primary sample
		ND	0.96	CNSU41-S-15169DUP	Duplicate analysis
SU41	4.8-4.9	ND	ND	CNSU41-S-15170	Primary sample
		ND	ND	CNSU41-S-15170DUP	Duplicate analysis
SU43	0.9-1.2	ND	ND	CNSU43-S-15173	Primary sample
		ND	ND	CNQCDU-S-15134	Replicate
SU43	4.8-5	ND	ND	CNSU43-S-15174	Primary sample
		ND	ND	CNQCDU-S-15175	Replicate

[a] ND, not detected at reporting limit of 0.1 µg/kg for carbon tetrachloride and 0.75 µg/kg for chloroform.

TABLE H.5 Results of organic analyses on quality control samples collected to monitor soil analyses at the AGEM Laboratory with the purge-and-trap method.

				Measured Values for Calibration Check Standards			
	Recovery of Surrogate Compounds[a] (%)			Carbon Tetrachloride		Chloroform	
Sample	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/kg)	RPD[b]	Concentration (µg/kg)	RPD[b]
SDG 02-3-23, analysis date March 23, 2002							
20-µg/kg standard	102	104	107	19.48	2.6	20.72	3.5
Methanol blank	100	100	100				
CNSU01-S-15096	114	107	109				
CNSU01-S-15097	99	100	102				
CNSU02-S-15098	114	109	111				
CNSU03-S-15101	114	110	113				
CNSU04-S-15102	114	107	111				
CNSU05-S-15104	110	100	101				
CNSU05-S-15105	110	114	117				
CNSU04-S-15103	109	112	114				
CNSU02-S-15099	113	114	115				
CNSU03-S-15100	111	112	114				
CNSU03-S-15100DUP	115	114	117				
SDG 02-3-25, analysis date March 25, 2002							
20-µg/kg standard	101	116	118	18.99	5.2	20.58	2.9
Methanol blank	100	100	100				
CNSB01-S-15257	91	97	94				
CNSB01-S-15252	75[c]	90	84	Reanalyzed on 3/26/02 without error.			
CNSB01-S-15250	88	97	94				
CNSB01-S-15254	83	93	89				
CNSB01-S-15256	86	96	92				

TABLE H.5 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/kg)	RPD[b]	Concentration (µg/kg)	RPD[b]
SDG 02-3-25, analysis date March 25, 2002 (Cont.)							
CNSB01-S-15246	83	92	88				
CNSB01-S-15248	85	94	90				
CNSB01-S-15259	89	98	94				
CNSB01-S-15260	85	96	91				
CNSB01-S-15249	91	103	96				
CNSB01-S-15261	88	101	95				
CNSB01-S-15251	90	101	96				
CNSB01-S-15258	84	97	91				
CNSB01-S-15253	84	98	93				
SDG 02-3-26, analysis date March 26, 2002							
20-µg/kg standard	100	109	102	21.64	7.9	23.31	15.3
Methanol blank	100	100	100				
CNSB01-S-15247	94	100	98				
CNSB01-S-15245	96	101	98				
CNSB01-S-15255	87	98	94				
CNTB01-S-15262	100	106	105				
CNSB01-S-15252	88	95	92				
SDG 02-3-27, analysis date March 27, 2002							
20-µg/kg standard	98	98	91	21.54	7.4	20.87	4.3
Methanol blank	100	100	100				

TABLE H.5 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/kg)	RPD[b]	Concentration (µg/kg)	RPD[b]
SDG 02-3-27, analysis date March 27, 2002 (Cont.)							
CNSU06-S-15107	92	92	94				
CNSU08-S-15111	90	93	95				
CNSU07-S-15108	90	94	96				
CNSU09-S-15112	88	95	94				
CNSU09-S-15113	86	89	89				
CNSU10-S-15116	87	92	93				
CNSU10-S-15116DUP	86	92	92				
CNSU11-S-15117	88	89	91				
CNSU12-S-15120	90	95	97				
CNSU12-S-15119	97	101	102				
CNSU08-S-15110	89	95	97				
CNSU07-S-15109	72[c]	84	83	Reanalyzed on 3/28/02 without error.			
CNSU10-S-15114	91	94	96				
CNQCTB-S-15277	87	95	98				
CNSU06-S-15106	92	95	99				
CNSU11-S-15118	89	94	95				
CNQCDU-S-15125	87	97	98				
CNQCDU-S-15125DUP	87	92	94				
SDG 02-3-28, analysis date March 28, 2002							
20-µg/kg standard	96	104	106	18.82	6.1	18.93	5.5
Methanol blank	89	91	92				
CNSU07-S-15109	88	96	100				
CNSU14-S-15124	94	99	103				

TABLE H.5 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/kg)	RPD[b]	Concentration (µg/kg)	RPD[b]
SDG 02-3-28, analysis date March 28, 2002 (Cont.)							
CNSU15-S-15136	95	103	105				
CNQCDU-S-15095	93	97	100				
CNSU15-S-15135	91	96	100				
CNQCDU-S-15126	95	98	104				
CNSU13-S-15122	61[c]	89	87	Reanalyzed on 3/29/02 without error.			
CNSU13-S-15121	78[c]	89	90	Reanalyzed on 3/29/02 without error.			
CNSU14-S-15123	102	106	110				
CNEX01-S-15127	99	107	112				
CNQCDU-S-15115	99	105	109				
CNSU25-S-15298	92	103	105				
CNSU25-S-15298DUP	93	101	104				
SDG 02-3-29, analysis date March 29, 2002							
20-µg/kg standard	81	86	85	16.3	20.3	17.01	16.2
Methanol blank	100	100	100				
CNSU13-S-15121	106	108	108				
CNSU13-S-15122	94	97	95				
CNQCTB-S-15278	105	109	109				
CNSU26-S-15299	103	105	105				
CNSU26-S-15299DUP	94	82	83				
CNSU26-S-15300	99	103	102				
CNSU28-S-15304	97	102	98				
CNSU20-S-15287	93	100	99				
CNSU24-S-15296	92	101	98				

TABLE H.5 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/kg)	RPD[b]	Concentration (µg/kg)	RPD[b]
SDG 02-3-29, analysis date March 29, 2002 (Cont.)							
CNSU29-S-15145	84	96	90				
CNSU28-S-15303	91	96	94				
SDG 02-4-1, analysis date April 1, 2002							
20-µg/kg standard	84	90	89	18.55	7.5	19.86	0.7
Methanol blank	100	100	100				
CNSU29-S-15146	92	93	91				
CNSU23-S-15293	89	94	92				
CNSU27-S-15301	91	94	92				
CNSU27-S-15302	88	89	87				
CNSU16-S-15280	91	96	93				
CNSU21-S-15289	87	91	89				
CNSU21-S-15290	105	104	103				
CNSU22-S-15291	99	99	98				
CNSU19-S-15285	118	116	116				
CNSU22-S-15292	99	101	100				
CNSU22-S-15292DUP	98	101	97				
CNSU20-S-15288	100	102	96				
CNSU17-S-15282	90	94	91				
CNSU17-S-15281	100	107	102				
CNSU24-S-15295	91	96	91				
CNSU23-S-15294	92	99	95				
CNSU19-S-15286	58[c]	74[c]	68[c]	Not reanalyzed.			

TABLE H.5 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/kg)	RPD[b]	Concentration (µg/kg)	RPD[b]
SDG 02-4-2, analysis date April 2, 2002							
20-µg/kg standard	109	114	110	18.6	7.3	19.06	4.8
Methanol blank	100	100	100				
CNSU16-S-15279	101	102	103				
CNSU25-S-15297	105	110	109				
CNSU18-S-15284	104	112	109				
CNSU18-S-15283	101	110	108				
CNSU32-S-15151	102	111	109				
CNSU33-S-15153	100	107	104				
CNSU36-S-15160	99	105	103				
CNSU35-S-15157	98	108	104				
CNSU34-S-15155	92	81	83				
CNSU34-S-15155DUP	86	96	93				
CNSU36-S-15159	101	110	107				
CNSU34-S-15156	97	106	104				
CNSU31-S-15150	97	105	102				
CNSU30-S-15148	88	101	98				
CNQCTB-S-15185	99	111	109				
SDG 02-4-3, analysis date April 3, 2002							
20-µg/kg standard	93	114	106	23.68	16.8	23.74	17.1
Methanol blank	107	116	115				
CNSU34-S-15156DUP	103	114	116				
CNSU33-S-15154	94	112	111				

TABLE H.5 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/kg)	RPD[b]	Concentration (µg/kg)	RPD[b]
SDG 02-4-3, analysis date April 3, 2002 (Cont.)							
CNSU32-S-15152	92	108	106				
CNSU31-S-15149	87	104	105				
CNSU35-S-15158	85	103	101				
CNSU30-S-15147	86	106	102				
CNSU43-S-15173	85	102	98				
CNSU43-S-15174	90	106	105				
CNSU40-S-15168	86	108	104				
CNSU37-S-15162	84	102	98				
CNSU42-S-15172	85	106	103				
CNSU42-S-15171	76[c]	97	90	Reanalyzed on 4/4/02 without error.			
CNQCDU-S-15133	80	100	95				
CNQCDU-S-15134	85	100	96				
CNQCDU-S-15128	99	111	108				
CNQCDU-S-15128DUP	97	112	111				
CNQCDU-S-15175	105	120	119				
CNSU37-S-15161	97	112	111				
CNSU38-S-15164	91	108	104				
CNQCDU-S-15132	90	107	102				
CNSU38-S-15163	89	105	102				
CNSU41-S-15169	85	105	101				
CNQCTB-S-15186	82	99	95				

TABLE H.5 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/kg)	RPD[b]	Concentration (µg/kg)	RPD[b]
SDG 02-4-4, analysis date April 4, 2002							
20-µg/kg standard	100	100	100	17.65	12.5	18.96	5.3
Methanol blank	116	115	115				
CNSU39-S-15165	92	95	95				
CNSU40-S-15167	16[c]	32[c]	23[c]	Reanalyzed on 4/8/02 without error.			
CNQCDU-S-15131	75[c]	87	82	Reanalyzed on 4/8/02 without error.			
CNQCDU-S-15130	89	92	90				
CNSU41-S-15170	88	96	93				
CNSU39-S-15166	89	93	91				
CNQCDU-S-15129	88	90	90				
CNQCDU-S-15129DUP	87	92	91				
CNSU42-S-15171	90	94	93				
CNQCDU-S-15175DUP	89	96	93				
CNQCTB-S-15187	100	104	113				
SDG 02-4-8, analysis date April 8, 2002							
20-µg/kg standard	99	102	103	17.89	11.1	17.97	10.7
Methanol blank	100	100	100				
CNSB06-S-15340	108	107	108				
CNSB06-S-15341	103	100	101				
CNSB06-S-15342	102	108	109				
CNQCDU-S-15314	100	99	99				
CNSU40-S-15167	100	102	102				

TABLE H.5 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/kg)	RPD[b]	Concentration (µg/kg)	RPD[b]
SDG 02-4-8, analysis date April 8, 2002 (Cont.)							
CNQCDU-S-15131	101	105	105				
CNSB06-S-15342DUP	96	102	101				
SDG 02-4-9, analysis date April 9, 2002							
20-µg/kg standard	97	110	107	20.47	2.3	22.08	9.9
Methanol blank	100	100	100				
CNSB06-S-15183	92	101	97				
CNSB06-S-15192	91	98	94				
CNSB06-S-15190	91	96	94				
CNSB06-S-15182	88	94	92				
CNSB06-S-15179	90	93	92				
CNQCDU-S-15181	86	92	91				
CNSB06-S-15191	84	94	93				
CNSB06-S-15194	88	95	84				
CNSB06-S-15178	85	94	93				
CNSB06-S-15178DUP	80	90	87				
SDG 02-4-10, analysis date April 10, 2002							
20-µg/kg standard	99	97	100	22.01	9.6	23.09	14.3
Methanol blank	105	101	92				
CNSB06-S-15194DUP	93	91	89				
CNQCDU-S-15180	84	81	81				

TABLE H.5 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/kg)	RPD[b]	Concentration (µg/kg)	RPD[b]
SDG 02-4-10, analysis date April 10, 2002 (Cont.)							
CNSB06-S-15193	98	96	97				
CNSB06-S-15177	87	88	86				
CNSB06-S-15189	86	86	86				
CNQCTB-S-15140	85	87	88				
CNSB06-S-15328	82	86	85				
CNSB06-S-15333	81	80	80				
SDG 02-4-12, analysis date April 12, 2002							
20-µg/kg standard	96	96	97	19.27	3.7	20.61	3
Methanol blank	100	100	100				
CNSB06-S-15333	107	112	105				
CNSB06-S-15331	120	118	118				
CNSB06-S-15188	106	105	103				
CNSB06-S-15336	109	107	108				
CNSB06-S-15327	102	106	106				
CNSB06-S-15334	107	107	108				
CNSB06-S-15337	104	105	106				
CNSB06-S-15337DUP	104	102	104				

TABLE H.5 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/kg)	RPD[b]	Concentration (µg/kg)	RPD[b]
SDG 02-4-18, analysis date April 18, 2002							
20-µg/kg standard	100	100	100	17.9	11.1	18.24	9.2
Methanol blank	100	100	100				
CNSB06-S-15339	101	101	101				
CNSB06-S-15343	102	104	102				
CNSB06-S-15332	101	103	102				
CNSB06-S-15338	80	97	100				
CNQCBG-S-15326	97	98	101				
SDG 02-4-19, analysis date April 19, 2002							
20-µg/kg standard	97	103	96	21.67	8	22.25	10.7
Methanol blank	93	89	89				
CNSB06-S-15344	92	91	91				
CNQCDU-S-15313	95	95	95				
CNQCDU-S-15313DUP	91	92	91				
CNSB06-S-15335	93	94	92				
CNSB06-S-15339DUP	91	85	86				

[a] Quality control limits for recovery of surrogate compounds: 80-120%.

[b] Quality control limits for RPD for calibration check standards: ±20%.

[c] Surrogate recovery outside quality control limit.

TABLE H.6 Results of dual organic analyses on soil samples at the AGEM Laboratory by the purge-and-trap method.

Location	Depth (ft BGL)	Concentration (µg/kg) Carbon Tetrachloride	Chloroform	Sample Identifier	Analysis Type
Near-surface soil samples					
SU03	0.8-1	ND[a]	ND	CNSU03-S-15100	Primary sample
		ND	ND	CNSU03-S-15100DUP	Duplicate analysis
SU06	0.5-0.8	ND	ND	CNSU06-S-15106	Primary sample
		ND	ND	CNQCDU-S-15095	Replicate
SU06	5-5.8	ND	ND	CNSU06-S-15107	Primary sample
		ND	ND	CNQCDU-S-15125	Replicate
		ND	ND	CNQCDU-S-15125DUP	Duplicate analysis
SU10	4.7-4.9	ND	ND	CNSU10-S-15116	Primary sample
		ND	ND	CNSU10-S-15116DUP	Duplicate analysis
SU13	1.5-1.7	ND	ND	CNSU13-S-15121	Primary sample
		ND	ND	CNQCDU-S-15115	Replicate
SU13	4.7-4.9	ND	ND	CNSU13-S-15122	Primary sample
		ND	ND	CNQCDU-S-15126	Replicate
SU18	0.8-1.1	ND	ND	CNSU18-S-15283	Primary sample
		ND	ND	CNQCDU-S-15128	Replicate
		ND	ND	CNQCDU-S-15128DUP	Duplicate analysis
SU18	4.5-4.8	ND	ND	CNSU18-S-15284	Primary sample
		ND	ND	CNQCDU-S-15129	Replicate
		ND	ND	CNQCDU-S-15129DUP	Duplicate analysis
SU22	4.5-4.7	ND	ND	CNSU22-S-15292	Primary sample
		ND	ND	CNSU22-S-15292DUP	Duplicate analysis
SU25	4.6-4.8	ND	ND	CNSU25-S-15298	Primary sample
		ND	ND	CNSU25-S-15298DUP	Duplicate analysis
SU26	0.9-1.1	ND	ND	CNSU26-S-15299	Primary sample
		ND	ND	CNSU26-S-15299DUP	Duplicate analysis
SU28	0.8-1.1	ND	ND	CNSU28-S-15303	Primary sample
		ND	ND	CNQCDU-S-15130	Replicate
SU28	4.7-5	ND	ND	CNSU28-S-15304	Primary sample
		ND	ND	CNQCDU-S-15131	Replicate

TABLE H.6 (Cont.)

Location	Depth (ft BGL)	Concentration (µg/kg) Carbon Tetrachloride	Chloroform	Sample Identifier	Analysis Type
Near-surface soil samples (Cont.)					
SU34	1.3-1.5	ND	ND	CNSU34-S-15155	Primary sample
		ND	ND	CNSU34-S-15155DUP	Duplicate analysis
SU34	4.2-4.5	ND	ND	CNSU34-S-15156	Primary sample
		ND	ND	CNSU34-S-15156DUP	Duplicate analysis
SU36	1-1.3	ND	ND	CNSU36-S-15159	Primary sample
		ND	ND	CNQCDU-S-15132	Replicate
SU36	4.2-4.5	ND	ND	CNSU36-S-15160	Primary sample
		ND	ND	CNQCDU-S-15133	Replicate
SU43	0.9-1.2	ND	ND	CNSU43-S-15173	Primary sample
		ND	ND	CNQCDU-S-15134	Replicate
SU43	4.8-5	ND	ND	CNSU43-S-15174	Primary sample
		ND	ND	CNQCDU-S-15175	Replicate
		ND	ND	CNQCDU-S-15175DUP	Duplicate analysis
Subsurface soil samples					
SB01	6	ND	ND	CNSB01-S-15247	Primary sample
		ND	ND	CNSB01-S-15248	Replicate
SB01	10	ND	ND	CNSB01-S-15250	Primary sample
		ND	ND	CNSB01-S-15251	Replicate
SB01	22	ND	ND	CNSB01-S-15257	Primary sample
		ND	ND	CNSB01-S-15258	Replicate
SB06	12.8-12.9	10	4.5 J[b]	CNSB06-S-15333	Primary sample
		10	4.2 J	CNSB06-S-15333DUP	Duplicate analysis
SB06	17-17.2	23	4.1 J	CNSB06-S-15335	Primary sample
		31	5.6 J	CNQCDU-S-15313	Replicate
		33	6 J	CNQCDU-S-15313DUP	Duplicate analysis
SB06	21-21.2	14	3.6 J	CNSB06-S-15337	Primary sample
		15	3.9 J	CNSB06-S-15337DUP	Duplicate analysis
SB06	25-25.2	ND	12	CNSB06-S-15339	Primary sample
		ND	ND	CNSB06-S-15339DUP	Duplicate analysis

TABLE H.6 (Cont.)

Location	Depth (ft BGL)	Concentration (µg/kg) Carbon Tetrachloride	Chloroform	Sample Identifier	Analysis Type
Subsurface soil samples (Cont.)					
SB06	27-27.2	135	ND	CNSB06-S-15340	Primary sample
		140	ND	CNQCDU-S-15314	Replicate
SB06	31-31.2	65	ND	CNSB06-S-15342	Primary sample
		68	ND	CNSB06-S-15342DUP	Duplicate analysis
SB06	45-45.2	ND	ND	CNSB06-S-15194	Primary sample
		ND	ND	CNSB06-S-15194DUP	Duplicate analysis
		ND	ND	CNQCDU-S-15180	Replicate
SB06	47-47.2	ND	ND	CNSB06-S-15177	Primary sample
		ND	ND	CNQCDU-S-15181	Replicate
SB06	49-49.2	ND	ND	CNSB06-S-15178	Primary sample
		ND	ND	CNSB06-S-15178DUP	Duplicate analysis

[a] ND, contaminant not detected.

[b] J, estimated concentration below quantitation limit of 10 µg/kg.

TABLE H.7 Recovery of system-monitoring compounds in verification organic analyses of soil samples at Severn-Trent Laboratory with EPA Methods 5030B and 8260B.

Sample	Analysis Date	Sample Delivery Group	Recovery[a] (%)			
			Toluene-d_8	1,2-Dichloro-ethane-d_4	Bromofluoro-benzene	1,2-Dichloro-benzene-d_4
LWSA MEOHBLK	4/3/02	87138	87	93	104	94
LWSA MEOHLCS	4/3/02	87138	102	102	97	90
CN-MEOHBLANK-27MAR02	4/3/02	87138	103	89	104	99
CNSU8-S-15110	4/3/02	87138	90	114	102	98
CNSU8-S-15110MS	4/3/02	87138	96	113	100	100
CNSU8-S-15110MSD	4/3/02	87138	96	112	101	98
CNSU01-S-15096	4/3/02	87138	109	90	104	98
CNSU03-S-15100	4/3/02	87138	84	92	107	101
CNSB01-S-15245	4/3/02	87138	102	97	103	97
CNQCDU-S-15126	4/3/02	87138	99	93	102	94
CNSU25-S-15298	4/3/02	87138	100	99	102	98
CNSU23-S-15293	4/3/02	87138	84	95	102	92
CNSU20-S-15288	4/3/02	87138	105	110	112	105
LWSC MEOHLCS	4/4/02	87138	107	108	105	94
LWSC MEOHBLK	4/4/02	87138	102	95	102	95
CNSU17-S-15282	4/4/02	87138	88	96	106	99
CNSU33-S-15153	4/4/02	87138	103	104	105	97
CNSU36-S-15160	4/4/02	87138	104	98	108	98
LWSI MEOHLCS	4/11/02	87398	204[b]	194[b]	208[b]	194[b]
CNSB06-S-15340	4/11/02	87398	104	92	102	95
CNSB06-S-15341	4/11/02	87398	104	100	113	102
CNSB06-S-15342	4/11/02	87398	104	101	109	97
LWSI MEOHBLK	4/11/02	87398	104	96	97	94
CNQCDU-S-15314	4/11/02	87398	99	90	102	93
CNSB06-S-15183	4/11/02	87398	99	90	98	91
CNSB06-S-15336	4/11/02	87398	98	92	103	95
CNQCDU-S-15313	4/11/02	87398	99	99	100	92
CNQCDU-S-15180	4/11/02	87398	97	90	91	85
CN-MEOHBLANK-09APR02	4/11/02	87398	101	97	104	96
LWSI LCS	4/12/02	87398	99	115	103	98
LWSI LCSD	4/12/02	87398	101	114	104	99
VBLKY4	4/12/02	87398	103	105	106	100

[a] Quality control limits for recovery are as follows:

Analyte	QC Limit (%)
Toluene-d_8	81-117
1,2-Dichloroethane-d_4	80-120
Bromofluorobenzene	74-121
1,2-Dichlorobenzene-d_4	80-120

[b] Two spike formulations, each having the surrogate compounds as constituents, were added. The apparently high surrogate concentration values reflect the higher spike amounts and are within the quality control limits.

TABLE H.8 Recovery and relative percent difference values for spike/spike duplicate organic analyses of soil samples at Severn Trent Laboratory.

Compound	Concentration (µg/kg)				Recovery (%)			Relative Percent Difference	
	Sample	Spike Added	Spike Analysis	Duplicate Analysis	Spike Analysis	Duplicate Analysis	QC Limit	RPD	QC Limit
MS/MSD analysis of CNSU8-S-15110 for SDG 87138									
Chloroform	0	81	84	86	104	106	74-106	2	40
Carbon tetrachloride	0	81	78	75	96	92	62-106	4	40
MS/MSD analysis of LWSI LCS for SDG 87398									
Chloroform	0	10	9.9	10	99	100	74-106	1	40
Carbon tetrachloride	0	10	9.6	9.7	96	97	62-106	1	40

TABLE H.9 Relative percent difference for verification organic analyses of soil samples at the AGEM Laboratory and Severn-Trent Laboratory.

			Carbon Tetrachloride			Chloroform		
			Concentration (µg/kg)			Concentration (µg/kg)		
Location	Sample	Depth (ft BGL)	AGEM	STL[a]	RPD	AGEM	STL[a]	RPD
Near-surface soil samples								
SU01	CNSU01-S-15096	0.9-1	ND[b]	ND	-	ND	ND	-
SU03	CNSU03-S-15100	0.8-1	ND	ND	-	ND	ND	-
SU08	CNSU08-S-15110	2.4-2.6	ND	ND	-	ND	ND	-
SU13	CNQCDU-S-15126	4.7-4.9	ND	ND	-	ND	ND	-
SU17	CNSU17-S-15282	3.8-4	ND	ND	-	ND	ND	-
SU20	CNSU20-S-15288	4.6-4.8	ND	ND	-	ND	ND	-
SU23	CNSU23-S-15293	0.9-1.1	ND	ND	-	ND	ND	-
SU25	CNSU25-S-15298	4.6-4.8	ND	ND	-	ND	ND	-
SU33	CNSU33-S-15153	1.1-1.2	ND	ND	-	ND	ND	-
SU36	CNSU36-S-15160	4.2-4.5	ND	ND	-	ND	ND	-
Subsurface soil samples								
SB01	CNSB01-S-15245	2	ND	ND	-	ND	ND	-
SB06	CNQCDU-S-15313	17-17.2	33	32	3.1	6 J[c]	6.1 J	1.6

TABLE H.9 (Cont.)

Location	Sample	Depth (ft BGL)	Carbon Tetrachloride Concentration (µg/kg) AGEM	Carbon Tetrachloride Concentration (µg/kg) STL[a]	Carbon Tetrachloride RPD	Chloroform Concentration (µg/kg) AGEM	Chloroform Concentration (µg/kg) STL[a]	Chloroform RPD
Subsurface soil samples (Cont.)								
SB06	CNSB06-S-15336	18.9-19.1	18	16	11.8	ND	2.6 J	-
SB06	CNSB06-S-15340	27-27.2	135	170	22.9	ND	3 J	-
SB06	CNQCDU-S-15314	27-27.2	140	130	7.4	ND	2.7 J	-
SB06	CNSB06-S-15341	29-29.2	113	120	6	ND	2.8 J	-
SB06	CNSB06-S-15342	31-31.2	68	60	12.5	ND	1.9 J	-
SB06	CNQCDU-S-15180	45-45.2	ND	3.2 J	-	ND	ND	-
SB06	CNSB06-S-15183	55-55.2	ND	1.5 J	-	ND	ND	-

[a] STL, Severn-Trent Laboratory.

[b] ND, contaminant not detected.

[c] J, estimated concentration below the quantitation limit of 10 µg/kg for the purge-and-trap method.

TABLE H.10 Results of organic analyses on quality control samples collected to monitor water analyses at the AGEM Laboratory by the purge-and-trap method.

				Measured Values for Calibration Check Standards			
	Recovery of Surrogate Compounds[a] (%)			Carbon Tetrachloride		Chloroform	
Sample	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/L)	RPD[b]	Concentration (µg/L)	RPD[b]
SDG 02-3-23, analysis date March 23, 2002							
20-µg/L standard	102	104	107	19.48	2.6	20.72	3.5
Laboratory blank	100	100	100				
CNSB05-W-15264	104	107	107	Carbon tetrachloride outside calibration range.			
CNSB05-W-15264	102	107	106	Analysis at dilution factor = 5.			
SDG 02-3-26, analysis date March 26, 2002							
20-µg/L standard	100	109	102	21.64	7.9	23.31	15.3
Laboratory blank	98	109	100				
CNSB05-W-15265	105	113	103	Outside calibration range for carbon tetrachloride.			
CNSB04-W-15274	111	96	92				
CNSB04-W-15274DUP	111	122[c]	111	Accepted.			
CNBR01-W-15267	108	116	104				
CNQCRI-W-15276	107	112	102				
CNQCTB-W-15137	102	107	95				
CNSB05-W-15265	105	113	103	Analysis at dilution factor = 5.			
SDG 02-3-27, analysis date March 27, 2002							
20-µg/L standard	98	98	91	21.54	7.4	20.87	4.3
Laboratory blank	110	114	116				
CNSB03A-W-15305	106	102	96				
CNSB03A-W-15307	101	102	97				

TABLE H.10 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/L)	RPD[b]	Concentration (µg/L)	RPD[b]
SDG 02-3-27, analysis date March 27, 2002 (Cont.)							
CNSB03A-W-15308	92	91	82				
CNQCTB-W-15176	100	92	85				
SDG 02-3-28, analysis date March 28, 2002							
20-µg/L standard	96	104	106	18.82	6.1	18.93	5.5
Laboratory blank	100	100	100				
CNSB04-W-15318	101	104	105				
CNSB04-W-15315	101	104	104				
CNSB01-W-15311	92	94	92				
CNQCTB-W-15325	96	100	99				
CNSB04-W-15317	93	95	92				
CNSB01-W-15311 (rinsate)	96	97	95				
CNSB04-W-15318DUP	99	99	98				
SDG 02-3-29, analysis date March 29, 2002							
20-µg/L standard	81	86	85	16.3	20.3	17.01	16.2
Laboratory blank	104	104	105				
CNSB01-W-15322	92	89	91	Outside calibration range. Reanalysis on 4/1 at dilution.			
CNSB04-W-15315DUP	89	94	92				
CNSB01-W-15323	96	96	95				

TABLE H.10 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/L)	RPD[b]	Concentration (µg/L)	RPD[b]
SDG 02-4-1, analysis date April 1, 2002							
20-µg/L standard	84	90	89	18.55	7.5	19.86	0.7
Laboratory blank	100	100	100				
CNSB01-W-15322DUP	97	99	97	Duplicate analysis at dilution factor = 5.			
CNSB01-W-15322	90	92	89	Analysis at dilution factor = 5.			
SDG 02-4-5, analysis date April 5, 2002							
20-µg/L standard	90	89	93	22.3	10.9	24	18.2
Laboratory blank	100	100	100				
CNSB01-W-15324	105	109	111				
CNSB01-W-15346	92	105	103				
CNSB01-W-15347	96	103	102				
CNSB01-W-15347DUP	87	93	93				
CNSB01-W-15348	88	93	91				
CNSB01-W-15352	86	93	92				
CNSB01-W-15353	90	91	90				
CNSB01-W-15351	93	97	95				
CNTB01-W-15355	93	86	82				
CNSB01-W-15345	81	83	80				

TABLE H.10 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/L)	RPD[b]	Concentration (µg/L)	RPD[b]
SDG 02-4-8, analysis date April 8, 2002							
20-µg/L standard	99	102	103	17.89	11.1	17.97	10.7
Laboratory blank	110	110	112				
CNSB04-W-15375	104	107	106				
CNSB05-W-15196	107	113	112				
CNSB05-W-15198	100	103	100				
CNSB04-W-15211	90	99	97				
CNSB04-W-15376	99	102	100				
CNSB06-W-15141	94	95	93				
CNSB06-W-15141DUP	89	92	88				
CNSB01-W-15356	97	99	98				
CNSB04-W-15213	91	75[c]	75[c]	Reanalyzed on 4/10 with same error.			
CNQCTB-W-15195	90	90	88				
CNQCRI-W-15206	96	93	91				
CNSB04-W-15378	93	93	90				
SDG 02-4-9, analysis date April 9, 2002							
20-µg/L standard	97	110	107	20.47	2.3	22.08	9.9
Laboratory blank	100	100	100				
CNSB04-W-15214	99	112	107				
CNSB05-W-15202	93	108	102				
CNSB04-W-15382	92	106	97				
CNSB04-W-15384	94	107	102				
CNQCDU-W-15204	93	108	101				
CNSB05-W-15200	83	98	89				

TABLE H.10 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/L)	RPD[b]	Concentration (µg/L)	RPD[b]
SDG 02-4-9, analysis date April 9, 2002 (Cont.)							
CNSB05-W-15200DUP	89	101	94				
CNQCRI-W-15236	89	98	91				
CNQCTB-W-15237	85	80	78[c]	Not reanalyzed.			
SDG 02-4-10, analysis date April 10, 2002							
20-µg/L standard	99	97	100	22.01	9.6	23.09	14.3
Laboratory blank	100	100	100				
CNQCDU-W-15226	85	90	86				
CNQCDU-W-15226DUP	90	96	93				
CNSB07-W-15240	97	85	85				
CNSB08-W-15238	88	96	91	Carbon tetrachloride outside calibration range.			
CNSB07-W-15242	93	82	80				
CNSB07-W-15244	89	77[c]	75[c]	Reanalyzed on 4/11 without error.			
CNQCRI-W-15228	95	77[c]	78[c]	Reanalyzed on 4/11 without error.			
CNSB04-W-15213	90	77[c]	74[c]	Second analysis with surrogate error.			
CNQCTB-W-15232	89	60[c]	62[c]	Not reanalyzed.			
CNQCRI-W-15233	89	75[c]	74[c]	Reanalyzed on 4/11 without error.			
CNQCRI-W-15234	83	74[c]	67[c]	Reanalyzed on 4/11 without error.			
CNSB08-W-15238	108	105	97	Analysis at dilution factor = 10.			

TABLE H.10 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/L)	RPD[b]	Concentration (µg/L)	RPD[b]
SDG 02-4-11, analysis date April 11, 2002							
20-µg/L standard	85	86	87	19.88	0.6	21.24	6
Laboratory blank	100	100	100				
CNSB09-W-15215	94	100	98				
CNSB07-W-15217	100	109	108				
CNQCDU-W-15219	93	90	94				
CNSB07-W-15229	92	102	101				
CNSB08-W-15365	86	94	92				
CNSB08-W-15367	99	104	102				
CNSB08-W-15370	95	106	104				
CNSB08-W-15370DUP	104	111	111				
CNSB08-W-15369	100	84	89				
CNQCTB-W-15220	102	112	112				
CNQCRI-W-15231	88	92	90				
CNSB07-W-15244	103	112	109				
CNQCRI-W-15233	99	102	102				
CNQCRI-W-15234	98	99	100				
CNQCRI-W-15228	96	96	95				
CNSB07-W-15244DUP	92	96	94				
SDG 02-4-12, analysis date April 12, 2002							
20-µg/L standard	96	96	97	19.27	3.7	20.61	3
Laboratory blank	100	100	100				
CNSB09-W-15372	97	94	94				
CNSB09-W-15373	96	105	102				

TABLE H.10 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/L)	RPD[b]	Concentration (µg/L)	RPD[b]
SDG 02-4-12, analysis date April 12, 2002 (Cont.)							
CNSB09-W-15386	92	98	95				
CNSB09-W-15388	95	102	99				
CNSB09-W-15391	95	100	98				
CNSB09-W-15393	86	90	85				
CNSB09-W-15393DUP	88	95	90				
CNSB09-W-15445	90	99	95				
CNSB09-W-15385	89	94	91				
CNSB09-W-15390	84	85	80				
CNQCTB-W-15221	82	88	83				
CNSB09-W-15394	83	89	83				
SDG 02-4-15, analysis date April 15, 2002							
20-µg/L standard	93	94	93	20.03	0.1	20.55	2.7
Laboratory blank	107	106	107				
CNSB06-W-15400	95	92	93				
CNSB08-W-15447	93	95	93				
CNSB06-W-15398	94	97	94				
CNSB08-W-15451	93	93	90	Carbon tetrachloride outside calibration range. Reanalysis on 4/18 at dilution.			
CNQCDU-W-15406	95	95	93				
CNSB06-W-15403	92	93	89				
CNSB06-W-15222DUP	93	90	88				
CNSB06-W-15222	93	91	87				
CNSB08-W-15449	89	90	86				
CNSB08-W-15453	84	81	76[c]	Reanalyzed on 4/18 without error.			

TABLE H.10 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/L)	RPD[b]	Concentration (µg/L)	RPD[b]
SDG 02-4-15, analysis date April 15, 2002 (Cont.)							
CNSB06-W-15409	90	86	84				
CNSB06-W-15395	93	90	88				
CNQCBR-W-15402	L[d]	L	L	Instrument failure. Reanalyzed on 4/18 without error.			
CNQCDR01-W-15413	L	L	L	Instrument failure. Sample recollected.			
CNQCDR02-W-15414	L	L	L	Instrument failure. Sample recollected.			
CNSB08-W-15455	L	L	L	Instrument failure. Reanalyzed on 4/18 without error.			
CNQCRI-W-15224	L	L	L	Instrument failure. Reanalyzed on 4/18 without error.			
CNQCRI-W-15408	L	L	L	Instrument failure. Reanalyzed on 4/18 without error.			
CNQCTB-W-15405	L	L	L	Instrument failure. Not reanalyzed.			
SDG 02-4-18, analysis date April 18, 2002							
20-µg/L standard	100	100	100	17.9	11.1	18.24	9.2
Laboratory blank	104	112	109				
CNSB08-W-15451	112	109	108	Analysis at dilution factor = 10.			
CNSB08-W-15451DUP	110	105	103	Duplicate analysis at dilution factor = 10.			
CNQCRI-W-15397	106	96	95				
CNQCBR-W-15402	107	99	101				
CNSB08-W-15453	106	97	99				
CNSB08-W-15455	106	94	98				

TABLE H.10 (Cont.)

Sample	Recovery of Surrogate Compounds[a] (%)			Measured Values for Calibration Check Standards			
				Carbon Tetrachloride		Chloroform	
	Fluorobenzene	1,2-Dichloro-benzene-d_4	4-Bromo-fluorobenzene	Concentration (µg/L)	RPD[b]	Concentration (µg/L)	RPD[b]
SDG 02-4-18, analysis date April 18, 2002 (Cont.)							
CNQCRI-W-15224	103	87	89				
CNQCRI-W-15408	105	88	91				

[a] Quality control limit for recovery of surrogate compounds: 80-120%.

[b] Quality control limit for RPD for calibration check standards: ±20%.

[c] Surrogate recovery outside quality control limit.

[d] L, analysis lost because of instrument failure.

TABLE H.11 Results of dual organic analyses on groundwater samples at the AGEM Laboratory by the purge-and-trap method.

Location	Sample Identifier	Analysis Type	Depth (ft BGL)	Sample Date	Analysis Date	Concentration (µg/L) Carbon Tetrachloride	Chloroform
SB01	CNSB01-W-15322	Primary sample	40-45	3/27/02	4/1/02	128	31
	CNSB01-W-15322DUP	Duplicate analysis		3/27/02	4/1/02	120	32
SB01	CNSB01-W-15347	Primary sample	56-61	4/3/02	4/5/02	ND[a]	ND
	CNSB01-W-15347DUP	Duplicate analysis		4/3/02	4/5/02	ND	ND
SB03	CNSB03A-W-15305	Primary sample	55.5-58.5	3/26/02	3/27/02	ND	ND
	CNSB03A-W-15307	Replicate		3/26/02	3/27/02	ND	ND
SB04	CNSB04-W-15274	Primary sample	52.5-55.5	3/22/02	3/26/02	1.3	ND
	CNSB04-W-15274DUP	Duplicate analysis		3/22/02	3/26/02	1.3	ND
SB04	CNSB04-W-15315	Primary sample	56-60	3/27/02	3/28/02	29	1
	CNSB04-W-15315DUP	Duplicate analysis		3/27/02	3/29/02	33	1.1
SB04	CNSB04-W-15382	Primary sample	65-70	4/6/02	4/9/02	3.8	ND
	CNSB04-W-15384	Replicate		4/6/02	4/9/02	3.6	ND
SB04	CNSB04-W-15375	Primary sample	87-91	4/5/02	4/8/02	ND	ND
	CNSB04-W-15376	Replicate		4/5/02	4/8/02	ND	ND
SB04	CNSB04-W-15318	Primary sample	99-104	3/27/02	3/28/02	ND	ND
	CNSB04-W-15318DUP	Duplicate analysis		3/27/02	3/28/02	ND	ND
SB06	CNSB06-W-15222	Primary sample	56-61	4/11/02	4/15/02	7.4	1.3
	CNSB06-W-15222DUP	Duplicate analysis		4/11/02	4/15/02	7.6	1.3
SB06	CNSB06-W-15141	Primary sample	61-66	4/5/02	4/8/02	49	2.2
	CNSB06-W-15141DUP	Duplicate analysis		4/5/02	4/8/02	51	2.3

TABLE H.11 (Cont.)

Location	Sample Identifier	Analysis Type	Depth (ft BGL)	Sample Date	Analysis Date	Concentration (µg/L) Carbon Tetrachloride	Chloroform
SB06	CNSB06-W-15403	Primary sample	76-81	4/12/02	4/15/02	ND	ND
	CNQCDU-W-15406	Replicate		4/12/02	4/15/02	ND	ND
SB07	CNSB07-W-15244	Primary sample	64-69	4/9/02	4/11/02	ND	ND
	CNSB07-W-15244DUP	Duplicate analysis		4/9/02	4/11/02	ND	ND
	CNQCDU-W-15227	Replicate		4/9/02	4/10/02	ND	ND
	CNQCDU-W-15227DUP	Duplicate analysis		4/9/02	4/10/02	ND	ND
SB08	CNSB08-W-15451	Primary sample	58-62	4/12/02	4/18/02	176	5.7
	CNSB08-W-15451DUP	Duplicate analysis		4/12/02	4/18/02	174	5.5
SB08	CNSB08-W-15367	Primary sample	62-67	4/10/02	4/11/02	12	ND
	CNSB08-W-15370	Replicate		4/10/02	4/11/02	13	ND
	CNSB08-W-15370DUP	Duplicate analysis		4/10/02	4/11/02	12	ND
SB09	CNSB09-W-15372	Primary sample	32-37	4/10/02	4/12/02	ND	ND
	CNSB09-W-15373	Replicate		4/10/02	4/12/02	ND	ND
SB09	CNSB09-W-15391	Primary sample	47-52	4/11/02	4/12/02	ND	ND
	CNSB09-W-15393	Replicate		4/11/02	4/12/02	ND	ND
	CNSB09-W-15393DUP	Duplicate analysis		4/11/02	4/12/02	ND	ND
SB10	CNSB05-W-15200	Primary sample	41-45	4/6/02	4/9/02	1.2	ND
	CNSB05-W-15200DUP	Duplicate analysis		4/6/02	4/9/02	1.2	ND
SB10	CNSB05-W-15202	Primary sample	55-58	4/6/02	4/9/02	ND	ND
	CNQCDU-W-15204	Replicate		4/6/02	4/9/02	ND	ND

[a] ND, contaminant not detected at the purge-and-trap method quantitation limit of 1 µg/L.

TABLE H.12 Recovery of system-monitoring compounds in organic analyses of water samples at Clayton Laboratory.

Primary sample	Analysis Date	Primary sample Delivery Group	Recovery[a] (%)		
			Toluene-d_8	Bromofluoro-benzene	1,2-Dichloro-ethane-d_4
VBLKKQ	4/12/02	2040320-ARG131	104	106	100
CNSB06-W-15141	4/12/02	2040320-ARG131	104	104	102
CNSB06-W-15141MS	4/12/02	2040320-ARG131	106	106	98
CNSB06-W-15141MSD	4/12/02	2040320-ARG131	100	100	94
CNSB05-W-15196	4/12/02	2040320-ARG131	100	106	96
CNSB04-W-15376	4/12/02	2040320-ARG131	102	98	94
CNSB04-W-15211	4/12/02	2040320-ARG131	100	102	98
CN-TripBlank-040902	4/12/02	2040320-ARG131	100	100	96
CNSB04-W-15382	4/12/02	2040320-ARG131	104	102	94
CNSB04-W-15214	4/12/02	2040320-ARG131	102	104	94
VHBLKKB	4/12/02	2040320-ARG131	104	106	94

[a] Quality control limits for recovery are as follows:

Analyte	QC Limit (%)
Toluene-d_8	88-110
Bromofluorobenzene	86-115
1,2-Dichloroethane-d_4	76-114

TABLE H.13 Recovery and relative percent difference values for spike/spike duplicate organic analyses at Clayton Laboratory with CLP methodology.

Compound	Concentration (µg/L)				Recovery (%)			Relative Percent Difference	
	Sample	Spike Added	Spike Analysis	Duplicate Analysis	Spike Analysis	Duplicate Analysis	QC Limit	RPD	QC Limit
MS/MSD analysis of CNSB06-W-15141 with SDG 204032-ARG131									
1,1-Dichloroethene	0	50	60	52	120	104	61-145	14	14
Trichloroethene	0	50	51	46	102	92	71-120	10	14
Benzene	0	50	56	49	112	98	76-127	13[a]	11
Toluene	10	50	53	46	106	92	76-125	14[a]	13
Chlorobenzene	0	50	52	49	104	98	75-130	6	13

[a] Value outside quality control limit.

TABLE H.14 Relative percent difference for verification organic analyses of water samples at the AGEM Laboratory and by CLP methodology at Clayton Laboratory.

			Carbon Tetrachloride			Chloroform		
			Concentration (µg/L)			Concentration (µg/L)		
Location	Sample	Depth (ft BGL)	AGEM	Clayton	RPD	AGEM	Clayton	RPD
SB04	CNSB04-W-15211	60-65	28	25	11.3	1.2	1.4	15.4
SB04	CNSB04-W-15382	65-70	3.8	3.8	0	ND[a]	ND	-
SB04	CNSB04-W-15214	70-75	ND	ND	-	ND	ND	-
SB04	CNSB04-W-15376	87-91	ND	ND	-	ND	ND	-
SB06	CNSB06-W-15141	61-66	51	65	24.1	2.3	2.5	8.3
SB10	CNSB05-W-15196	38-41	6.5	8.5	26.6	ND	ND	-

[a] ND, contaminant not detected.

TABLE H.15 Percent recovery of known analyte concentrations achieved during inorganic analyses of quality control samples at Severn Trent Laboratory.

	Recovery[a] (%) in Indicated Sample Delivery Group									
Analyte	87067	87077	87101	87129	87158	87365	87467	87469	87471	87478
Alkalinity	99-102	102	102	102	102	98-102	98-102	NA[b]	98-102	NA
Chloride	98-99	99-100	101	99	101	99-100	99-101	NA	101-102	NA
Sulfate	99-100	101	101	102	103	100	99-101	NA	101	NA
Total nitrogen	93	100	104-105	104-105	104-105	96-98	NA	96-105	NA	101-102
Aluminum	97	101-102	100	100	100	98	99-101	NA	98-100	NA
Calcium	101	100-102	99-100	99-100	99-100	96	100-103	NA	103-110	NA
Iron	100	104-105	106-107	106-107	106-107	101	102-104	NA	98-101	NA
Magnesium	98	101-103	100-101	100-101	100-101	96	100-104	NA	99-101	NA
Manganese	99	101	101-102	102-103	102-103	100	99-100	NA	101-102	NA
Potassium	97	90	100	100	100	99	98-101	NA	95-96	NA
Phosphorus	95	101-102	101-102	101-102	101-102	96	94-100	NA	100-107	NA
Sodium	99	103	99	102-103	102-103	98	98-100	NA	98-106	NA
Silicon	100	101	102	102	102	99	98-100	NA	98-101	NA
Zinc	99	97-100	100-101	100-101	100-101	102	100-103	NA	100-102	NA

[a] Quality control limit for recovery = 80-120%.

[b] NA, samples in this sample delivery group were not analyzed for this constituent.

TABLE H.16 Calculated relative percent difference in duplicate inorganic analyses of groundwater samples at Severn-Trent Laboratory.

Analyte	Concentration (µg/L) Sample	Duplicate Analysis	Relative Percent Difference
Duplicate laboratory analysis of CNSB06-W-15141 in SDG 87467			
Aluminum	< 200	< 200	-[a]
Calcium	87,300	88,100	0.9
Iron	< 100	125	-
Magnesium	35,300	35,600	-
Manganese	1,180	1,180	0.0
Potassium	5,230	5,270	0.8
Phosphorus	< 250	< 250	-
Sodium	50,300	50,800	1.0
Silicon	13,600	13,800	1.5
Zinc	< 20	< 20	-
Duplicate laboratory analysis of CNSB05-W-15198 in SDG 87467			
Chloride	14,400	14,400	0.0
Sulfate	2,020	2,000	1.0
Alkalinity	340,000	360,000	5.7
Duplicate laboratory analysis of CNSB07-W-15241 in SDG 87469			
Total nitrogen	352	369	4.7
Duplicate laboratory analysis of CNQCDU-W-15227 in SDG 87469			
Total nitrogen	153	158	3.2
Duplicate laboratory analysis of CNSB05-W-15202 in SDG 87471			
Chloride	3,520	4,040	13.7
Sulfate	1,930	2,050	6.0
Alkalinity	340,000	350,000	2.9
Aluminum	< 200	< 200	-
Calcium	73,100	71,700	1.9
Iron	< 100	< 100	-
Magnesium	28,600	28,000	2.1
Manganese	73.9	72.5	1.9
Potassium	< 5,000	< 5,000	-
Phosphorus	< 250	< 250	-
Sodium	28,700	27,500	4.3
Silicon	14,100	13,800	3.3
Zinc	< 20	< 20	-

TABLE H.16 (Cont.)

Analyte	Concentration (µg/L) Sample	Duplicate Analysis	Relative Percent Difference
Analysis of sample CNSB05-W-15202 in SDG 87471 and replicate CNQCDU-W-15204 in SDG 87467			
Chloride	3,520	3,450	2.0
Sulfate	1,930	1,380	33.2
Alkalinity	340,000	350,000	2.9
Aluminum	< 200	< 200	-
Calcium	73,100	67,100	8.6
Iron	< 100	< 100	-
Magnesium	28,600	28,700	0.3
Manganese	73.9	137.0	59.8
Potassium	< 5,000	< 5,000	-
Phosphorus	< 250	< 250	-
Sodium	28,700	27,200	5.4
Silicon	14,100	13,800	2.2
Zinc	< 20	< 20	-
Duplicate laboratory analysis of CNSB06-W-15396 in SDG 87478			
Total nitrogen	1,190	1,230	3.3
Analysis of sample CNSB06-W-15404 and replicate CNQCDU-W-15407 in SDG 87478			
Total nitrogen	742	707	4.8
Analysis of sample CNSB07-W-15244 and replicate CNQCDU-W-15226 in SDG 87467			
Chloride	6,300	5,820	7.9
Sulfate	1,890	2,290	19.1
Total nitrogen	121	153	23.3
Alkalinity	340,000	370,000	8.5
Aluminum	< 200	< 200	-
Calcium	66,500	64,800	2.6
Iron	< 100	< 100	-
Magnesium	28,900	26,200	9.8
Manganese	443	< 15	-
Potassium	6,620	< 5,000	-
Phosphorus	< 250	< 250	-
Sodium	39,600	31,600	22.5
Silicon	7,900	15,000	62.0
Zinc	< 20	39	-

[a] Analyte concentration below the quantitation limit in both the sample and duplicate analyses.

TABLE H.17 Recovery of system-monitoring compounds in organic analyses of waste characterization samples at Severn-Trent Laboratory with EPA Methods 5030B and 8260B.

Sample	Analysis Date	Sample Delivery Group	Recovery[a] (%)			
			Toluene-d_8	1,2-Dichloro-ethane-d_4	Bromofluoro-benzene	1,2-Dichloro-benzene-d_4
LWOE LCS	4/26/02	87618	104	101	108	106
LWOE LCSD	4/26/02	87618	105	92	108	105
VBLKD8	4/26/02	87618	101	96	111	105
CNQCDR1-W-15411	4/26/02	87618	98	95	107	102
CNQCDR2-W-15412	4/26/02	87618	93	93	102	102
CNTRIP-W-15415	4/26/02	87618	102	100	110	106
CNCITY-W-15416	4/26/02	87618	101	102	112	109

[a] Quality control limits for recovery are as follows:

Analyte	QC Limit (%)
Toluene-d_8	81-117
1,2-Dichloroethane-d_4	80-120
Bromofluorobenzene	74-121
1,2-Dichlorobenzene-d_4	80-120

TABLE H.18 Recovery and relative percent difference values for spike/spike duplicate organic analyses of waste characterization samples at Severn Trent Laboratory.

Compound	Concentration (µg/L)				Recovery (%)			Relative Percent Difference	
	Sample	Spike Added	Spike Analysis	Duplicate Analysis	Spike Analysis	Duplicate Analysis	QC Limit	RPD	QC Limit
MS/MSD Analysis of LWOE LCS for SDG 87618									
Chloroform	0	50	47	47	94	94	74-106	0	40
Carbon tetrachloride	0	50	48	41	96	82	62-106	16	40